B. Sc. Thesis

Designing for Emotional Awareness: A Human-Centered Study of ShelterFeels as a Tangible Reflective Device

Freie Universität Berlin

Institute of Computer Science

Human-Centered Computing (HCC) Research Group

Philipp Schmidt
Student Number: 5565314
schmip99@fu-berlin.de

Date of Submission: June 17, 2025
Version: 1.0

Supervisor:
Peter Sörries[*] Freie Universität Berlin, Germany

Examiner:
Prof. Dr. Claudia Müller-Birn[†] Freie Universität Berlin, Germany
Prof. Judith Glaser[‡] Technische Hochschule Würzburg-Schweinfurt, Germany

[*]Department of Mathematics and Computer Science, Human-Centered Computing Research Group
[†]Department of Mathematics and Computer Science, Human-Centered Computing Research Group
[‡]Department of Design, Neoanaloge Objektgestaltung / Design in digitalen Lebens- & Wissenswelten

Summary

This thesis focuses on exploring the potential of *ShelterFeels*, a tangible object to support emotional awareness and comprehension in everyday life. The central research question is: "How can tangible artifacts be designed and utilized to gain emotional awareness through physical interaction?" This question is further explored through user interaction, the impact of physicality, and their effects on emotional awareness, i.e. the ability to identify, understand and name one's own emotions.

This research is motivated by the challenges individuals face in recognizing, interpreting, and expressing their emotions. This thesis adds a digital component to the existing *ShelterFeels* concept and examines its usability in everyday life as part of a qualitative study. The existing prototype incorporates voice recording, software for processing input, and light-based feedback.

Following a Human-Centered Design (HCD) approach, this thesis will include revisioning the project *ShelterFeels*, providing a review of literature and gaining insights from a professional, iterative prototyping and assessing a usability study to evaluate the project. Planned steps are to refine data collection methods, improve user experience, and integrate a web application to visualize data.

The study contributes to the field of Human-Computer Interaction (HCI) by investigating how physical interfaces, such as tangible and interactive objects and digital visualization tools can support emotional awareness. The findings aim to provide information on the design of interactive tools that support mental well-being, potentially forming future applications in therapy, education, and self-care.

Zusammenfassung

Diese Arbeit beschäftigt sich mit dem Potenzial von *ShelterFeels*, einem greifbaren Objekt zur Unterstützung von emotionalem Bewusstsein und emotionalem Verständnis im Alltag. Die zentrale Forschungsfrage lautet: „Wie können greifbare Artefakte gestaltet und genutzt werden, um durch physische Interaktion emotionales Bewusstsein zu fördern?“ Diese Frage wird anhand der Benutzerinteraktion, dem Einfluss der Physikalität sowie deren Wirkung auf das emotionale Bewusstsein, also die Fähigkeit, eigene Gefühle zu erkennen, zu verstehen und zu benennen, näher untersucht.

Die Motivation dieser Forschung liegt in den Herausforderungen, denen viele Menschen beim Erkennen, Interpretieren und Ausdrücken ihrer Emotionen gegenüberstehen. Diese Abschlussarbeit ergänzt das bestehende *ShelterFeels*-Konzept um eine digitale Komponente und untersucht dessen Nutzbarkeit im Alltag im Rahmen einer qualitativen Studie. Der bestehende Prototyp beinhaltet eine Sprachaufnahmefunktion, Software zur Verarbeitung des Inputs sowie ein lichtbasiertes Feedbacksystem.

Unter Anwendung des Human-Centered Design (HCD)-Ansatzes umfasst diese Arbeit eine Weiterentwicklung des Projekts ShelterFeels, eine fundierte Literaturrecherche, die Einbindung professioneller Expertise, iteratives Prototyping sowie eine Usability-Studie zur Evaluation des Projekts. Geplante Schritte beinhalten die Verfeinerung der Datenerfassung, die Verbesserung der User Experience und die Integration einer Webanwendung zur Visualisierung der gesammelten Daten.

Die Studie leistet einen Beitrag zum Forschungsfeld der Human-Computer Interaction (HCI), indem sie untersucht, wie physische Schnittstellen, wie tangible und interaktive Objekte, in Kombination mit digitalen Visualisierungstools emotionales Bewusstsein fördern können. Die gewonnenen Erkenntnisse sollen Hinweise für die Gestaltung interaktiver Tools liefern, die das mentale Wohlbefinden unterstützen, mit potenziellen Anwendungsbereichen in Therapie, Bildung und Selbstfürsorge.

Contents

1. Introduction

Many people struggle to identify their emotions, reflect on them, and find the right words to express what they feel [30]. Existing tools for emotional exploration often take the form of text-based journaling apps or mobile platforms such as Headspace[17], How We Feel[18], or Apple's mental health features in Apple Health [1]. These systems typically rely on abstract representations, such as text, graphs, or numerical ratings, to capture emotional states. However, emotions are inherently complex, intangible, and often difficult to articulate, making them challenging to fully capture through digital interfaces alone.

This thesis explores the potential of data physicalization, an approach in which objects represent data through tangible properties such as shape, texture, movement, sound, or light, as a means to support emotional awareness. As Jansen et al. define it, a data physicalization is "a physical artifact whose geometry or material properties encode data"[21]. While screen-based visualizations can display emotional data in rich and detailed ways, research in tangible computing shows that interacting with physical representations of data can offer more intuitive, embodied, and emotionally resonant experiences[13].

Data physicalization is part of the broader field of personal informatics, which focuses on helping individuals collect, interpret, and act on personal information. Within this field, reflection plays a central role—supporting users in gaining emotional insight and self-knowledge [24]. Psychologically, reflection refers to the ability to observe and analyze one's own cognitive, emotional, and behavioral processes [33, 2]. According to Li et al. [24], systems in personal informatics are often designed to "help people collect personally relevant information for the purpose of self-reflection and [to] gaining self-knowledge."

This creates a valuable opportunity for interactive technologies, not only to track emotional states, but also to foster deeper emotional comprehension. In this thesis, I investigate how physical interaction can enhance emotional awareness, and how tangible, reflective tools may offer a more human-centered alternative to purely digital methods.

1.1. Motivation

It can be challenging to recognize one's emotions and even more so to express them accurately to others. However, talking about emotions is very important to gain a better understanding of them and develop a more constructive way of dealing with them. Language enables us to precisely differentiate between emotions, a skill that requires practice [40, 26].

As part of the CodingIxD [10] course, which was initiated by Prof. Dr. Claudia Müller-Birn [37] from the Human-Centered Computing (HCC) Research Group at Freie Universität Berlin [19] and Prof. Carola Zwick [36] from Weißensee Kunsthochschule Berlin [46], students explored the intersection of body data and tangible objects.

Rather than developing yet another generic self-tracking tool, such as a step counter, our team consisting of: Anna Winkler (Computer Science), Elisa Machmer (Product Design), Evelina Gudauskayte (Data Science), Gaith Adra (Computer Science), and Myself (Computer Science), chose to focus on mental health applications, recognizing the potential of tangible interaction to create meaningful and engaging experiences beyond mere data collection.

Working in an interdisciplinary team of computer scientists and designers, we developed *ShelterFeels*, a tangible object designed to facilitate daily emotional exploration and expand emotional vocabulary in a playful and intuitive way. Our iterative design process allowed us to refine the concept and adapt it based on feedback rounds with professional interaction designers.

Through a daily personal ritual, *ShelterFeels* enables people to better understand themselves and grow emotionally. Following an exciting development phase and multiple exhibitions that allowed us to present our prototype, we recognized the potential to contribute meaningfully to ongoing research on supporting emotional awareness through analog devices. Based on these previous efforts, I aim to further explore how Human-Centered Computing (HCC) can offer innovative solutions in this space.

1.2. Research Goal and Question

Throughout the course, we successfully developed a functional prototype that incorporated a voice recorder, software to process verbal input, an NFC tagging stage, and a simple interface with light-based feedback. With just a single semester to develop a functional prototype, our options were quite restricted, but by analyzing the several feedback rounds, as part of the module, we reflected on ways to improve the design and consider the next logical steps for further development:

1. **Improvements**
    - **Keyword Generation:** Enhance the process to make it more accurate and meaningful.
    - **Data Collection:** Optimize how data is gathered to ensure reliability and usability.
    - **User Experience:** Provide clearer instructions during use to help users better understand the concept and navigate the system more effectively.
2. **Additions**
    - **Data Visualization:** Develop a user interface (e.g., a web application) to display previously collected data, enabling users to reflect on their past interactions more effectively.

The feedback rounds gave us an idea of what the user experience could look and feel like, but we never got the chance to enroll a usability study. This thesis will mainly focus on developing a web interface based on a diary approach and getting the missing insights into usability by conducting a usability study. Important to notice is, that the already existing design and concept of *ShelterFeels* will not be reworked in this thesis.

2. ShelterFeels - Concept and Development

Figure 1: Coding IxD Expanding:THE BODY Project *ShelterFeels*

The foundation and overall motivation for this thesis is *ShelterFeels*, an object designed as a part of Coding IxD, an interdisciplinary course of Freie Universität Berlin and Weißensee Kunsthochschule Berlin. The topic focused on the creation of physical objects that visualize human body data. During the design process, we decided to incorporate user emotions into the device throughout a meaningful interaction. For us, "meaningful" meant, that the user gains in emotional awareness. To achieve this, we designed interactions that encourage users to actively communicate and reflect on their emotional state regarding the everyday situations they are currently facing. From this core thought we developed the fundamental principles of the project: understand, reflect, and communicate emotions.

2.1. Interaction Design Concept

Engaging with *ShelterFeels* involves the user progressing through three phases:

The interaction begins with a conversation initiated by the device, which asks the user a straightforward question about how their day has been. In order to answer, the person should talk to the object, by describing the events of their day.

Phase two begins with the user encountering the most significant spoken words derived from the previously recorded text. These keywords are extracted by a deep learning algorithm to then be displayed on the small LCD screen in the middle of the box. This interactive part involves the user associating a particular emotion token with the word they are presented with. To support this process, we placed a variety of emotion tokens on the object. We chose emotions of different complexity, having their origin in the model introduced by Gloria Willcox [47]. The tagging then influences the lid's visualization by accumulating the emotion color onto one of the LED rings.

The third step embodies daily reflection. The lid is composed of seven LED rings, each representing a day of the week. These rings light up in colors that match the emotions the user has assigned each day, as seen in Figure 2 below. This visualization provides the user with a general understanding of their emotional condition over the past seven days. The left and right picture in Figure 2 gives some insight into the interactive design concept of *ShelterFeels*. Furthermore, a video demonstrating the described interaction can be found at the CodingIxD website [20].

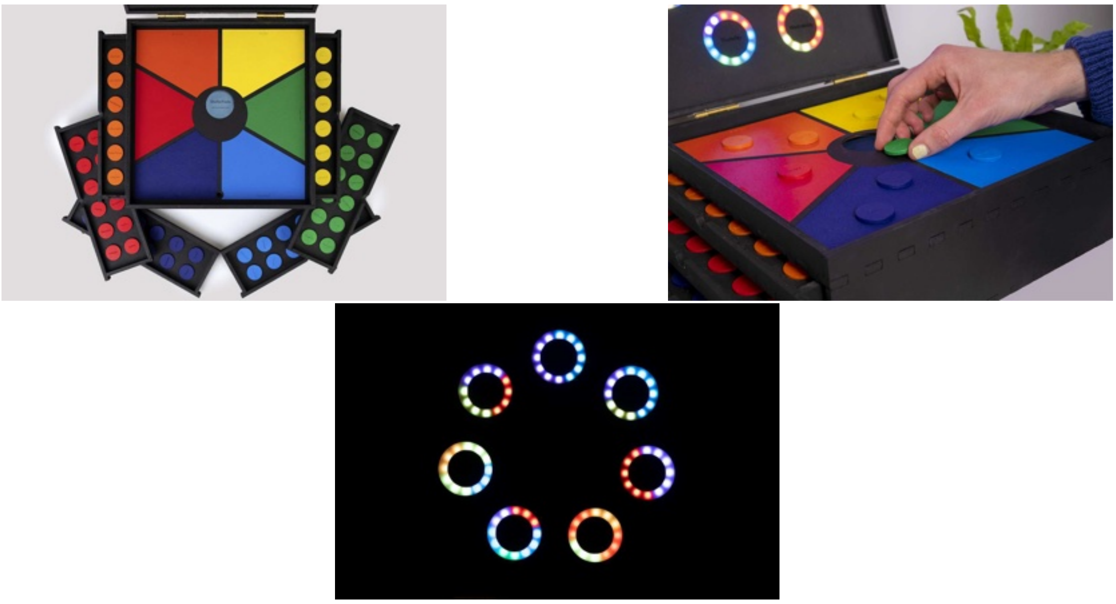

Figure 2: (left) interchangeable tokens representing different emotions, (right) NFC tagging, (below) visualization through LED rings

2.2. Feeling Wheel by Gloria Willcox

To provide users with a meaningful selection of emotions during the tagging phase, we based our NFC tokens on "The Feeling Wheel" by Gloria Willcox [47], shown in Figure 3. This model offers a well-structured overview of both comfortable and uncomfortable emotions. At its core, the wheel features six primary emotions: joyful, powerful, peaceful, sad, mad, and scared. Surrounding these, the outer circles expand on each primary emotion with more nuanced secondary feelings, offering a richer and more detailed emotional spectrum. These secondary emotions may appear more subtle or complex, helping users articulate their emotional states with greater precision. This broad collection of taggable feelings should enable the user to describe their feelings and to extend their emotional vocabulary.

