Design of a mobile-based user interface for eye workouts

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Abstract

Objective

The objective of this thesis is to develop a mobile application that aims to make eye workouts more accessible to a wider audience, specifically targeting individuals suffering from headaches or migraines. The study focuses on investigating the research questions surrounding the development of the user interface and employs a user-centered approach to effectively address the challenge. By developing a mobile app that guides users through the process of specific eye exercises, the objective is to provide a convenient and accessible solution that can be practiced independently.

Approach

The study follows a user centered design process that includes a literature study, competitor analysis, requirement identification, user-centered interface design, technology evaluation, prototype implementation, and final evaluation. Research questions addressed in this study are:

1) **Target Group:** Identify the target audience to tailor the app experience to their preferences and needs.
2) **Feedback Mechanisms:** Explore reliable feedback methods to ensure correct execution of workouts.
3) **User Retention:** Develop strategies to encourage regular app usage for long-term benefits.

Conclusion

A functional prototype in the form of an angular web app was created based on the extensive conceptualization developed within the thesis. The implementation focused on addressing the research questions and provided valuable insights. The findings highlighted the importance of customization options to optimize the execution of eye workouts for different individuals. By enhancing personalization and ensuring usability according to recognized principles, the application can better cater to user needs. The recommendations and evaluation findings serve as a foundation for future iterations and improvements of the application, with a focus on customization and adherence to recognized usability principles.

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Part I: Conceptual Design

Part II: Project Documentation

Part III: Appendix

Part I

Conceptual Design

Chapter 1

1 Introduction

In this chapter, an introduction to the thesis is given. We present the aim and objective of this thesis and provide the required background knowledge, to follow the thesis.

1.1 Aims and Objectives

This section introduces the given problem description of the thesis and our solution.

1.1.1 Problem

Approximately 20% of the population's daily lives are impacted by headaches or migraine attacks, which significantly hinder their quality of life. Despite medical advancements, most forms of headaches are not curable, and existing medications typically come with undesirable side effects. However, practicing specific eye exercises has shown promise in reducing the frequency, severity, and duration of headaches. The demand for such exercises further indicates their effectiveness. However, in order for these eye workouts to yield benefits, correct and regular execution is key. In addition, these eye workouts are only accessible to a limited group of people, since in person therapy sessions are expensive, sparse, and often booked out weeks in advance.

To make eye workouts more accessible and allow patients to practice by themselves successfully, a mobile application mimicking these in person workouts needs to be developed.

1.1.2 Solution

This thesis aims to address the challenge of making these exercises more accessible to a wider audience by developing a mobile app that guides users through the process. The focus of this thesis lies in investigating the research questions surrounding the development of the user interface and employing a user-centered approach to tackle the issue effectively.

1.2 Eye Workouts Introduction

In order to fully grasp the challenges of this thesis, a basic understanding of eye workouts is required. In order to provide that understanding, we will introduce the concept using the example of the OTO-workout. The OTO-workout is one among several eye exercises practiced by Pascal Abegg, but it holds a special significance as his preferred choice for digital implementation.

In an in-person therapy session, the therapist provides a paper with the distinctive OTO-symbol, as shown in figure 1.2. The paper should be positioned approximately 30 cm away from the patient's face. The workout entails a sequence of actions: assuming a specific eye position, achieving a state of relaxation, and transitioning back into the desired eye position. By consistently practicing this exercise and alternating between tense focusing and

relaxation, individuals have reported remarkable improvements in reducing the severity and frequency of headaches and migraines when performed regularly, according to Pascal Abegg.
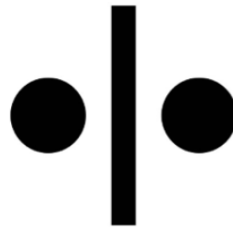
Figure 1.2: OTO-symbol

1.3 Thesis Structure

The following two sections will describe how the thesis is structured.