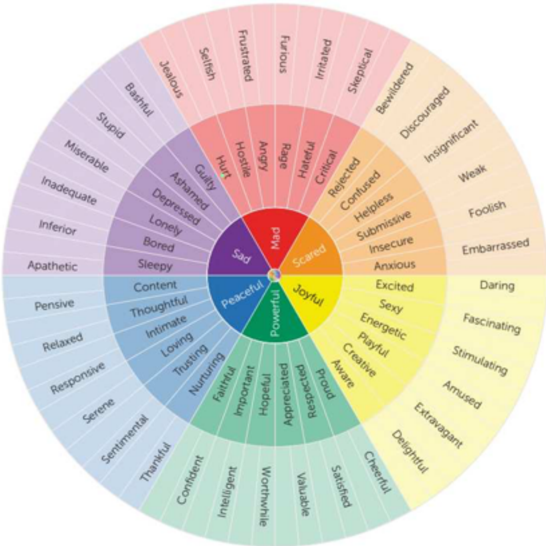

Figure 3: The Feeling Wheel by Gloria Willcox [47]

2.3. Technical Implementation

The wooden box of *ShelterFeels* was laser-cut and hand-painted. The centerpiece is a Raspberry Pi, equipped with a small LCD screen and a microphone. To control the seven LED rings embedded in the lid, they are wired with the Raspberry Pi's GPIO (programmable digital pins on integrated circuits), while an NFC reader enables user interaction. The assembly process is illustrated in the left and right pictures shown in Figure 4. Without the cover, easy access to the hardware was guaranteed, as seen in Figure 4 below. All hardware components are listed in table 1. The software for voice recognition, extracting keywords, and presenting them to the user via a Graphical User Interface (GUI), is mainly written in Python. A list of software used is listed in table 2 and the source code can be found on the github project [15].

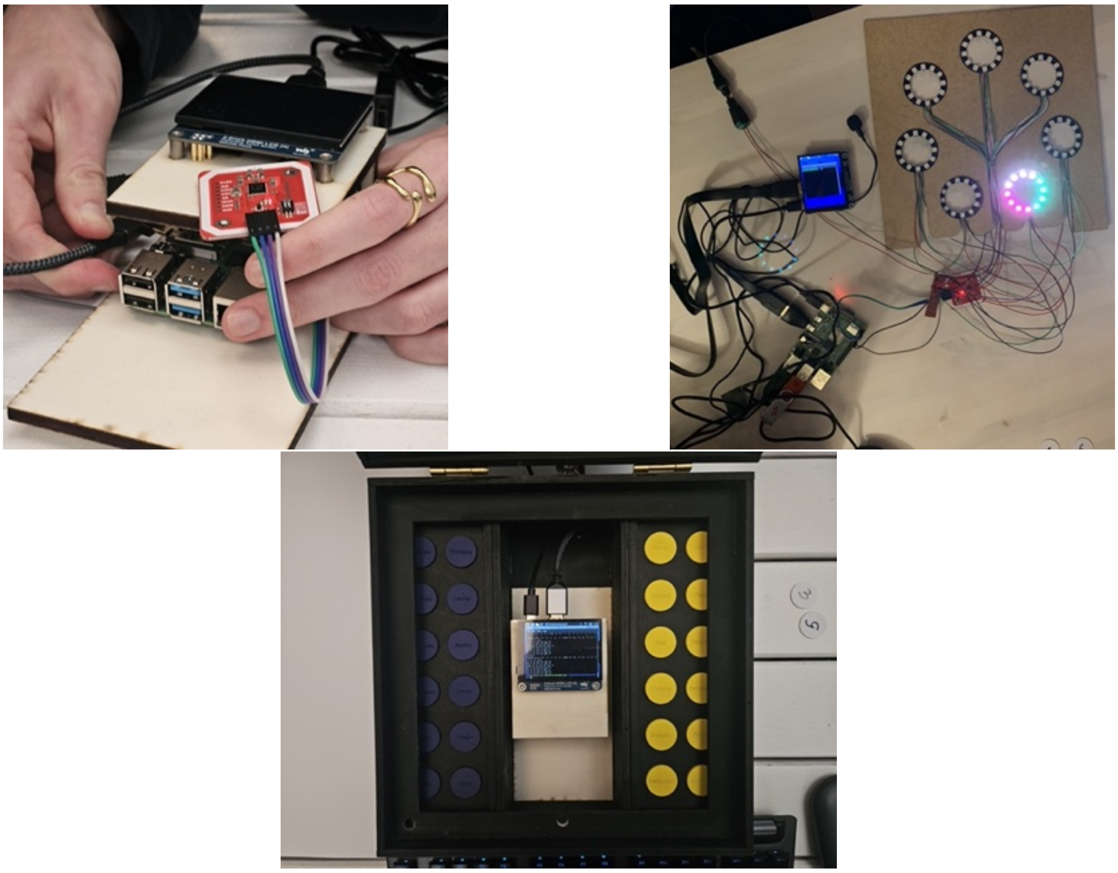

Figure 4: (left) Raspberry Pi with NFC reader and screen, (right) wiring, (below) LCD screen inside object

#	Hardware Name	Hardware Description
1	2.8inch HDMI LCD (H) (SKU:21316)	touchscreen display
2	PN532 NFC NXP RFID module (supports I2C)	NFC reader and chips
3	Raspberry Pi 4 Model B (4GB RAM)	processing unit
4	iGOKU USB Microphone	microphone for voice recording
5	Neopixel compatible LEDs	LEDs for vizualisation

Table 1: Hardware used

#	Software Name	Software Description
1	openai-whisper	Python library for voice recognition
2	transformers	Machine learning library that was used to inference key word extraction model ml6team/keyphrase-extraction- kbirinspec[42] from Hugging Face library of models
3	tkinter	Python library for graphical user interface
4	neopixel	Python library to control LEDs
5	PN532pi	Python library for NFC reader (PN532)
6	soundfile	Python library for saving audio files
7	sounddevice	Python library for recording audio

Table 2: Software used

2.4. Feedback on the Project

After presenting the project at the DesignFair hosted by the Weizenbaum Institute [11], during the Rundgang at Weißensee Kunsthochschule Berlin [45], and at the Lange Nacht der Wissenschaften [23], as well as receiving a critical review from the jury of the ACM International Conference on Tangible, Embedded, and Embodied Interaction (TEI) [3] of the TEI'25, I identified following challenges to tackle:

1. The evaluation methods used for the tool are informal and lack systematic data collection and analysis. The absence of concrete findings or meaningful insights derived from the evaluation, making it difficult to assess the effectiveness of the tool or the potential impact. Therefore, a broader evaluation strategy is necessary.
2. *ShelterFeels* struggles to communicate its main idea of aiding users in understanding, reflecting on, and communicating their emotions, leading to problems in proper interaction with the platform. This especially applies to the interaction via voice and the tagging phase.
3. The project needs to be situated in current research in personal informatics. The thesis will embed the work into scientific research.
4. The project did not adequately address the potential implications of deploying *ShelterFeels* in sensitive contexts, such as mental health settings.

In this thesis, I embedded the project within the scientific context of personal informatics and data physicalization by reviewing relevant literature and situating *ShelterFeels* within current HCI research. To understand how to improve clarity and interaction, particularly in the voice and tagging phases, I gathered expert feedback and conducted a structured usability study, enabling a more systematic analysis of user experiences and the tool's effectiveness.

3. Related Work

Research found, understanding emotions is essential for self-awareness, personal growth, and emotional regulation [28]. The ability to engage with one's emotions can improve well-being, strengthen communication, and support healthier decision-making [22]. This creates the opportunity for digital tools and interactive technologies to offer guided or intuitive ways to improve emotional awareness.

My literature review mainly focuses on reflection in general, it being a fundamental ability for gaining emotional awareness and also being the main inspiration for refining *ShelterFeels* in my thesis.

This section contains the theoretical foundations of exploring personal data in general, by the help of digital tools and through data physicalization. It includes research on the gaps in recent approaches and proposes insight for designing digital tools that encourage users to engage in emotions in everyday situations. By bringing together findings across multiple domains, this review lays the groundwork for a deeper understanding of how data physicalization, e.g. tangible and interactive objects can enhance reflective experiences in meaningful and human-centered ways.

3.1. About Feelings

Earlier, I mentioned Gloria Willcox's The Feeling Wheel. Before I go into computer science, I would like to provide a more detailed overview of her work, which is the foundation of the concept *ShelterFeels*. Gloria Willcox [47] developed The Feeling Wheel to help individuals recognize and communicate their emotions more effectively. Expanding the vocabulary used to describe feelings significantly enhances the quality of interpersonal communication. In her work as a psychotherapist, Willcox often encountered patients who were at a loss when it came to articulating their emotions. For example, she observed that, in many American families, emotions are rarely expressed or openly discussed. In response to questions like "How do you feel?", people often resort to vague answers such as "good" or "bad," "O.K." or "not O.K.," or "better" or "worse," which leads to poor communication and a lack of mutual understanding. With the creation of "The Feeling Wheel", Willcox laid the groundwork for future explorations, offering a foundation that can support playful and meaningful interactions for individuals seeking to express and better understand their emotions.

3.2. Consideration in Exploring Personal Data

Emotional awareness is a central concept in personal informatics, with systems designed to help people collect and interpret personal data to better understand their emotions and gain self-knowledge [25]. However, research on personal informatics and emotional awareness often lacks detailed explanations of how individuals engage with their emotional data, sometimes defining it simply as "looking at lists of collected personal information or exploring or interacting with information visualizations" [5].

In an interesting approach by Baumer [5] on technology for reflection, he is proposing three key dimensions: breakdown, inquiry, and transformation. Breakdown is described as a moment of doubt, puzzlement, surprise, uncertainty, or conflict. These moments occur when something unexpected happens or when expectations are violated. Inquiry refers to the conscious and intentional process of exploring emotions, understanding their causes, and making sense of their impact on thoughts and actions. Transformation involves a shift in emotional understanding, helping individuals not only become aware of their current emotional state but also explore alternative ways of interpreting and responding to their emotions. These dimensions provide a framework for designing technologies that support emotional reflection and self-understanding, ensuring that users can engage meaningfully with their personal data rather than passively observing it. These dimensions are not prescriptive nor strictly linear, as seen in the model by Atkins and Murphy [4], but they offer a conceptual model for designing technologies that help individuals recognize and process emotions. The model introduced by Atkins and Murphy [4] offers a quiet similar perspective, explaining three key stages of the process. In stage one, the individual notices uncomfortable feelings and thoughts. Stage two involves critically analyzing and examining their knowledge and emotions. The final stage, termed learning, involves gaining a new perspective on the issue. Although this stage results in affective and cognitive changes, it may not always lead to behavioral changes.

In summary, exploring personal data involves engaging in a process that can be understood through different conceptual models in the area of personal informatics. By analyzing such models, valuable conclusions can be drawn: tools should actively support user engagement with emotions, allow for discomfort, and offer flexible paths for reflection. These insights help inform the development of digital and tangible technologies, like *ShelterFeels*, that aim to foster emotional awareness.

3.3. Digital Tools for Data Engagement

Digital tools have changed the way individuals perceive, interpret, and engage with their emotions. These tools are accessed and interacted with via screens, touch, or digital devices like apps, websites, or software. Research in this area highlights the critical role of data representation, feedback mechanisms, and user engagement in helping individuals recognize, process, and make sense of their body data [24, 13]. This ensures that users can interact meaningfully with their personal emotional data, fostering greater awareness and understanding of their feelings and experiences.

In personal informatics, for example Pirzadeh et al. [34] emphasize journaling as a key method to record and reflect on emotions, thoughts, and experiences. They developed

"Wandering Mind", a tool designed to support this process, allowing users to annotate entries with tags, emotions, and social network content. Their main findings highlighted that users of their application reported data visualization as an important tool to identify patterns and trends. Marit Bentvelzen, Jasmin Niess, and Paweł W. Woźniak [7] extended this exploration by studying fitness trackers designed to offer data-driven insights for reflection. Furthermore their findings revealed that simply presenting the data does not automatically lead to introspection. Research, including critiques from Baumer [6], underscored that systems need to go beyond displaying raw numbers, they must guide users in connecting data points to personal goals and contexts. Critically, Bentvelzen et al. [7] observed that fitness trackers often provide limited feedback, making it difficult for users to align data with their broader fitness understanding. This misalignment hinders the system's capacity to deliver meaningful insights or support higher-level goal achievement. Bentvelzen et al. [7] also summarize the key takeaways of how to support reflection through design specifically. One thing is to connect quantitative and qualitative goals. Users often attempt to relate the numerical data from trackers to qualitative personal goals. For example, steps counted by a tracker might connect to broader goals such as improving overall health or staying active. Systems that facilitate this connection can better support users in making sense of their data. Additionally, tools that go beyond raw data presentation, such as those providing narrative summaries, patterns, or prompts for thought, can guide users toward deeper reflection. By framing data in ways that align with users' values and experiences, systems can support more meaningful engagement.

An important realization by the authors is, that visualization tools showcasing historical data can significantly improve the process of reflection. Participants in the study indicated that examining prior data led to introspection and a sense of empowerment.

The rise in popularity of mental health apps such as Calm [9] or Headspace [17], shows great potential, but many of these apps lack scientific evaluation, raising concerns about their reliability and safety. Apps integrated with professional mental health support have proven more effective. For instance, apps designed with psychiatrist involvement offer better reliability and safety [38]. Despite their benefits, many apps lack personalization, which is critical since mental health treatments often need to be tailored individually [16].

Woodward et al. [48], who in their study, focused on mental health mobile apps, e.g. Calm or Headspace, which often offer a tool for daily reflection on emotional and mental state, discovered, that many mobile apps struggle to effectively capture mental health fluctuations due to infrequent patient-reported outcomes. People at risk of mental health issues often face significant barriers in accessing quality mental health care [8]. Particularly in the early stages of symptoms [12], mobile apps have demonstrated potential in addressing these barriers by providing cost-effective, real-time symptom monitoring and increased accessibility [44]. This comes from the fact that mobile phones, often with pre-installed mental health apps, enable everyone to access them easily, while e.g. stigma could prevent someone from seeking professional assistance [43].

In summary, digital tools hold significant potential in supporting reflection on emotions, thoughts, and experiences. However, designing such tools requires a thorough understanding of the reflective process, such as is provided by Baumer's dimensions, as well as considering the user experience as discussed by Woodward et al. The insights from Pirzadeh et al. and other researchers regarding journaling, and the variety of tools described in the sources, already provide useful guidance for effective designs, but also show a lot of challenges to face.

While digital tools provide a powerful way for tracking, analyzing, and visualizing data, they often rely on abstract representation, such as charts or logs. This is where physicalization comes into place. The following section will explore, how tangible objects can contribute in the field of exploring personal data.