1.3.1 Conceptual design

The Conceptual design part of the thesis is divided into several chapters, each focusing on specific aspects of the development process and implementation of the eye-workout application.

- **Introduction:**
  In this chapter, we provide an overview of the problem at hand, establish the goals of the thesis, and present the necessary background information.
- **Literature Study and Competitors Analysis:**
  To inform our decision-making process, we conduct a comprehensive literature study and analyze existing competitor solutions related to eye-workout applications and the relevant research questions.
- **Requirements:**
  This chapter outlines the various requirements that the final conceptualized system of the thesis needs to fulfill in order to meet the needs and expectations of users.
- **User-Centered Interface Design:**
  Here, we delve into the iterative development process of the conceptual design. We describe the creation of prototypes through two iterations and the testing conducted to refine the design further.
- **Technology Evaluation:**
  To implement our concept as a functional prototype, we conduct a technology evaluation. This chapter presents the evaluation criteria and results obtained during the procedure.
- **Implementation:**
  The implementation chapter documents the final implementation of the prototype. It highlights the most relevant features and design decisions made during the development process.

- **Final Evaluation:**
  In this chapter, we evaluate the prototype in collaboration with our project partners and perform a heuristic review. The findings from the evaluation inform numerous improvements and refinements that can be found in the same chapter.

1.3.2 Project Documentation

The Project Documentation provides an overview of the project, including organizational strategies and management processes. It includes information on the chosen management method, time management approach, milestones and project timeline, and risk management analysis with corresponding mitigation strategies.

Chapter 2

2 Literature Study and Competitors Analysis

To establish a solid initial knowledge base for informed decision-making, we conducted a literature study. The consistent and proper execution of eye-workouts is crucial to maximize their effectiveness and benefits. To create a personalized experience that promotes accurate and regular execution, it is important to investigate the specific needs and preferences of our target group, which is the first step in user centered design [2]. Additionally, we delve into the industries approach to maintain user engagement and retention, while also exploring methods to guide and correct users to ensure proper execution. In addition to studying scientific and professional literature, we conduct an analysis of competitor solutions addressing similar issues.

2.1 Research Questions

The literature study provides a base for requirements engineering and captures the current state of knowledge on the research questions. The research questions are summarized in table 2.1 to give a quick overview. Furthermore, this section provides details on how these questions came to be and what motivates us to explore them further.

Research Questions Summary			
ID	Title	Question	Motivation
Q1	Target Group	Who is the target group?	In order to inform the design decision process, a user analysis has to be conducted
Q2	Feedback Mechanisms	How to provide reliable feedback to users?	Workouts need to be executed correctly in order to yield benefits.
Q3	User retention	How to encourage regular app usage?	Workouts need to be executed regularly and over the long term in order to yield benefits

Table 2.1: Functional requirements definition as user stories

Target Group

First, we have to find out, who we are conceptualizing our system for. Understanding the target audience helps inform the design process and ensures that the software meets their specific needs and preferences [1][2]. We want to know what motivates them to use our app and what challenges they might face when trying to achieve their goals. By identifying the user's motivations, goals, and potential challenges, we can tailor the system to ensure a user-friendly and effective solution.

Feedback Mechanisms

To unlock the benefits of the workout method, it is crucial for users to execute the exercises correctly and as intended. Feedback plays a vital role in ensuring the users' proper form and technique. By exploring feedback mechanisms and strategies, we can find out how the system could guide users, minimize errors, enhance their workout experience, and make sure their execution is correct and enables the effectiveness of the method.

User Retention

Another important factor in ensuring the success of the method, is regular execution. In order to benefit from its long term effects, users need to work out regularly for multiple weeks. Since the journey to achieve the methods' health improving effects can be quite lengthy and straining, we assume promising long term effects is not enough to make sure users execute their workout routinely. By exploring user retention, strategies, we hope to find a fitting short term enticement, and make each workout session feel rewarding.

2.2 Literature Review

In this section, we review literature to address our research question. We present concise textual summaries and accompanying tables that highlight the findings for each question, providing a comprehensive overview of the insights gained. To facilitate easy reference and comprehension, table 2.2 serves as a summary, listing all key findings identified during the literature review, along with their corresponding IDs.

Insight summary		
Research Question	**Insights**	**ID**
Q1 – Target Group	Migraines are most prevalent in women (approx. 2:1 ratio).	Insight-01
	Highest prevalence of migraines are among adults aged 18-44.	Insight-02
	Occupational groups that show the most prevalence of migraines include healthcare workers, teachers, and office workers.	Insight-03
	People with higher levels of education may be at a higher risk of migraines.	Insight-04
	Regular routines and managing triggers can be beneficial for managing migraines and headaches.	Insight-05
	People suffering from migraine often suffer from increased sensitivity towards bright lights/screens and stress.	Insight-06
Q2 – Feedback Mechanisms	Users generally prefer visual and text-based feedback over audio and haptic feedback.	Insight-07
	Combining multiple feedback mechanisms can be more effective than relying on visual feedback alone.	Insight-08
	Feedback should be immediate, specific, and informative for optimal effectiveness.	Insight-09
	Feedback should be personalized, contextual, and timely to be most relevant to users.	Insight-10
Q3 – User Retention	Setting goals can help users stay motivated and engaged with the app.	Insight-11
	Social support can provide encouragement and a sense of community, but also put pressure onto users.	Insight-12

	Gamification elements, when used meaningfully, can help motivate users.	Insight-13
	Personalization can provide a sense of ownership, as long as the options are diverse and relevant to users.	Insight-14
	A pleasing user experience is important to encourage regular app usage.	Insight-15

Table 2.2: Literature review insights summary

2.2.1 Q1 – Target Group

Since our product's aim is to treat migraine and headaches, it is safe to assume that our target group is equivalent to the demographic suffering most from headaches and migraines.

Target Group Summary	
Gender	Higher prevalence of migraines in women (approx. 2:1 ratio)
Age	Highest prevalence among adults aged 18-44
Occupation	Healthcare workers, teachers, and office workers at risk
Education level	Potential higher risk for those with higher education
Behavioral patterns	Regular routines and managing triggers can be beneficial
Other characteristics	Likely to have an increased sensitivity towards bright lights/screens and stress

Table 2.2.1: Target group summary

2.2.1.1 Gender

According to a US study that review health data from multiple sources published in 2015, women are more likely to suffer from headaches and migraines than men.

The study, published in the journal "Headache," examined the prevalence of migraines in both genders. It found that the overall prevalence of migraines was higher in women compared to men. Specifically, the study reported a female-to-male ratio of migraine prevalence of approximately 2:1 [3].

2.2.1.2 Age

The previously named US study, from 2015, also found that the prevalence of migraine was highest among adults aged 18-44 [3]. According to a study on migraine characteristics and prevalence across different age groups, it was observed that the prevalence of migraine tends

to decrease with increasing age. The study, which stratified patients into three age groups, found that specific variables associated with migraine, such as stress as a trigger, photophobia, phonophobia, throbbing, pressure, and stabbing sensations, tend to decline with age. Additionally, the study highlighted that the 50+ age group showed trends suggesting a "lesser acute migraine attack," indicating a lower prevalence of migraine in older individuals [4].

2.2.1.3 Occupation

Unfortunately, there are no studies comparing a wide range of professions and their migraine prevalence. However, there are many studies that delve into the prevalence of migraine in a specific field. The Occupations that came up most whilst searching for papers related to migraine in certain occupation were the follow:

- **Healthcare workers:** Healthcare workers, including nurses and physicians, are at increased risk of developing headaches and migraines due to factors such as stress, long work hours, and irregular sleep patterns [5][6].
- **Teachers:** Teachers are also at increased risk of developing headaches and migraines due to factors such as stress, prolonged reading or computer use, and poor classroom lighting [7].
- **Office workers:** Office workers who spend long hours sitting in front of a computer are at increased risk of developing tension-type headaches due to poor posture and eye strain [8].