3.4. Data Physicalization as an Alternative to Digital Tools

In recent years, research on data physicalization has been on the rise. Pierre Dragicevic, Yvonne Jansen, and Andrew Vande Moere [13] defined the term data physicalization as follows:

"A data physicalization (or simply physicalization) is a physical artifact whose geometry or material properties encode data." [21]

As an example, Figure 5 on the left displays data collected on a student's posture throughout the week, which is then translated into the height of the 3D printed relief illustrated on the right.

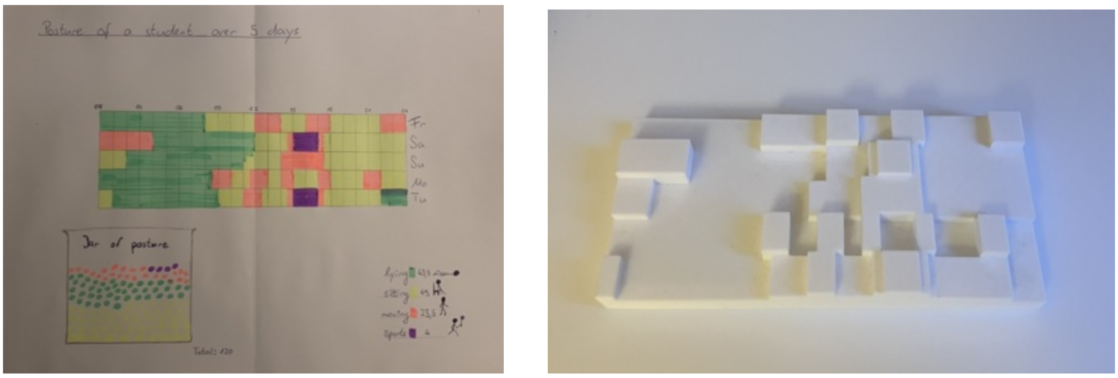

Figure 5: Example of Data Physicalization: (left) collected data, (right) data embodied in 3D print

In their research [13] they discovered that data physicalization offers unique opportunities for emotional comprehension and self-reflection by transforming personal data into tangible forms. Unlike traditional screen-based visualizations, these physical artifacts can be more straightforward to perceive and interpreted, leading to a deeper more profound engagement of once behavior and feelings. However, poorly designed tangible objects, such as overly large devices, can reduce user motivation to interact with it. This highlights the importance of prioritizing both functionality and user-centered design [39]. Tangible interfaces represent a largely unexplored area in mental health technology, with few studies demonstrating their effectiveness or statistical robustness.

In their study, Mols et al. [28] explored three different design approaches to address reflection of emotions and daily life experiences through physical artifacts, which can be seen in Figure 6.

Figure 6: Left to right: Balance, Cogito and Dott

Balance is an abstract object that serves as a voice recorder for daily reflections, especially when coming home from work. It uses two sides like a seesaw to represent positive or negative feeling towards a topic. By pushing one side recording starts. To play back, users can tap the center of the device to replay a recording. Cogito, a text-based concept that is intended to send “messages to the self”. It combines mobile messaging with manual writing. Short text messages can be sent throughout the day and are stored in the object, which glows slightly when it has been a while since the last message. When the object is 'full', meaning messages haven't been further explored or reflected upon, it blinks more actively. Users can open the object to explore the messages, and a paper notepad allows for further handwritten reflections. The last displayed artifact is Dott, a visual concept that transforms selected photos into abstract art, using color and other visual parameters. Users can tweak the visualizations in a mobile app and the artwork is displayed in the home, and fades after 24 hours. Past visualizations can be browsed and displayed again.

Marit Bentvelzen et al. [7] focused on systems such as fitness trackers, that automatically collect data, while Mols et al. highlight tools following the concept of collecting user-generated media, such as written journals, photos, or voice recordings, which is often viewed as an effective medium for personal reflection. These forms of media provide individuals with a tangible way to externalize and process their thoughts and emotions. In contrast, systems that automatically collect data, such as fitness trackers or mood monitoring apps, face criticism. It is said that they are often designed to focus narrowly on specific metrics (e.g., step count, hours slept) and fail to capture the diverse and nuanced nature of everyday reflection. Emotions being very complex cannot be excluded from that statement. The lack of open-endedness in such systems limits their ability to capture and represent the full spectrum of human emotions and experiences. Their research suggests that the way users generate and interact with personal data significantly impacts their ability to recognize and understand their emotions. By actively creating their own content, users engage more deeply with their emotional states, leading to greater self-awareness and emotional processing. The study emphasizes the integration of open-ended reflection into daily life, highlighting the importance of systems that allow for flexible creation, evaluation, and interpretation of diverse data types. The study also provides insight into the aspects under which reflection in general occurs using tangible artifacts and the results of reflective practices. One notable finding is that engagement with physical representation of data, weather through creation, modification, or review, can help individuals recognize and process their emotions more effectively. Interaction with tangible data makes emotions more concrete and accessible, encouraging deeper emotional engagement and self-exploration.

After Baumer [5] and Atkins et al. [4], reflective practices, that can be useful for emotional awareness, are influenced by specific opportunities and external triggers. For example, a photo taken during a meaningful moment might prompt reflection when revisited later, like shown in the previously mentioned project Dott [28]. Tools that allow users to embody their thoughts and emotions provide a structured way to process complex feelings. This embodiment helps users make sense of their internal states. In addition, the research identifies the home as a critical space for reflection. Home environments often provide the calm, privacy, and safety that users need to engage in meaningful self-reflection on emotions and everyday situations.

In summary, mobile applications offer significant advantages, such as real-time monitoring and reduced barriers to care, while tangible interfaces introduce new ways to interact with and visualize mental health data. These physical tools have the potential to enhance traditional assessment methods, offering more intuitive and engaging experiences for users. A key advantage of tangible artifacts and data physicalization is their ability to make emotional states more concrete, allowing users to interact with their emotions in a direct and sensory way. This can lead to deeper emotional engagement and awareness, making it easier for users to recognize and process their emotions. Unlike purely digital tools, physical interaction can create stronger cognitive and emotional connections, enhancing the understanding and interpretation of personal data. However, challenges such as design flaws, lack of personalization, and limited evidence of efficacy must be addressed to fully realize their potential. Additionally, data physicalization presents a key limitation: not all data can be effectively embodied in a physical form, which contrasts sharply with 2D visualizations, where complex datasets can be represented more comprehensively and flexibly. Although physical objects can create deeper engagement, they may lack the scalability and precision of screen-based visualizations, making it crucial to consider which type of representation best supports the intended reflection process. Despite these challenges, tangible artifacts present a promising approach to supporting emotional awareness, as they bridge the gap between digital data and human sensory experience, creating more meaningful and accessible ways to engage with emotions.

The insights from mobile applications informed the design of the ShelterFeels web app, especially for supporting reflection and emotional vocabulary. However, physicalization holds the promise to make emotions more tangible and accessible by grounding them in sensory experience, highlighting the value of combining digital and physical elements to support emotional awareness [34].

4. HCC Methodology

4.1. Research Approach and Methodology

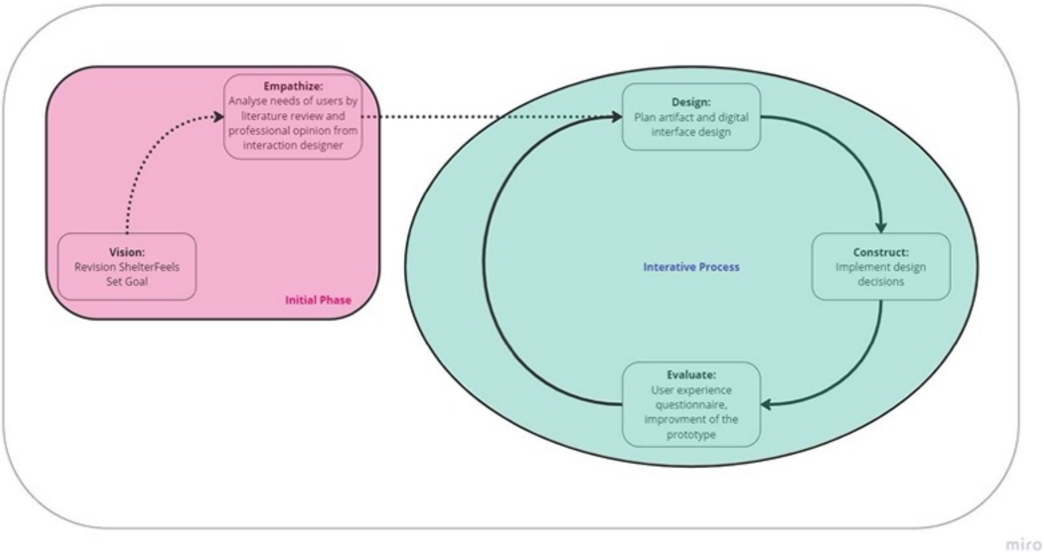

Figure 7: Human-centered System Design process, adapted from [14]

In this section, I will envision the relevant steps focused on user perspective. This iterative process consists of the following planned steps:

1. **Vision:** This first stage includes outlining the final *ShelterFeels* project and setting up a road map. To achieve this, a review of the current state is needed, including existing data, features, and limitations. This will help identify the key challenges. Insights will be a clear understanding of the project scope, and constraints. This part can be found in Section 2.

2. **Empathize:** To validate the previous stage, there must be a broad understanding of user needs, expectations, and reflective behaviors to inform design decisions. My strategy involves providing a review of the literature (found in Section 3) on improving reflective behavior on emotions, as well as an opinion from a professional interaction designer (found in Section 4.2). They will obtain a view of the object in its current state. This will give me a clear direction for the design phase, ensuring that the interface choices are aligned with the needs of the user.

3. **Design:** Goal of the design phase is to draft an intuitive and effective web application that translates the insights of the empathizing phase into a concrete prototype. To achieve this, I will analyze the expert interviews results to inform the structure

and layout of the web interface. For first results, there will be a low-fidelity prototype for the web application. This will provide the foundation for the construction phase, ensuring a smooth transition to implementation.

4. **Implementation:** The goal will be to develop the back-end functionalities, including data collection, access, and the configuration of a web server to host the web application. This includes choosing a method to capture the user data for further processing, as well as developing a web application featuring the previously designed interface. The outcome will be a working system that can be tested in real-world conditions, being ready for evaluation to assess its usability and effectiveness. The base of the project is already provided and can be found on GitHub [32]. The user data will be stored in a PostrgrSQL [35] database to further process it on a web application build on FastAPI [41] web framework and Jinja [31] web template engine.

5. **Evaluate:** In the end I will assess usability of the overall project. In a thinking-aloud study, six participants will interact with the *ShelterFeels* box and the web interface to then take part in a semi structured interview guided by a questionnaire. I will qualitatively analyze the findings after Mayring's Qualitative Content analysis [27]. The gained insights into usability of *ShelterFeels* will be discussed and findings on emotional understanding through interaction with physical objects will be shared. This will give a clear guidance to iterate and further improve the artifact.

The methodology described aims to improve the *ShelterFeels* project and to understand how tangible objects can help individuals identify, reflect upon, and communicate their emotions effectively. The approach is iterative, ensuring that the design is continually refined based on user feedback and research insights. The human-centered design approach is important for the thesis, and should be understood before starting. To achieve the goals of the thesis, it is important to choose the most suitable research methods.

4.2. Expert Interview

As part of the empathize phase, an expert interview was conducted before entering the design phase and conducting a usability study. The expert studied product and interaction design and has extensive practical experience in the field of data visualization and UI/UX, before being appointed as a professor at a university of applied sciences with a focus on object/artifact-oriented interaction design. The aim of this interview was to gather a professional insight on the existing prototype *ShelterFeels*, identifying areas for improvement, and refine the concept and design, before presenting it to a broader audience. The feedback served as a foundation for adjustments to enhance usability, accessibility, and overall user experience. The interview followed a semi-structured format, allowing open-ended discussions while ensuring that key areas were addressed. The expert was selected based on their experience in interactive technologies and data-driven user interfaces. The interview focuses on five key aspects:

1. Understanding the Design Concept
2. Interaction and Experience
3. Learning About Emotions
4. Potential Improvements
5. Possible Future Additions

4.2.1. Interview Procedure

Before the interview began, a consent form provided by the Human-Centered Computing (HCC) Research Group was filled out, allowing for audio recording and the use of the collected information for further research purposes. This was followed by a few demographic questions to gain an understanding of the experts background in the field of product and interaction design. The interview started with a discussion about the interaction design concept and the overall user experience. Follow-up questions focused on expanding emotional vocabulary, learning, and self-tracking. To conclude the session, a debriefing was conducted to explain how the gathered insights would be used and what the next steps in the research process would be. The consent form and the questionnaire can be found in appendix C and appendix A.

4.2.2. Selected Findings

After transcribing the interview, I analyzed the gathered material to extract selected findings. The following list covers the different categories, the interview questions were structured after:

1. **Understanding the Design Concept** The expert liked the metaphor of a treasure box or jewelry box, noting that the physicality of the object is key to effectively trigger known patterns from familiar objects, like a diary. They emphasized that the tactile and symbolic nature of the design is essential for engaging users on a emotional level. From their professional perspective, they see the projects core concept as being about fostering emotional learning on vocabulary and using it as a vehicle for reflecting on ones own emotions based on daily routines. One of the project's most valuable contributions, they noted, is its potential to help users move beyond the six basic emotions and articulate a broader range of feelings. In their view, many people struggle with expressing themselves emotionally due a limited emotional vocabulary, which is directly addressed by the project's concept.

2. **Interaction and Experience** The expert identified the voice recording and tagging phase is the "trickiest part" of user experience. They pointed out the potential oddness users might feel when speaking to an anonymous, black-box-like device. To tackle this, they suggested to incorporate subtle design elements like a simple animations, sounds, or an initial interaction phase, that could help users attribute character to the device. This, they noted, is less about the physical form itself and more about a playful and emotionally engaging interaction style. From an accessibility and usability standpoint, the expert also raised concerns about visual contrast and typography, particularly for users with visual impairments, as well as the ease of taking out the tokens from the drawers for users with limited mobility. To support a smooth user experience, they emphasized the importance of providing sufficient "onboarding" or accordance (intuitive physical design) is crucial to ensure that users understand how to use the device right from the moment it is opened.