2.2.1.4 Education Level

Research about the relation between migraine prevalence and educational level as not yet come to a clear. While one study suggested a higher prevalence associate with lower levels of education [9], another paper found an increased prevalence with higher educational levels [10].

2.2.1.5 Behavioral Patterns

It's possible that people who suffer from chronic pain, migraines, or headaches may be more likely to develop a daily routine, as having a routine can help manage symptoms and reduce the likelihood of triggering headaches or pain [11]. However, it's important to note that developing a routine can be challenging, and may require significant effort and support.

2.2.1.6 Other Characteristics

Mobile devices may play a role in triggering headaches for some people. Here are some additional factors we found to be worth considering for our target group.

Brightness and Contrasts as a Trigger
Bright lights and screens are a common trigger for migraines and headaches[11].
Mobile devices such as smartphones and tablets emit blue light, which can contribute to eye strain and headaches [12].

Influence of Notification on Stress Level

Stress is a common trigger for migraines and headaches, and mobile devices may contribute to stress levels[11].

For example, constant notifications and the pressure to be constantly connected can increase stress levels and contribute to headaches.

2.2.2 Q2 – Feedback Mechanisms

Since the correct execution of workouts is crucial for the success of the method, providing reliable feedback to users is key. Some options include:

- **Visual feedback:** This can include animations, color changes, or other visual cues that indicate to the user that an action has been taken, or a task has been completed.
- **Text feedback:** This can include notifications, messages, or prompts that provide the user with information about the app's status or the completion of a task.
- **Audio feedback:** This can include sounds or voice prompts that provide the user with information about the app's status or the completion of a task.
- **Haptic feedback:** This can include vibrations or other tactile cues that provide the user with information about the app's status or the completion of a task.

The appropriateness of a feedback mechanism depends heavily on the context. However, there are clear benefits to combining multiple mechanisms instead of relying on a single one. This combination can act as an accessibility feature, providing a fallback option for users with diverse needs and abilities. Furthermore, it enhances the user experience by offering a multi-sensory interface, engaging users through different modalities simultaneously.

Another important aspect of app feedback is the message it tries to convey. Feedback has to be immediate, specific, and informative to be most effective. Providing personalized, and informative feedback can also further improve learnability and understandability.

Since the eye workouts itself rely on the visual sense and adding additional cues could break the experience, further user evaluation is necessary to develop an optimal solution to provide feedback.

2.2.3 Q3 – User Retention

Since the effectiveness of eye workouts rely on regular execution and habit-forming, utilizing strategies to promote long term app usage has a high priority in the design process. These strategies include:

2.2.3.1 Goals

B incorporating goals in a system, it can feed off the psychological need of competence [13]. Setting goals can help users stay motivated and engaged with the app. Focusing on achieving a specific outcome can provide a sense of accomplishment and progress that can motivate users to stay engaged with the app. However, goals that are too challenging or unrealistic can

cause demotivation and frustration in users. It is therefore important to enable users to see progress towards their goals in order to keep them interested. In general, goals should be specific, measurable, and achievable to be relevant for users.

2.2.3.2 Progress and Feedback

Feedback can help users track their progress and stay engaged with the app, once again harvesting user's desire to feel competent [13]. However, feedback can also be overwhelming or demotivating if given too frequent or too critical. For feedback to be relevant to users, it should be personalized, contextual, and timely.

2.2.3.3 Social support

Addressing the psychological need of relatedness in the form of a social support network can increase user motivation and engagement [13]. The social support system can help users stay motivated and engaged with the app by providing encouragement and a sense of community. This can include features like sharing, challenges, and leaderboards. On the other side, actively engaging in a community can be time and emotionally consuming, especially if not moderated well. Users may lose interest if they feel like they are not able to keep up with the social aspects of the app.

2.2.3.4 Gamification

Gamification denotes the use of game design elements in other non-gaming contexts for the purpose of user engagement [14]. Elements, such as points, badges, and rewards, can help users stay motivated and engaged with the app. These elements should be integrated in a meaningful way that reinforces the app's goals, providing a sense of achievement and progress. However, gamification can also be distracting or overwhelming if overused or if it takes away from the core purpose of the app.

2.2.3.5 Personalization and Customization

Personalization can help users feel a sense of ownership and investment in the app. This can include features like personalized content and UI customization options. While personalization can be a great tool to provide a sense of ownership to users, its implementation is time-consuming and users might get turned off if customization options are not diverse enough. Besides that, personalization does not incorporate itself into the core purpose of the app and can seem out of place or irrelevant to users. [15]

2.2.3.6 Usability

Making the app easy to use and providing a pleasing experience can help users stay engaged with the app. Besides encouraging regular use, keeping usability in mind also lowers the entry barrier for users. [16]

2.3 Competitor analysis

Conduct a comprehensive analysis of the solutions offered by competitors to the problem at hand. This section presents a summary of the key features, strengths, and weaknesses of each solution, and discuss how they compare to the proposed solution.

2.3.1 Headspace

This app offers guided meditation sessions and mindfulness exercises that can help relieve stress and tension, which can contribute to headaches and chronic pain [17].

Figure 2.3.1: Screenshots Headspace App

2.3.2 Calm

Similar to Headspace, Calm offers guided meditations and relaxation exercises to reduce stress and anxiety, which can help alleviate pain symptoms [18].
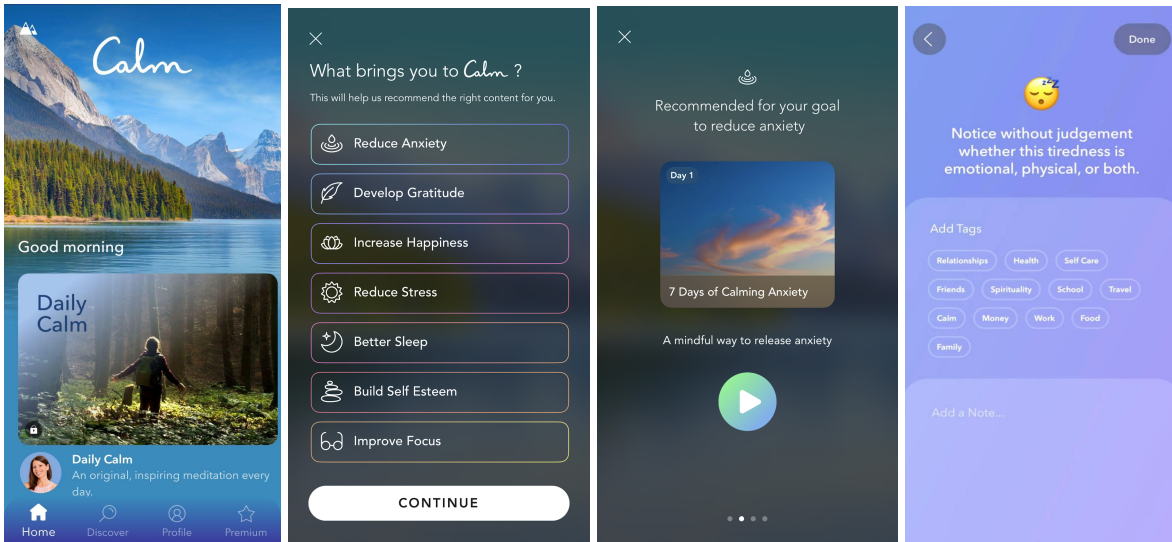
Figure 2.3.2: Screenshots Calm App

A summary of the findings of this section can be found in table 2.3.2 below.