3. **Learning About Emotions** The expert believes playfulness is important for helping people stay on track with their reflections. The simple mechanism of making users aware that there is more emotional language than just anger is seen as a big advantage. They think, that once people are aware of a new word, they are more likely to use it. Creating a routine that dedicates time to learning new emotional expressions contributes to expanding one's vocabulary and increases the likelihood of using this language in different situations

4. **Potential Improvements** Regarding the physical design of the object, they recommended aligning it more closely with the metaphor of a personal or treasured item particularly in terms of CMF (Color, Material, Finish). While the current black-box design is clean and minimal, they cautioned that it might evoke negative associations. The expert recommended incorporating warmer, more inviting materials and details to remind of cherished, intimate personal objects, such as handcrafted journals. Additionally, they suggested rethinking the presentation of the tokens and integrating guiding elements such as gestures, routines, or even auditory feedback from the box, to improve the intuitiveness of the voice input phase. For evaluating the project's long-term success, the expert recommended context-sensitive methods such as cultural probes, allowing users to engage with the object

in their personal environments over time, rather than relying on controlled lab studies.

5. **Possible Future Additions** The expert sees *ShelterFeels* fitting into the field of personal informatics, emphasizing its capacity to support users in expanding their emotional vocabulary and abilities to talk and reflect on things. They highlighted the strength of the coin metaphor (the NFC tokens) and suggest to further explore this element. Regarding the role of emotional data in personal informatics, they suggests that the focus shouldn't necessarily be on capturing emotional data digitally but rather on capturing moments or contexts that prompt the user to reflect on their emotions. They advocate for technology that enables user reflection rather than performing automated analysis.

The expert interview offered a valuable insight into the conceptual potential of the *ShelterFeels* project, particularly regarding its analog qualities and potential for fostering emotional learning through physical interaction.

While many of the expert's suggestions focused on the further development of the physical aspects of the project, their reflections also significantly informed the digital direction of *ShelterFeels*. Specifically, points raised during the interview, such as the importance of intuitive interaction, emotional vocabulary expansion, and user engagement, directly shaped the design and focus of the web application. Furthermore, the interview contributed to the formulation of the usability questionnaire used in the later conducted study, ensuring that it addressed not only technical usability aspects (like Nielsen's heuristics), but also emotional expressiveness, interaction comfort, and long-term user motivation. This helped to maintain a strong conceptual thread from the expert interview to design and evaluation phase.

4.3. Design Process Web Application

The next step in the HCC methodology is the Design phase, in which a prototype of the interface was created using *Figma*. It helped getting an idea of how data can be represented in an appealing way, without getting to formal, before than implementing it.

4.3.1. Design Web Application Mainpage and Emotionpage

The main page of the web application as seen on the left in Figure 8 is designed to provide an intuitive and visually engaging overview of the user's emotional data. The layout is centered around six vibrant emotion circles, each representing one of the core emotional categories inspired by Gloria Willcox's *Feeling Wheel* [47]. These include emotions such as *Mad*, *Sad*, *Scared*, *Joyful*, *Powerful*, and *Peaceful*. Each circle is color-coded according to Willcox's emotion spectrum.

In the center of the circles, a polar area chart visualizes the number of emotions in each category currently stored in the database. This provides insight into the distribution of emotions the user has experienced and tagged.

At the top of the interface, the heading "Your overall emotional state" contextualizes the visualization. The emotion circles layout should encourage exploration. Clicking on any of these circles redirects the user to a detailed page for the selected emotion, where further information and related tagged words are presented.

Beneath the emotion display, you find a button titled *Learn about feelings*, linking to a dedicated page designed to educate users on emotional vocabulary. This button is similarly colored like the emotion display.

The interface is optimized for tablet display, featuring a dark background that enhances the vividness of the emotion colors, improving visual clarity and focus. The overall layout supports both exploratory and goal-oriented interaction, making the emotional data accessible and engaging for users.

For each of the six core emotions, a dedicated detail page was designed to provide a focused view of all the emotion words associated with that category. As shown in Figure 9, the selected core emotion is displayed prominently at the center of the screen, surrounded by all the words that have been tagged to it during user interactions with the *ShelterFeels* system.

Each tagged emotion word is represented as a colored circle, visually matching the parent emotion's color. In this case, red for *Mad*. Each circle represents a possible entry, holding a word, an emotion and a timestamp on when it was created. Potentially this view is expandable in the future for additional data.

This visualization approach highlights the hierarchical structure of emotions derived from Gloria Willcox's *Feeling Wheel* [47], encouraging users to explore the nuances within a broad emotional category.

4.3.2. Learning Page

The learning page as seen on the right in Figure 8 was designed to educate users about the feelings, presented on Gloria Willcox [47] feeling wheel. They are the same, as the ones written on the physical tokens. The definitions are not linked to any scientific work.

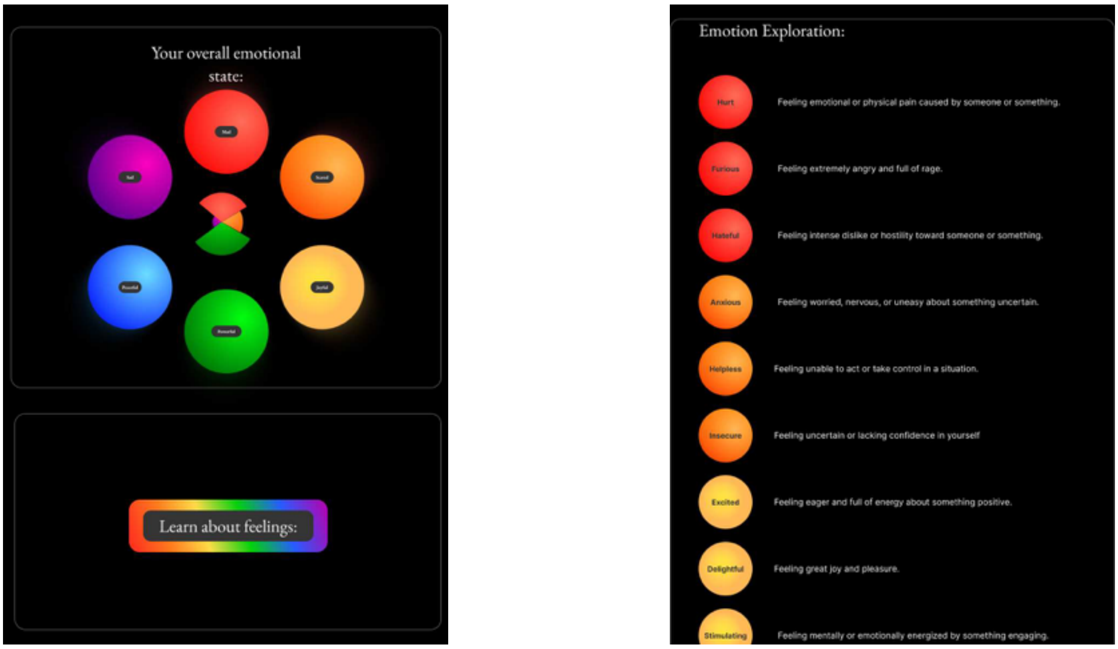

Figure 8: (left) Main page, (right) Learning page designed on *Figma*

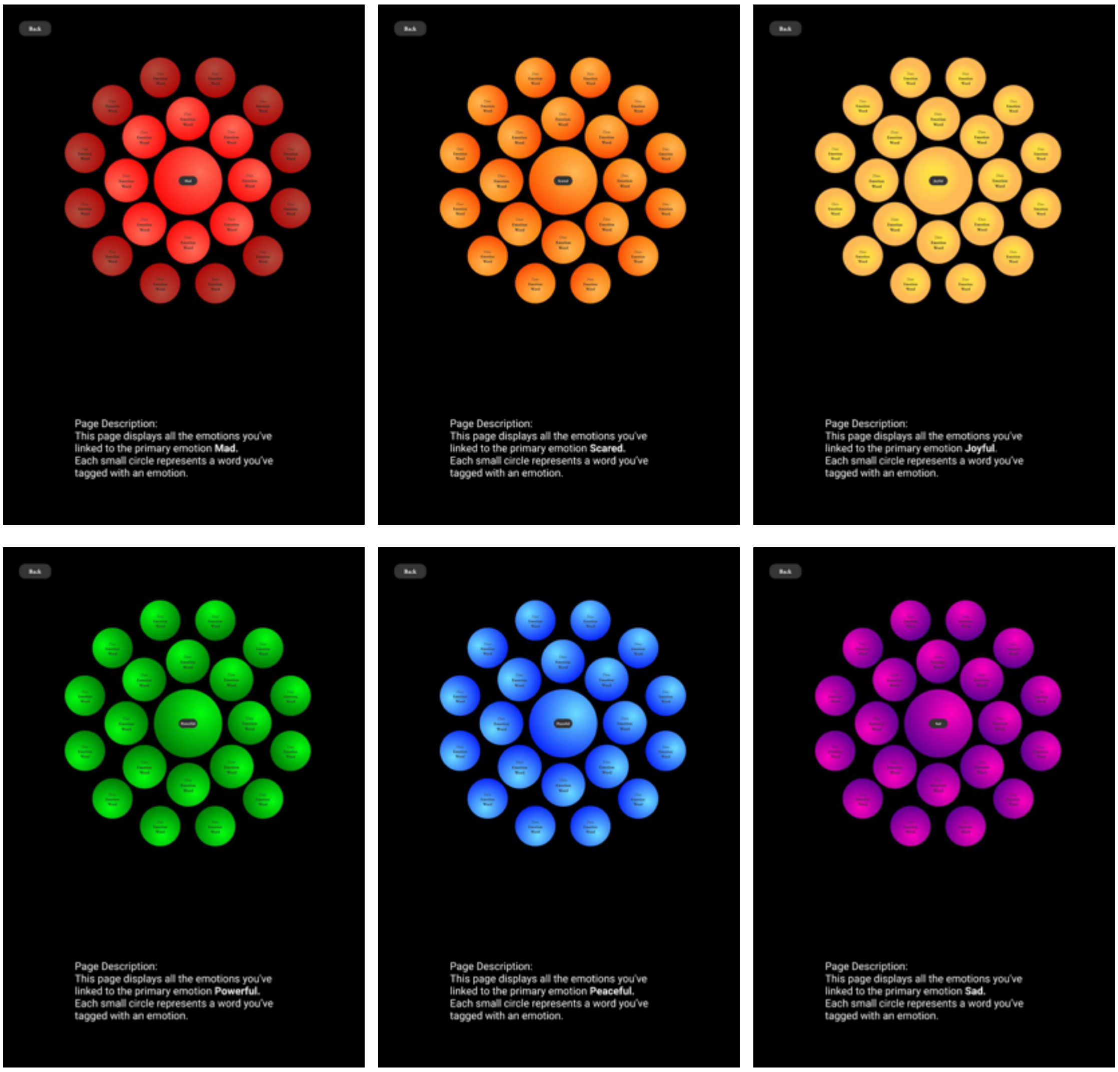

Figure 9: Emotion pages designed on *Figma*

4.4. Implementation

The next phase of the HCC methodology, after designing the prototype in *Figma*, was to implement the web application and all other backend functionalities.

This section outlines the implementation of the data storage and retrieval system, as well as the development of the front-end interface. The project is distributed across two devices: (1) a Raspberry Pi, which handles audio recording, NFC tagging, and local data storage; and (2) a server, which transcribes audio files, generates keywords, and hosts the web interface for data visualization.

This thesis focuses specifically on the implementation of data storage, access, and visualization. As such, only these components will be described in detail. For background information on the foundational elements of the project, please refer to Section 2, the GitHub repository [15], or the CodingIxD website [20].

Figure 10 shows the sequences the system runs through during interaction, while Figure 11 shows the connectivity between the different devices. A list of the software used can be found in table 3.

#	Software Name	Software Description
1	PostgreSQL	Database Management System on Raspberry Pi
2	psycopg2	PostgreSQL database adapter for Python, to store and access data
3	uvicorn	ASGI web server implementation for Python
4	FastAPI	FastAPI web framework for frontend
5	jinja	web-template-enging for python

Table 3: Software used

4.4.1. Raspberry Pi

The database was set up on the Raspberry Pi for flexibility reasons. The server hosting the web interface can then be transferred to a different machine being able to access the same data. For this purpose, I used the *PostgreSQL* database management system, accessed through the Python library *psycopg2*. Upon startup, the application checks whether the required data table exists; if it does not, the table is created automatically. Each time a word is tagged with an emotion via NFC, a new entry is added to the table.

4.4.2. Server

On the server, the web application is hosted using *Uvicorn*, an ASGI (Asynchronous Server Gateway Interface) web server implementation for Python. The backend is built with *FastAPI*, a web framework designed to build APIs in Python. For generating the website's HTML pages, the *Jinja* templating engine was used. Jinja enables the integration of dynamic data into HTML files, making it suitable for building interactive and data-driven interfaces. For styling the HTML files, CSS was used. To display the data stored in the database, the server makes a request to fetch the data in a JSON-file. This JSON-file serves as a cache to promptly display content during user interaction on the web application.

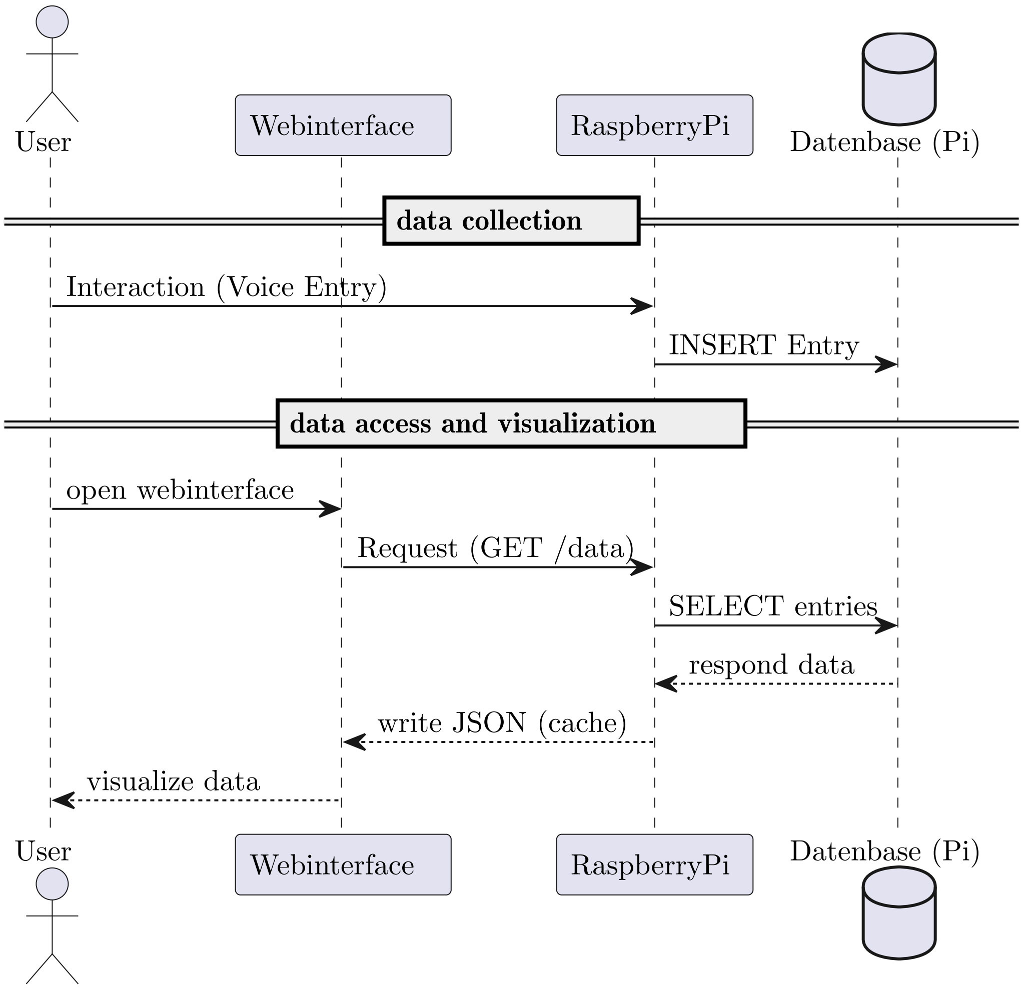

Figure 10: UML sequence diagram

4.4.3. Interconnection

For data exchange between devices, *ZeroTier* was utilized. *ZeroTier* creates a virtual private network (VPN) that ensures secure encrypted communication between devices, even when they are on different physical networks.

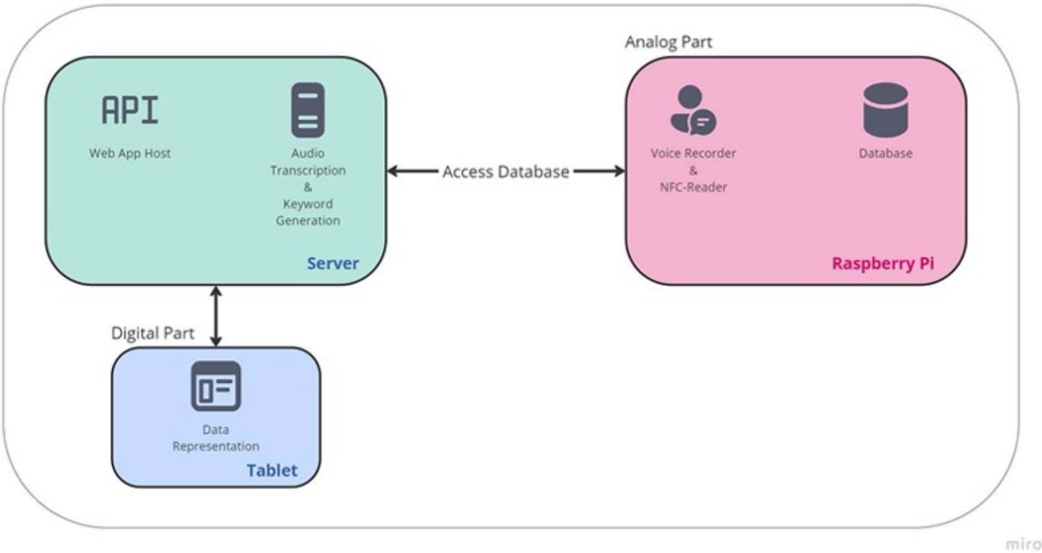

Figure 11: Connectivity diagram

4.5. Evaluation

The final part of the HCC methodology is the evaluation phase, including the usability study, presenting and discussing the findings.

To evaluate the usability of *ShelterFeels*, a thinking-aloud study was conducted. Six participants were asked to first interact with the *ShelterFeels* box and then with the web application before subsequently responding to questions from a user experience questionnaire. By qualitatively analyzing the results using Mayring's Qualitative Content Analysis [27], a foundation for discussing emotional understanding through interaction with physical objects was established. Additionally, the findings support the project's further development and iteration.

4.5.1. Study Setting

The primary focus of the usability study was the evaluation of the web application, with additional observations on the *ShelterFeels* box. The goal is to assess whether the web application could support users in learning a richer emotional vocabulary and subsequently use it as a tool for emotional awareness within the context of their daily routines. Participants were informed that the primary focus of this study and of the thesis as a whole was on evaluating the web interface. As discussed in subsection 4.2, the expert recommended conducting a long-term study within users' personal environments to better understand the project's impact over time. Due to limited resources, it was not possible to assess insights over a longer timescale. However, efforts were made to simulate this context by conducting the sessions in participants' familiar and comfortable environments, such as their living rooms or bedrooms. Participants were guided through the process in a way that aimed to respect and preserve the natural character of their personal spaces. To simulate a long term use of the device, the database was filled with previously tagged entries. This study setting allowed for valuable insights into both the digital webapp and the analog aspects of the design, providing a basis for iterative improvement. Furthermore, the study highlighted the potential for emotion-centered technologies to support long-term emotional learning and reflection in real-world settings.

All participants were run through the following steps, which will be described in the next sections:

1. Scenario and Task Explanation
2. Thinking Aloud study
3. Semi structured interview with open-ended questions
4. Demographic questions

Before conducting the study, the participants were asked to fill a consent form provided by the Human-Centered Computing (HCC) Research Group, which can be found in appendix C.

4.5.2. Scenario Description

To evaluate the usability of *ShelterFeels*, the study was designed to simulate a realistic and personal moment of daily reflection. Participants were asked to engage with the tool as if they were using it at the end of their day in a quiet, familiar space. This scenario mirrors the intended use context of *ShelterFeels*, as a personal routine to understand the state of emotions.

The scenario was introduced to participants with the following prompt:

> *"Imagine it's the end of your day. You've just come home and are winding down. You want to take a few minutes to reflect on how your day went. What felt good? What didn't? ShelterFeels is here to help you capture and explore your emotions."*

The aim was to observe how naturally and intuitively they engaged with the interface under conditions similar to its intended use.

To simulate a natural setting as closely as possible, sessions were conducted in participants' own living spaces (e.g., living rooms or bedrooms) where they felt comfortable. This was done to minimize distractions that are often present in laboratory environments. An impression of the study scenario is provided in Figure 12.

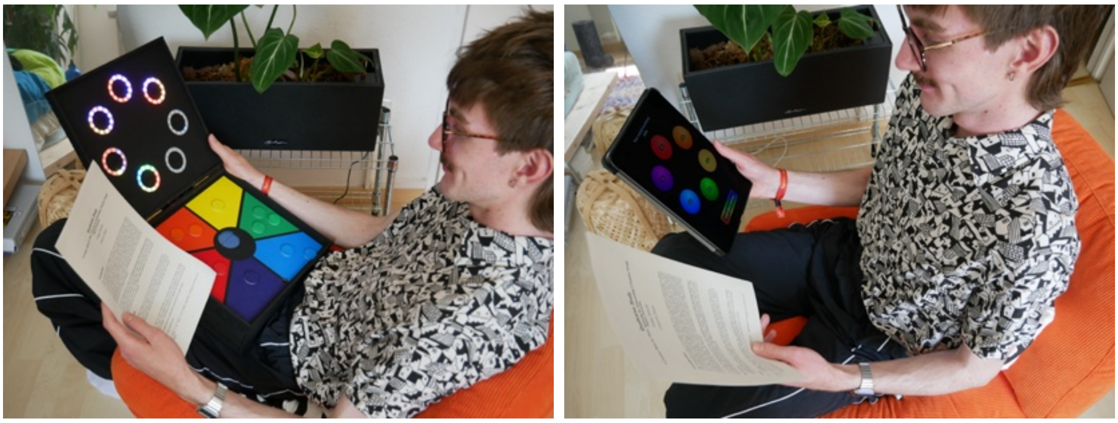

Figure 12: Study Scenario

4.5.3. Task Definition

The usability study was structured around a series of tasks aligned with the main functionalities of *ShelterFeels*. Each participant completed the following steps while speaking out their thoughts through a think-aloud protocol. During conducting the study, minimal guidance was offered.

The users were asked to perform the following tasks:

Task 1: Participants were asked to interact with the object *ShelterFeels* by running through the basic phases, including recording a short voice message describing their day and situations in which they felt emotionally engaged. Following up, the tagging phase was performed on the given input. This step is mainly used to give the user a complete understanding on how the project works.

Task 2: Participants were asked to open the *ShelterFeels* web application and explore freely, forming an initial impression without instructions.

Task 3: To conclude, participants were invited to imagine using *ShelterFeels* as part of their daily routine and to share their thoughts on how helpful, engaging, or sustainable they felt the experience would be. While this task offered preliminary insight into the system's potential for long-term use, a broader understanding would require an extended study conducted over a longer period of time.

4.5.4. Study Method

To gain deeper insights into the participants' interactions, a *thinking aloud* method was used during the usability testing. Participants were encouraged to verbalize everything that came to mind while completing the assigned tasks. This included thoughts, impressions, emotions, and immediate reactions to what they observed or did. This feedback was recorded for later analysis.

Following the task, participants engaged in a semi-structured interview designed around a set of open-ended questions. These interviews provided an opportunity to reflect on the experience and allowed participants to elaborate on their thoughts, offering richer context to complement the data gathered through the thinking aloud protocol. This combination of thoughts during the interaction and reflection after enabled a better understanding of the user experience and usability of both the digital and analog components of the project. The whole usability test took approximately 30 minutes per participant.

4.5.5. Define Measures

The semi-structured interview was guided by a questionnaire developed based on Nielsen's usability heuristics [29], which are outlined in Section 4.5.7. The questionnaire was organized into six thematic sections. The first section included general questions aimed at capturing participants' overall impressions of the overall *ShelterFeels* system. The second section focused specifically on the web interface, which forms a central element of this thesis and therefore got dedicated attention.

The third section addressed the core research questions, particularly concerning users' experiences with talking about emotions and reflecting on them through an analog-digital tool like *ShelterFeels*. It also explored participants' perspectives on the potential for regular use of a device like the *ShelterFeels* box. The final section dealt with the future potential of the system and was intentionally broad in scope to encourage participants to share ideas, suggestions, and thoughts on possible improvements or extensions to the project.

Following the main questionnaire, participants were invited to answer a few questions related to their demographic background, including questions on their age, their general background and if they ever used or considered using a method to assess their emotional awareness. This provided additional context for interpreting the study results.

The detailed interview script can be found in appendix B.

4.5.6. Data Analysis

The method for analyzing the gathered data is the qualitative content analysis described by Mayring [27]. This approach is well-suited for systematically and transparently categorizing textual data based on predefined categories, a process known as deductive content analysis. This allows, to extract meaning from the data by identifying patterns, categories and themes emerge from the participants feedback. The transcribed material was then analyzed row by row to extract information, to match Nielsen's heuristics [29] and additional categories.

The analysis of the thinking-aloud study and the open ended questionnaire follows a structured, step-by-step procedure:

1. Prepare heuristics for deductive coding
2. Prepare transcripts of recordings
3. Encode transcripts (connect passages towards heuristics)
4. Summarize of Findings
5. Evaluation of findings and derive usability challenges

4.5.7. Categories

The categories were based on the 10 usability heuristics for User Interface Design described by Nielsen [29] and additional categories that focus on the research question. Table 4 enlists all Heuristics and their definition, which were used to code the data.

Category	Definition
Visibility of System Status	The system should continuously inform users about what is happening, providing timely and appropriate feedback that reflects current system status.
Match Between the System and the Real World	The system should use concepts, terminology, and structures that are familiar to users, aligning with real-world conventions to ensure that information is presented in a natural and logical sequence.
User Control and Freedom	Users should have the ability to easily undo or exit unintended actions. Systems should support error recovery through clearly marked exits and flexible navigation paths.
Consistency and Standards	The design should maintain consistent terminology, layout, and behavior across the interface, following established platform or industry standards to reduce cognitive effort.
Error Prevention	The system should be designed to minimize the risk of errors. This includes eliminating error-prone conditions and offering confirmation steps before committing to potentially critical actions.
Recognition Rather than Recall	Interfaces should reduce memory load by making options, actions, and necessary information visible or easily accessible, rather than relying on users to remember information from one part of the interface to another.
Flexibility and Efficiency of Use	The interface should support a range of user expertise by offering shortcuts or accelerators for experienced users while remaining accessible to novices. Customization options can further improve efficiency.
Aesthetic and Minimalist Design	The interface should avoid unnecessary elements or content that do not support the user's tasks. Every visual or textual element should serve a clear purpose to avoid cognitive overload.
Help Users Recognize, Diagnose, and Recover from Errors	When errors occur, messages should be expressed in clear, human-readable language, explain the problem precisely, and offer constructive guidance for resolution.
Help and Documentation	While intuitive design should minimize the need for help, support materials should be available when necessary. Documentation should be easy to access, search, and understand, especially for new or infrequent users.

Table 4: Definitions of Nielsen Heuristics

Next to Nielsens Heuristics some additional Categories were used to assess emotional expressiveness, interaction comfort, and the interplay between digital and analog components. These categories were designed after the insights gathered through the expert interview described in Section 4.2.

Category	Definition
Talking about Emotions	Captures how users experienced the act of expressing their emotions during the interaction, and whether the system design supported or inhibited emotional openness.
Reflecting Emotions	Describes how the system facilitated emotional reflection, including whether it enabled users to gain deeper insight into their feelings and experiences.
Digital and Analog Interaction	Examines user perceptions of the interplay between the digital (web app) and analog (physical box) components, and whether their integration enhanced or disrupted the overall experience.

Table 5: Definitions of Additional Categories

4.5.8. Participant Recruitment

Due to the analog nature of the project, the study had to be conducted in close proximity to my home. As a result, participant recruitment was limited to my immediate social environment. Some were already familiar with the field of Human Computer Interaction (HCI), while others were not. Despite that, all participants already used methods to deal with emotional awareness, with the majority of them documenting thoughts and some using applications to track their mood or for meditation. The study was conducted with six participants with an average age of 25. Five of the participants were active students studying medicine, computer science, political science, media design, and journalism, while one person worked as a teacher.

4.6. Findings

This section presents the key findings from the usability study structured according to reoccurring themes. The results are categorized into six main sections:

1. Overall Impression and Suggestions on Functional and Conceptual Improvement
2. Usability Challenges and Opportunities for Improvement of the **physical** *ShelterFeels* Box
3. Usability Strengths and Interface Limitations of the **digital** *ShelterFeels* Web Application
4. User Perspectives on the Interplay Between Digital and Analog Components
5. User Experiences of Emotional Awareness While Talking About Emotions
6. Supporting Emotional Awareness Through Reflective Interaction

While conducting the study all participants felt comfortable with the study environment, despite being distracted from the interviewer. However, they engaged intuitively with the project, interacting with the box and completing the tasks.

4.6.1. Overall Impression and Suggestions on Functional and Conceptual Improvement

Participants generally responded positively to the overall design and conceptual clarity of *ShelterFeels*. The emotion tokens and their associated colors were perceived as well-designed. Participants described them as precisely differentiated (P4) and "intuitive" (P3), with the color choices feeling "natural" (P5) and "visually appealing" (P6).

The consistency of the system was acknowledged by all participants. While some noted that the graphical user interface (GUI) of the physical box and the web application layout were not perfectly aligned (P5), this discrepancy was not viewed as problematic. Some participants (P1, P2) suggested that both parts of the project could benefit from offering identical functionalities. P2 felt like you would use *ShelterFeels* more often by giving the web application the same functionality as the box for "when you're not at home" (P1). Also the box was titled as "more like a gadget" (P2). Participant 5 suggested that the box could take on more of the web applications functionality, particularly if "the screen of the box was bigger" (P5) and capable of displaying richer content like the web application. There was a general opinion that the system's functionality may need to grow in future to guarantee repeated use. Additionally, a desire for more "individualization" (P1) was expressed, which would lead to a stronger emotional attachment between the user and *ShelterFeels*. A suggestion involved the way emotions are connected towards user input. Currently, emotions are linked to isolated keywords extracted from users' voice input. Several participants felt that this approach may overlook the context in which the words were used. They proposed that emotions should rather be tagged to a "phrase or [...]a sentence" (P5), in order to not loose context (P2). Another similar approach was discussed by Participant 6. They suggested, to "somehow pick the words yourself or just have a little bit more control over that". This led to their conclusion, that there should be a possibility to revisit the spoken text and "if you're not satisfied with the result of the AI and can also choose yourself some more words, which you want to reflect on." (P6).

4.6.2. Usability Challenges and Opportunities for Improvement of the physical ShelterFeels Box

The interaction with the physical *ShelterFeels* box revealed several usability challenges, particularly in the areas of system feedback, user guidance, and interaction control.

A central issue reported by all participants concerned the progress bar displayed during the voice input phase. Intended to indicate how long users should speak, it often caused confusion. Participants were uncertain about when to begin or stop talking, and whether the system would proceed automatically. This lack of clarity led to a sense of rushed interaction, especially for Participant 3, who described feeling stressed due to the fear of accidentally skipping important steps. The absence of visible or responsive system control during this phase contributed to uncertainty in the early stages of use.

Beyond the talking phase, participants expressed a clear desire for greater control within the box interface. Participants 1 and 3 proposed adding options such as the ability to skip steps, revisit tagged words, or re-tag emotions in case of errors. Such controls would not only improve the tool's flexibility but also increase users' confidence while interacting with the box.

The tagging phase, where users assign emotions via NFC tokens, also introduced challenges. Several participants were unsure where exactly to place the tokens to ensure proper recognition (P3, P5, P6). Participant 3 suggested the addition of a loading bar to indicate that the token needs to remain on the NFC reader for a longer time to register the input: "a loading bar, which indicates that you have to put it on to the NFC connector longer for it to register the feeling you want to add to the words that are given in the middle." Participant 1 recommended including a small animation to confirm successful tagging: "there should be a small animation or something" every time an emotion is tagged.

Feedback on the LED ring visualizations in the lid of the box was mixed. While Participant 3 stated they "did not see the benefits of the [LED] rings," others, such as Participant 2, described them as visually comforting. This suggests that the LED feature has potential to enhance the emotional tone of the experience, provided its purpose is better communicated to the user.

4.6.3. Usability Strengths and Interface Limitations of the digital ShelterFeels Web Application

Participants generally responded positively to the design and usability of the *ShelterFeels* web application. The interface was described as "intuitive" (P2, P3, P4, P5), "inviting" (P3), and "clearly structured" (P4). However, several areas of improvement were identified. One recurring issue involved the small emotion circles displayed on the emotion pages. All participants expected these circles to be interactive, assuming they would reveal additional information such as emotion definitions (P5), timestamps (P1), or contextual notes (P1,P2) about how the emotion was used. The empty small circles were not perceived as placeholders but as to be filled on the website. They sparked confusion and where suggested to be removed (P2). Also all participants suggested to add the possibility to add notes to the entries on the emotion page for further reflection.

The learning page received positive feedback. All participants appreciated having access to a resource that helped them to better understand the emotional vocabulary used by the tokens: "I'm a big fan of explaining emotions, because sometimes you don't really know which emotion fits in which context" (P1). It was seen not only as useful but essential, especially when users were unsure about the meaning of a certain emotion or their appropriate application. The listing of emotions was described as straightforward and easy to understand. Despite this, Participant 3 noted, that the "Learn about feelings" button was not immediately recognized as a clickable element.

Navigation throughout the web application was generally seen as intuitive (all). However, some components were questioned: the sidebar, for example, was viewed as redundant (P2, P4) and featuring low contrast (P4), which made it harder to engage with.

The analytics chart in the middle of the main page generated mixed responses. Participant 1, 3 and 6 suggested adding a filter option for switching between different time frames (daily, weekly, monthly, overall), which would offer more personalized insight. Participant 4 and 5 asked for more explanation of what the chart represented, indicated a need for improved contextual guidance.

Participant 3 found the centering of potentially negatively connotated emotions emotions visually problematic, while P2 suggested that charts showing increasing negative emotions might become emotionally frustrating and proposed to display such analytics only when requested, allowing users more control over when and how they engage with emotionally charged information. In addition to that, another participant (P1) expressed interest in more detailed emotional analytics in general.

4.6.4. User Perspectives on the Interplay Between Digital and Analog Components

Participants provided a range of perspectives on the interplay between the digital (the web app on the iPad) and analog (the box) components of *ShelterFeels*, offering valuable insight into the perceived strengths and limitations of each. Overall, there was a shared appreciation for the combination of both formats, with differing preferences depending on familiarity, context of use, and expectations around emotional engagement.

Several participants (P1, P2, P4, P5) noted that the web application felt easier and more intuitive to use, largely due to their familiarity with screen-based tools: “[I felt more comfortable] using the digital interface,] because my whole day I am using digital stuff” (P1); “The digital is more intuitive to use, because I’m a digital native” (P2); “I would actually say the digital part was a little bit more intuitive to use, but mainly because I encountered the problem with the voice recording in the beginning.” (P4); “the web interface felt generally more intuitive to use.” (P5). Only Participant 3 felt more comfortable using the analog part of the object.

The physical box, despite being seen as more effortful to use, was valued for its haptic and tangible qualities: “I really like the haptic feel of using actual objects” (P3); “I think that’s really nice because [...] it’s just nicer to work with your hands. It’s like a kind of a game. So it could be more motivating for you to reflect on your day” (P1); “it’s an actual haptic thing [...] something you can touch and play around with [...], it’s way nicer” (P6).

Also participants P1 and P3 highlighted the motivational aspect of interacting with tokens and engaging with a physical device, which provided a welcome break from screen-based interactions. They labeled the interaction with the box as “digital detox” (P1). P3, in particular, described the analog experience as more intimate, suggesting that talking about one’s day felt more appropriate within the context of the box rather than through a digital interface. They felt like “if [they are] talking to something about my day, it feels better kept if [they] do it to a box than to an iPhone or an iPad” (P3).

While P2 and P5 appreciated the tactile interaction with the tokens, they also expressed concern about the box’s practicality for routine use. The physical device was described as “a bit too clunky [...] too heavy and big to use on a daily base” (P2), and suggested improvements in form factor and guidance to enhance its usability. P4 emphasized that the lack of clear instructions contributed to the analog system feeling less accessible, but believed that improved guidance could make the experience more comfortable and even help establish a routine—especially if the box served as a visual or spatial reminder in the participant’s living environment.

While Participants 1 and 2 appreciated the idea of having all core functionalities available in both the box and the web application, allowing users to choose their preferred mode of interaction, Participants 3 and 4 viewed the web app primarily as a complementary tool. For them, it served best as a platform for data visualization and for adding contextual information or notes, rather than as a full replacement for the analog experience. Participant 5 introduced the idea of bringing all features directly into the physical box, suggesting that this could be achieved by integrating a larger screen to enhance its interactive capabilities.

In summary, while the web application was complimented for its usability and clarity, the physical box was recognized for offering a more engaging and reflective experience, particularly when enhanced with better feedback and guidance.

4.6.5. User Experiences of Emotional Awareness While Talking About Emotions

Participants expressed their impression of expressing their feelings during the voice recording part of *ShelterFeels*.

Participant 1 noted that it felt "weird because you are [directly] confronted with their emotions" (P1), mentioning that people are often more likely to suppress or ignore their feelings in daily life. Participant 2 reported feeling "distracted" (P2) during the process, largely due to the presence of the interviewer, highlighting the importance of conducting such studies in private, familiar settings and over a longer duration. Despite this, P2 appreciated the tool's low-threshold approach, viewing it not as a therapeutic device but more as a helpful system for categorizing emotions, learning more about them, and using it "like an emotional diary" (P2).

Participant 3 reflected on how social expectations may have influenced their input, stating that they felt inclined to "coded my day into a more positive way" (P3). Nevertheless, they found the experience of talking about their day surprisingly natural. P3 was also intrigued about what came up spontaneously during the interaction and realized that they had not previously reflected on their day in such depth: "right now I felt like it was very naturally and interesting to see what came up spontaneously when I started talking" (P3). Although uncertain about using the gained emotional vocabulary in social conversations, they found value in the subcategories, which helped deepen their understanding on specific situations they had through out their day.

Participant 4 described the interaction as natural and appreciated how the interface has "shown specific parts of their story" (P4) on the display. This feedback loop "gives you another chance to reflect on specific things from your day" (P4). P4 also remarked that, in everyday language, they typically use only the basic emotions, but could imagine that regular use of the system might influence and expand their emotional vocabulary over time: "If I was using the device more often, I can imagine that they [the emotions described by the device] would slowly go over into my vocabulary as well" (P4).

Participant 5 found it "a bit unusual to talk to a box like this" (P5) rather than a person, noting the difference in emotional expression compared to speaking with a friend. They suggested making the interaction more comfortable. Interestingly, they observed that when talking to a human, their answers about how their day was might have been shorter and less precise than what they expressed during the interaction with the system and added that "if they [their friends] don't ask about the specific emotions like the shelter feels box, the emotionality wouldn't have been in the focus as much" (P5).

Participant 6 felt like “somebody is analyzing what they say, and then, basically digging deeper, on situations of your day, like, asking you more about your emotions towards certain situations.” (P6)

4.6.6. Supporting Emotional Awareness Through Reflective Interaction

Participants shared how the system influenced their ability to reflect on emotions more consciously and in greater depth.

Participant 1 explained that they typically only categorize emotions as “good” or “bad” in everyday thinking. However, during the interaction, they felt they genuinely reflected on a specific situation and gained a better understanding of it: “I talked a lot about one specific situation and it showed me okay, there could be a reason why I think I had to like, still think about this situation” (P1). They expressed appreciation for the opportunity to analyze their habits in a more structured way.

Participant 2 noted that they had not reflected on their emotions in the moment when a situation occurred but found that the box helped them articulate and process those feelings afterward: “I was feeling them [emotions] on the day, but I didn’t articulate them [emotions]. [...] I needed to go back into that emotional state and find words for it. And I think when you have a toolbox like that, where there are many emotions [displayed], [...] and you can learn about them. Then maybe you are more likely to articulate them.” (P2).

Participant 3 highlighted the potential benefits of regular use, suggesting that familiarity with the tokens over time would lead to more meaningful and accurate emotional reflection: “if I’m doing that more often, I will be able to maybe pick something [a token] more suitable [for a keyword]” (P3). With increased routine, they believed the reflection process would become deeper and more effective.

Participant 4 felt like the device “gives you a nice opportunity to reflect on a day. I think I’m doing this not often enough, actually. So basically like a better version of a diary entry” (P4). They stated, having “problems with keeping routines” and “having like a physical device that reminds me to do these entries, I can put somewhere for example like next to my bed or something, I imagine this would be very helpful” (P4).

Similarly, Participant 5 felt that the act of connecting emotions to specific words encouraged a more thoughtful and deliberate reflection process. As said earlier, they appreciated that the system’s focus remained on emotions themselves, in contrast to typical conversations with friends, which often center more on the events of the day than on the underlying emotional experience.

Participant 6 saw potential in the project “because [...] you’re just by yourself reflecting. [...] technically nobody is there, so you can just be super real and don’t have to care about what another person you might be talking to would think about you or they would judge you” (P6).

4.6.7. Summary

The usability study revealed that ShelterFeels was generally well received by the participants, who appreciated the emotional focus of the system, the clarity of the emotion tokens, and the aesthetic appeal of the analog and digital components. Users found the web interface intuitive and valuable for reviewing past emotions, while the physical box evoked a personal and reflective experience. However, several usability challenges emerged, particularly during the voice recording and tagging phases, where participants felt uncertain or lacked control. Feedback indicated a desire for more context in keyword selection, better onboarding, and deeper personalization.

These findings suggest that, while ShelterFeels has strong potential to support emotional reflection, its design must better align with user expectations and emotional processes. The following discussion connects these results with theoretical frameworks from the literature and insights from the expert interview, exploring how physical-digital systems can more effectively foster emotional awareness and reflective interaction.

4.7. Discussion

4.7.1. Supporting Emotions through Physical-Digital Objects

The findings of this study suggest that ShelterFeels effectively fosters emotional awareness through its tangible and digital aspects. Participants highlighted that the voice interaction and token tagging phases encouraged them to reflect on and verbalize their emotions and experiences. This directly supports Baumer's framework of breakdown, inquiry, and transformation [5], where the act of speaking initiates reflection (breakdown), selecting emotion tokens enables analysis (inquiry), and reviewing past entries potentially fosters new insights (transformation). Similarly, the use of Gloria Willcox's Feeling Wheel [47] expanded users' emotional vocabulary, confirming the expert interview's view that many people struggle to articulate emotions due to limited expressive tools.

Importantly, the combination of analog and digital elements offered complementary strengths. While the physical box created a sense of ritual and intimacy, echoing the expert's metaphor of a "treasure box" or a valuable personal item e.g. a diary, the web application enabled structured exploration and pattern recognition, aligning with findings from Pirzadeh et al. [34] and Bentvelzen et al. [7] on the role of visualization in supporting introspection. However, to fully support emotional awareness, users need more freedom to choose what they want to reflect on. This supports Bentvelzen et al.'s [7] point that systems should help people connect their data to their personal goals and experiences.

4.7.2. Design Process

The iterative human-centered design approach used in this project (combining literature insights, expert opinion, and user testing) was key to uncover what worked well at *ShelterFeels* and what needed improvement. As emphasized by the expert interview, intuitive onboarding and playful interaction are crucial for user engagement. While the emotional metaphor and ritualistic quality of the object were appreciated, onboarding issues, lack of feedback, and confusion during the voice input phase revealed areas where usability heuristics were not fully met, especially regarding system status visibility and user control [29].

The integration of a web application allowed for contextual reflection beyond the moment of recording, addressing critiques in personal informatics that systems often lack long-term reflection tools [7]. Users appreciated being able to revisit and make sense of their emotional data, aligning with the goals of reflective systems highlighted in the literature. Nevertheless, several participants desired more personal context or notes attached to each emotion, suggesting future designs should offer more flexible and expressive data entry methods, as recommended by Mols et al. [28].

4.7.3. Limitations and Future Potential

As noted during the expert interview (see Section 4.2), a cultural probe approach would have been the most appropriate method to evaluate the long-term impact of the *ShelterFeels* system. However, due to time limitations and the fragile nature of the prototype, it was not feasible to deploy the device in the home environments of the participants over an extended period.

Although efforts were made to simulate a context-sensitive setting by conducting the study in environments familiar to the users, such as their living rooms or bedrooms, the presence of the interviewer during emotionally sensitive tasks influenced the authenticity of the interaction. Several participants reported feeling uncomfortable or inhibited when reflecting on emotionally charged situations while being observed, which may have limited the depth and openness of their emotional engagement with the system.

Another limitation involves the automated keyword extraction. While the technical solution worked, participants felt constrained by the system's choices. This suggests a need for hybrid approaches where users can override or supplement algorithmically generated content. This raises concerns about balancing automation (in form of an AI) and human control.

While this thesis focused primarily on the design and evaluation of the web application, the next phase of development should shift attention toward rethinking the design of the physical *ShelterFeels* box. As outlined by the expert in Section 4.2, there remain several critical challenges related to user interaction, accessibility, and onboarding that must be addressed to enhance the usability of the analog component. Findings from the usability study further underscored these issues, indicating that resolving these challenges should be prioritized in the next stages of the design process.

During the study Participants already identified several promising directions for future development of the *ShelterFeels* system. These included expanding opportunities for personalization, such as the ability to add custom emotions and visual or auditory feedback to enhance the character of the device. Suggestions also focused on improving emotional engagement through a guided start-up phase and a stronger guided voice interaction. Additionally, participants expressed interest in integrated note-taking, both on the device and via the web application, as well as the option to view more detailed emotional analytics and contextual information associated with each entry. All these findings will help further development of *ShelterFeels*.

4.8. Conclusion

To answer the research question, “How can tangible artifacts be designed and utilized to gain emotional awareness through physical interaction?”, this study shows that these artifacts work best when they create simple, meaningful ways for users to reflect on their emotions. The design of *ShelterFeels*, with its voice input, emotion tokens, and light-based feedback, helped users pause, express, and think about how they feel. The connected web application further enhanced this process by allowing users to revisit and explore their emotional data over time. Visualizing user data helped recognize patterns supporting deeper reflection. Using models like Gloria Willcox's Feeling Wheel [47] supported users in naming emotions more precisely, which is an important step toward emotional awareness. Feedback from users and the expert interview also showed that people want more control over how they reflect, such as choosing their own keywords or adding personal notes. This suggests that for a tangible object to truly support emotional awareness, it should combine intuitive interaction, emotional guidance, and flexible ways for users to make the experience personal.

Ultimately, this thesis contributes to the growing field of tangible interfaces in mental well-being by demonstrating how emotionally engaging, hybrid systems can help develop a stronger emotional awareness. *ShelterFeels* shows that emotional awareness is not just about collecting data, it is about designing meaningful, engaging experiences that invite people to pause, reflect, and connect with their emotions.

References

[1] Apple Inc. Apple Health. https://www.apple.com/health/, 2025. Retrieved June 13, 2025 from https://www.apple.com/health/.

[2] M. Ardelt and S. Grunwald. The importance of self-reflection and awareness for human development in hard times. *Research in Human Development*, 15:1–13, 07 2018.

[3] Association for Computing Machinery (ACM). ACM International Conference on Tangible, Embedded, and Embodied Interaction (TEI) 2025. https://tei.acm.org/2025/, 2025. Retrieved June 13, 2025 from https://tei.acm.org/2025/.

[4] S. Atkins and K. Murphy. Reflection: a review of the literature. *Journal of Advanced Nursing*, 18(8):1188–1192, 1993.

[5] E. P. Baumer. Reflective informatics: Conceptual dimensions for designing technologies of reflection. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, page 585–594, New York, NY, USA, 2015. Association for Computing Machinery.

[6] E. P. Baumer, V. Khovanskaya, M. Matthews, L. Reynolds, V. Schwanda Sosik, and G. Gay. Reviewing reflection: on the use of reflection in interactive system design. In *Proceedings of the 2014 Conference on Designing Interactive Systems*, DIS '14, page 93–102, New York, NY, USA, 2014. Association for Computing Machinery.

[7] M. Bentvelzen, J. Niess, and P. W. Woźniak. The technology-mediated reflection model: Barriers and assistance in data-driven reflection. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, CHI '21, New York, NY, USA, 2021. Association for Computing Machinery.

[8] P. M. Burgess, J. E. Pirkis, T. N. Slade, A. K. Johnston, G. N. Meadows, and J. M. Gunn. Service use for mental health problems: Findings from the 2007 national survey of mental health and wellbeing. *Australian and New Zealand Journal of Psychiatry*, 43(7):615–623, 2009.

[9] Calm. Calm Website. https://www.calm.com, 2025. Retrieved June 13, 2025 from https://www.calm.com.

[10] Coding IxD. Coding IxD Website. https://codingixd.mi.fu-berlin.de/, 2025. Retrieved June 13, 2025 from https://codingixd.mi.fu-berlin.de/.

[11] Coding IxD. Design Fair – Expanding the Body. https://codingixd.mi.fu-berlin.de/designfair-expandingthebody/, 2025. Retrieved June 13, 2025 from https://codingixd.mi.fu-berlin.de/designfair-expandingthebody/.

[12] T. Donker, K. Petrie, J. Proudfoot, J. Clarke, M.-R. Birch, and H. Christensen. Smartphones for smarter delivery of mental health programs: A systematic review. *J Med Internet Res*, 15(11):e247, Nov 2013.

[13] P. Dragicevic, Y. Jansen, and A. Vande Moere. Data Physicalization. In J. Vanderdonckt, P. Palanque, and M. Winckler, editors, *Springer Handbook of Human Computer Interaction*, Springer Reference. Springer, Cham, 2021.

[14] I. O. for Standardization. Iso 9241-210:2019 ergonomics of human-system interaction - part 210: Human-centred design for interactive systems, 2019. ISO Standard.

[15] E. Gudauskayte, E. Machmer, A. Winkler, P. Schmidt, and G. Adra. Shelterfeels - a tangible interface for emotional awareness, 2024. Accessed: 2025-03-28.

[16] V. Harrison, J. Proudfoot, P. P. Wee, G. Parker, D. H. Pavlovic, and V. Manicavasagar. Mobile mental health: Review of the emerging field and proof of concept study. *Journal of Mental Health*, 20(6):509–524, 2011.

[17] Headspace. Headspace. `https://www.headspace.com`, 2025. Retrieved June 13, 2025 from `https://www.headspace.com`.

[18] How We Feel Project. How We Feel. `https://howwefeel.org/`, 2025. Retrieved June 13, 2025 from `https://howwefeel.org/`.

[19] Human-Centered Computing (HCC) Research Group. Human-Centered Computing (HCC) Research Group – Freie Universität Berlin. `https://www.mi.fu-berlin.de/en/inf/groups/hcc/index.html`, 2025. Retrieved June 13, 2025 from `https://www.mi.fu-berlin.de/en/inf/groups/hcc/index.html`.

[20] C. IxD. Expanding: The body – project showcase. Online Video, 2024. Accessed: 2025-02-10.

[21] Y. Jansen, P. Dragicevic, P. Isenberg, J. Alexander, A. Karnik, J. Kildal, S. Subramanian, and K. Hornbæk. Opportunities and challenges for data physicalization. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, CHI '15, page 3227–3236, New York, NY, USA, 2015. Association for Computing Machinery.

[22] L. Karimi, S. G. Leggat, T. Bartram, L. Afshari, S. Sarkeshik, and T. Verulava. Emotional intelligence: Predictor of employees' wellbeing, quality of patient care, and psychological empowerment. *BMC Psychology*, 9(1):93, 2021.

[23] Lange Nacht der Wissenschaften. Lange Nacht der Wissenschaften Berlin. `https://www.langenachtderwissenschaften.de/`, 2025. Retrieved June 13, 2025 from `https://www.langenachtderwissenschaften.de/`.

[24] I. Li, A. Dey, and J. Forlizzi. A stage-based model of personal informatics systems. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '10, page 557–566, New York, NY, USA, 2010. Association for Computing Machinery.

[25] I. Li, Y. Medynskiy, J. Froehlich, and J. Larsen. Personal informatics in practice: improving quality of life through data. In *CHI '12 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '12, page 2799–2802, New York, NY, USA, 2012. Association for Computing Machinery.

[26] K. A. Lindquist, J. K. MacCormack, and H. Shablack. The role of language in emotion: predictions from psychological constructionism. *Frontiers in Psychology*, 6, 2015.

[27] P. Mayring. Qualitative content analysis. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 1, 06 2000.

[28] I. Mols, E. van den Hoven, and B. Eggen. Everyday life reflection: Exploring media interaction with balance, cogito & dott. In *Proceedings of the Fourteenth International Conference on Tangible, Embedded, and Embodied Interaction*, TEI '20, page 67–79, New York, NY, USA, 2020. Association for Computing Machinery.

[29] J. Nielsen. Enhancing the explanatory power of usability heuristics. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '94, page 152–158, New York, NY, USA, 1994. Association for Computing Machinery.

[30] W. H. Organisation. Depression and other common mental disorders. *WHO/MSD/MER/2017.2*, 2017.

[31] Pallets Projects. Jinja Website. `https://jinja.palletsprojects.com/en/stable/`, 2025. Retrieved June 13, 2025 from `https://jinja.palletsprojects.com/en/stable/`.

[32] Philipp1305. ShelterFeels GitHub Repository. `https://github.com/Philipp1305/ShelterFeels.git`, 2025. Retrieved June 13, 2025 from `https://github.com/Philipp1305/ShelterFeels.git`.

[33] A. G. Phillips. Self-reflection. In V. Zeigler-Hill and T. K. Shackelford, editors, *Encyclopedia of Personality and Individual Differences*, pages 4791–4794. Springer International Publishing, Cham, 2020.

[34] A. Pirzadeh, L. He, and E. Stolterman. Personal informatics and reflection: a critical examination of the nature of reflection. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '13, page 1979–1988, New York, NY, USA, 2013. Association for Computing Machinery.

[35] PostgreSQL Global Development Group. PostgreSQL Website. `https://www.postgresql.org/`, 2025. Retrieved June 13, 2025 from `https://www.postgresql.org/`.

[36] Prof. Carola Zwick. Website of Prof. Carola Zwick. `https://kh-berlin.de/personen/1212`, 2025. Retrieved June 13, 2025 from `https://kh-berlin.de/personen/1212`.

[37] Prof. Dr. Claudia Müller-Birn. Website of Prof. Dr. Claudia Müller-Birn. https://www.mi.fu-berlin.de/en/inf/groups/hcc/members/professor/mueller-birn.html, 2025. Retrieved June 13, 2025 from https://www.mi.fu-berlin.de/en/inf/groups/hcc/members/professor/mueller-birn.html.

[38] S. L. Rizvi, L. A. Dimeff, J. Skutch, D. Carroll, and M. M. Linehan. A pilot study of the dbt coach: An interactive mobile phone application for individuals with borderline personality disorder and substance use disorder. *Behavior Therapy*, 42(4):589–600, 2011.

[39] F. Sarzotti. Self-monitoring of emotions and mood using a tangible approach. *Computers*, 7(1), 2018.

[40] A. B. Satpute, E. C. Nook, and M. E. Cakar. 56the role of language in the construction of emotion and memory: A predictive coding view. In *Neuroscience of Enduring Change*. Oxford University Press, 03 2020.

[41] Sebastián Ramírez. FastAPI Website. https://fastapi.tiangolo.com/, 2025. Retrieved June 13, 2025 from https://fastapi.tiangolo.com/.

[42] M. Team. Keyphrase extraction - kbir inspec, 2025. Accessed: 2025-03-28.

[43] G. Thornicroft. Stigma and discrimination limit access to mental health care. *Epidemiologia e Psichiatria Sociale*, 17(1):14–19, 2008.

[44] S. G. Trusz, A. W. Wagner, J. Russo, J. Love, and D. F. Zatzick. Assessing barriers to care and readiness for cognitive behavioral therapy in early acute care ptsd interventions. *Psychiatry*, 74(3):207–223, 2011.

[45] Weißensee Kunsthochschule Berlin. Rundgang Exhibition. https://kh-berlin.de/rundgang, 2025. Retrieved June 13, 2025 from https://kh-berlin.de/rundgang.

[46] Weißensee Kunsthochschule Berlin. Weißensee Kunsthochschule Berlin. https://kh-berlin.de/, 2025. Retrieved June 13, 2025 from https://kh-berlin.de/.

[47] G. Willcox. The feeling wheel. *Transactional Analysis Journal*, 12(4):274–276, 1982.

[48] K. Woodward, E. Kanjo, D. J. Brown, T. M. McGinnity, B. Inkster, D. J. Macintyre, and A. Tsanas. Beyond Mobile Apps: A Survey of Technologies for Mental Well-Being . *IEEE Transactions on Affective Computing*, 13(03):1216–1235, July 2022.

Appendices

A. Expert Interview

Expert Interview Interview

Designing for Emotional Awareness:
A Human-Centered Study of ShelterFeels as a Tangible Reflective Device

Philipp Schmidt

Computer Sience

Introduction

This interview is part of a bachelor thesis focused on improving *ShelterFeels*, a tool designed to help users expand their emotional vocabulary through a combination of physical interaction and digital feedback. The object was design as part of the CodingIxD Series, an interdisciplinary course of Freie Universität Berlin and Weißensee Kunsthochschule Berlin with focus on body data. The general goal of the thesis is to explore how interaction and product design can help support emotional understanding. The insights as an interaction and product designer will help evaluate the current concept and identify ways to improve the overall user experience and effectiveness of the tool before conducting a broader usability study. To get a better understanding of the project, a short product video[1].

This will be a **semi-structured interview**. Feel free to share any thoughts that come to mind, even going beyond the questions asked.

Participant Demographics

Q1: What is your background in interaction and product design, and how did your work intersect with design for user experience and personal informatics?

On *ShelterFeels*

Part 1: Explanation of the *ShelterFeels* Interaction Design Concept and User Experience:

> To better understand the idea of ShelterFeels, a short video (`https://codingixd.mi.fu-berlin.de/expandingthebody/`) will be provided for clarity.

Q2: What are your thoughts about the combination of physical and digital elements in this project?

Q3: Do you think the main concept of *ShelterFeels*—understanding, reflecting on, and communicating feelings—is well communicated by the current design? If not, what could clarify it?

[1] Video can be found on the bottom of the following page:`https://codingixd.mi.fu-berlin.de/expandingthebody/`

Q4: How intuitive do you think the voice recording and tagging phase is?

Q5: What would you suggest to make the voice-based input and tagging more accessible and meaningful?

Q6: In your perspective, what are effective strategies to make abstract concepts like emotional understanding more tangible in interaction design?

Q7: *ShelterFeels* aims to be a personal, intimate object. Do you think the design reflects this? Why or why not?

Part 2: Reflections on Learning of the Emotional Vocabulary through Personal Informatics:

Definition: Emotional Vocabulary

Emotional vocabulary refers to the range and precision a person can use to identify, explain, and express their emotions. Beyond basic emotions (like happy, sad, angry, or afraid), there are more nuanced, complex ones (like disappointed, anxious, nostalgic).

Q8: How effective, in your opinion, is *ShelterFeels* in encouraging users to expand their emotional vocabulary?

Q9: How important is playfulness in fostering emotional learning, and do you think *ShelterFeels* uses it effectively?

Definition: Personal Informatics

Personal Informatics refers to systems designed to assist individuals in gathering personal data to enhance their self-awareness.

Q10: How do you see *ShelterFeels* fitting into the field of personal informatics and self-tracking tools?

Q11: What role do you think emotional data plays in personal informatics, and how could *ShelterFeels* contribute to this field?

Debriefing

The collected data will significantly influence the design and arrangement of a new prototype, leading to an enhanced version of *ShelterFeels* that effectively promotes learning about emotions in a meaningful and accessible way. The findings of this interview will be included in my thesis as part of the early research phase and will help inform improvements before conducting a larger-scale usability study.

B. Usability Study

Qualitative Study

Evaluation Phase for Thesis:
Designing for Emotional Awareness:
A Human-Centered Study of ShelterFeels as a Tangible Reflective Device

Philipp Schmidt

Computer Sience

Introduction

This qualitative study to investigate usability, is part of a bachelor's thesis focused on *ShelterFeels*. A device consisting out of two components, an analog box and a web interface. The Box is a tangible object which invites the user to verbally reflect on their day. It uses voice input, keyword extraction, and NFC-tagged Tokens based on feelings described by Gloria Willcox. The box provides immediate feedback through LED-rings visualizing the daily emotional state of the user. The web interface complements the box by adding a long term visualization of data. It gives the user the possibility to revisit past entries and learn about emotional vocabulary. The general goal of the study is to explore how interaction and product design can help support emotional understanding. To get a better understanding of the project, a short product video can be found at the codingIxD Webpage[1].

The study is divided into two steps: **(1) thinking-aloud study while exploring the project**. This means, while interacting with the project, capture whatever comes to your mind. This includes what you are looking at, thinking, doing or feeling while interacting. Feel free to share any thoughts that come to mind. **(2) Open ended questions** in form of a semi structured Interview, guided by a set of questions.

Scenario

ShelterFeels is meant to be used in your personal safe space (e.g. bedroom, living room). Therefore I want you to *"Imagine it's the end of your day. You've just come home and are winding down. You want to take a few minutes to reflect on how your day went. What felt good? What didn't? ShelterFeels is here to help you capture and explore your emotions."*

Task

Task 1: Interact with the object *ShelterFeels* by running through the basic phases, including recording a short voice message describing your day and situations in which you felt emotionally engaged. Following up, perform the tagging phase based on your given input.

Task 2: Open the *ShelterFeels* web application on the IPad and explore freely.

Task 3: Interview with questionnaire

[1] Video can be found on the bottom of the following page: `https://codingixd.mi.fu-berlin.de/expandingthebody/`

On *ShelterFeels*

Part 1: General questions

Q1: Was it clear to you what *ShelterFeels* is intended to do? If not, what was confusing?

Q2: Did the way *ShelterFeels* presents emotions and feedback feel natural or familiar to you?

Q3: Did you feel in control throughout interacting with the system?

Q4: Were similar elements always used consistently throughout the system?

Q5: Did *ShelterFeels* guide you in a way that helped you avoid mistakes or confusion?

Q6: Did you find it easy to understand what to do next in each step?

Q7: Would you have preferred more shortcuts or control options?

Part 2: Web Interface

Q8: How did you feel about the visual design and structure of the web interface?

Q9: If something didn't work as expected, was it clear what happened and how to fix it?

Q10: Was there any point where you would have liked more explanation or help?

Q11: How did you like the combination of digital web interface and analog Device (Box)?

Q12: What was more comfortable to use to you? The digital or analog part of the project?

Part 3: Talking about Emotions:

Q13: How did you feel while talking about emotions through *ShelterFeels*?

Q14: Did the process help you notice or name emotions you hadn't thought about before?

Part 4: Future Potential:

Q15: If you could improve or change something at *ShelterFeels*, what would it be? What on the web app? What on the box?

Q16: Do you think this is something you would consider using regularly? If so, why?

Participant Demographics

These questions are optional. If you don't feel like answering them, you don't have to.

Q1: How old are you?

Q2: What is your background?

Q3: Have you ever used or considered using tools in the area of emotional awareness? If so, which?

Debriefing

The collected data will be analyzed after Mayring's Qualitative Content Analysis method. This approach allows me to systematically identify recurring themes and insights with your responses, which will help evaluate the usability of *ShelterFeels*. The data will be anonymized and not be inked to your name or identity in the thesis or any publications.

C. HCC Consent Form

FREIE UNIVERSITÄT BERLIN

Information und Einverständniserklärung
Erhebung, Verarbeitung und Übermittlung von personenbezogenen Daten

1. Grundlegende Informationen

Name der/des Teilnehmenden:	____________________
Datum:	____________________
Ort:	Berlin
Titel der Forschung:	Enhancing the Understanding of Emotions Through Physical Interaction
Untersuchende/r Forscher:innen:	Philipp Schmidt

Vielen Dank, dass Sie zugestimmt haben, an der oben genannten Forschung teilzunehmen. Forschungsethik und Datenschutzbestimmungen (d. h. DSGVO[1]) erfordern, dass die Teilnehmenden ausdrücklich zustimmen, aufgezeichnet zu werden und wie die erhobenen Informationen verwendet werden. Diese Informations- und Einwilligungserklärung ist notwendig, damit wir sicherstellen können, dass Sie den Zweck Ihrer Teilnahme verstehen und mit den Bedingungen Ihrer Teilnahme einverstanden sind. Ihre Einwilligung stellt gemäß Art. 6 Abs. 1 lit. a DSGVO die Rechtsgrundlage für die Datenverarbeitungsprozesse im Zuge der Forschung dar.

2. Hintergrund
Hintergrund dieser Forschung ist das Projekt ShelterFeels zu untersuchen. Ziel ist es, zu untersuchen, zu untersuchen, wie Interaktions- und Produktdesign dazu beitragen können emotionales Verständnis zu unterstützen.

3. Ablauf
Die Forschung findet in einem Zeitraum von ca. zwei Monaten statt. Der Ablauf der Evaluation erfolgt mittels Interviews. Während der Interviews werden Sprachaufnahmen gemacht und anschließend transkribiert. Mit Ihrer Teilnahme werden keine Risiken erwartet, aber Sie haben das Recht, eine Aufnahme jederzeit abzubrechen oder von der Forschung zurückzutreten. Es kann sein, dass Nachfragen zur weiteren Klärung erforderlich sind. Wenn dies der Fall ist, werden wir Sie per E-Mail kontaktieren, um dies zu erbitten.

3. Datenverwertung und -veröffentlichung
Elemente des digitalen Dokuments dürfen in anonymisierter Form direkt oder indirekt in meiner Abschlussarbeit zitiert und angezeigt werden.

4. Entschädigung
Sie werden für die Teilnahme an dieser Forschung nicht entlohnt.

5. Vertraulichkeit
Ihre Daten werden vertraulich behandelt. Der Zugang zu Ihren Daten (Transkripte) wird auf mich (Untersuchende/r Forscher:innen) beschränkt sein. Wir werden einzelne Namen stets anonymisieren.

6. Datensicherheit und -speicherung

[1] Weitere Informationen zur DSGVO finden Sie unter: https://dsgvo-gesetz.de/

Die Daten (digitalen Dokumente und Bildmaterial) werden auf den passwortgeschützten Servern der Freien Universität Berlin gespeichert und anonymisiert. Die Daten werden im Falle eines Widerrufes Ihrer Einwilligung umgehend gelöscht.

9. Rechte der betroffenen Person

Laut DSGVO haben Sie die folgenden Rechte, sobald Ihre personenbezogenen Daten erstellt wurden:

- Recht auf Auskunft über die gespeicherten personenbezogenen Daten (Artikel 15 DSGVO).
- Recht auf Berichtigung, wenn Daten zu Ihrer Person falsch oder unvollständig sind (Artikel 16 DSGVO).
- Recht auf Löschung der Sie betreffenden Daten, sofern eine der gesetzlichen Voraussetzungen vorliegt und keine gesetzliche Ausnahmeregelung dem entgegensteht (Artikel 17 DSGVO).
- Recht auf Einschränkung der Verarbeitung, insbesondere wenn die Richtigkeit der Daten bestritten wird, wenn einer der im Gesetz genannten Gründe eingreift, insbesondere auf Ihren Wunsch auch anstelle der Löschung der Daten (Artikel 18 DSGVO).
- Recht auf Datenübertragbarkeit. Sie haben das Recht, Auskunft über alle personenbezogenen Daten zu verlangen, die über Sie in einem strukturierten, gängigen und maschinenlesbaren Format gespeichert sind, und haben das Recht, diese Daten einem anderen Verantwortlichen ohne Behinderung durch den Verantwortlichen, dem die personenbezogenen Daten bereitgestellt wurden, zu übermitteln (Artikel 20 DSGVO)
- Recht, eine Beschwerde bei einer Aufsichtsbehörde einzureichen. Die zuständige Aufsichtsbehörde kann jede beliebige Datenschutzaufsichtsbehörde sein (Artikel 77 DSGVO).
- Recht auf Widerruf der Einwilligung (Art. 7 Abs. 3 DSGVO)

10. Kontakt

Wenn Sie Fragen zu dieser Forschung haben, können Sie uns gerne kontaktieren: schmip99@zedat.fu-berlin.de

I. Verantwortliche:r

Verantwortliche für die Datenverarbeitung ist:

Philipp Schmidt

II. Datenschutzbeauftragte:r

Wenn Sie über diese Forschung beunruhigt sind oder wenn Sie Bedenken haben, wie sie durchgeführt wird, können Sie sich an den Datenschutzbeauftragten der Freien Universität Berlin wenden. Diesen erreichen Sie unter:

Dr. Karsten Kinast, LLM
Am Hohenzollernring 54
50672 Köln
E-Mail: leidinger@kinast.eu

Einverständniserklärung

Mit meiner Unterschrift erkläre ich mich damit einverstanden, an dieser Forschung gemäß den Bedingungen des Informationsblattes (Seiten 1-2 dieses Dokuments), teilzunehmen.

Im Einzelnen willige ich in die folgenden Verarbeitungsvorgänge im Zuge dieser Forschung ein:

☐ Anfertigung von Tonaufnahmen während der Forschung.

☐ Anonymisierte Nutzung der Transkripte für meine Abschlussarbeit

Diese Einwilligungserklärung wird auf freiwilliger Basis erteilt und kann jederzeit formlos mit Wirkung für die Zukunft gegenüber Philipp Schmidt widerrufen werden, ohne dass dies nachteilige Folgen hätte.

____

Unterschrift der/des Teilnehmenden

____

Unterschrift der/des Forschenden

_________________, __________________

Ort, Datum