Competitors Analysis Summary			
Competitor	**Target group**	**Feedback strategies**	**User retention strategies**
Headspace	All ages and genders	• Audio • Video • Textual	• Personalized reminders • Streak tracking • Gamification (badges, rewards) • Progress tracking • Variety of content
Calm			

Table 2.3.2: Competitors Analysis Summary

2.3.3 Q1 – Target Group

Both Headspace and Calm do not provide any specific data on the demographic of its user base. However, they, both, claim that their apps are used by people of all different ages and genders. Headspace and Calm are toward novice meditators of every demographic [17] [18].

2.3.4 Q2 – Feedback Mechanisms

2.3.4.1 Headspace

Headspace provides audio and video guidance to users during meditation sessions to help ensure that they are executing the exercises correctly. The app also offers a variety of resources, such as articles and videos, to help users learn more about meditation and how to practice it effectively [17].

17

2.3.4.2 Calm

The Calm app employs the exact same feedback strategies as the Headspace app, which are already listed above [18].

2.3.5 Q3 – User Retention

2.3.5.1 Headspace

Headspace encourages regular app usage through a variety of strategies [17]:

- **Personalized reminders:** The app offers personalized reminders to help users build a daily meditation habit. These reminders can be customized to fit users' schedules and preferences.
- **Streak tracking:** Headspace tracks users' meditation streaks and encourages them to maintain a consistent practice.
- **Gamification:** The app includes gamification elements, such as badges and rewards, to motivate users to meditate regularly and achieve their goals.
- **Progress tracking:** Headspace allows users to track their progress over time, giving them a sense of accomplishment and helping them stay motivated.
- **Variety of content:** The app offers a wide range of guided meditations and mindfulness exercises, giving users the flexibility to choose the content that works best for them.
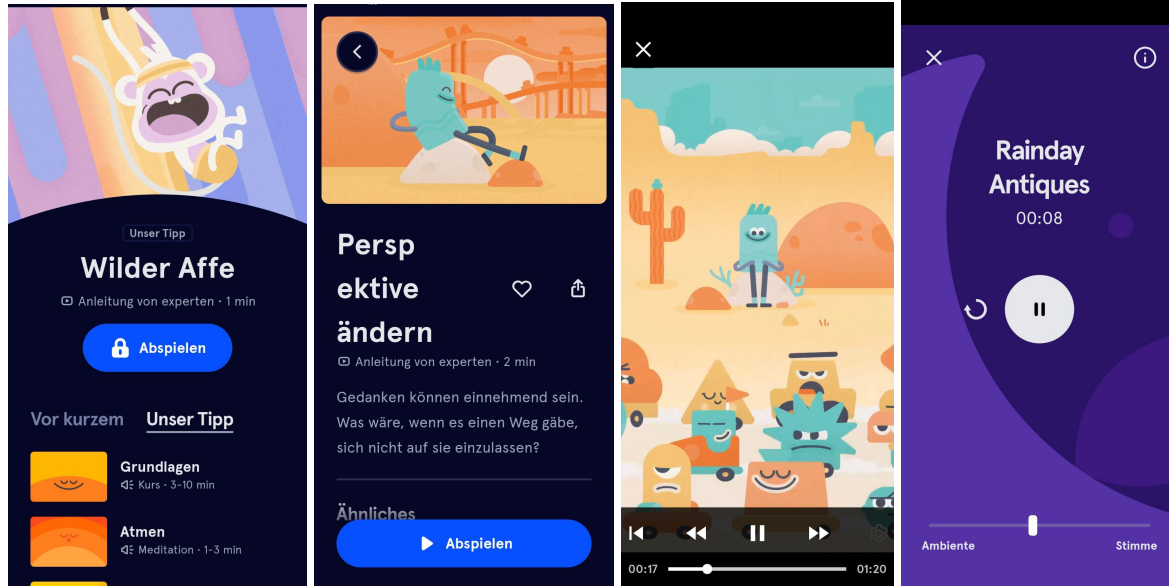

Figure 2.3.5.1: Screenshots Variety of Content of the Headspace App

2.3.5.2 Calm

The Calm app employs the same user retention strategies as the Headspace app, which are already listed above [18].
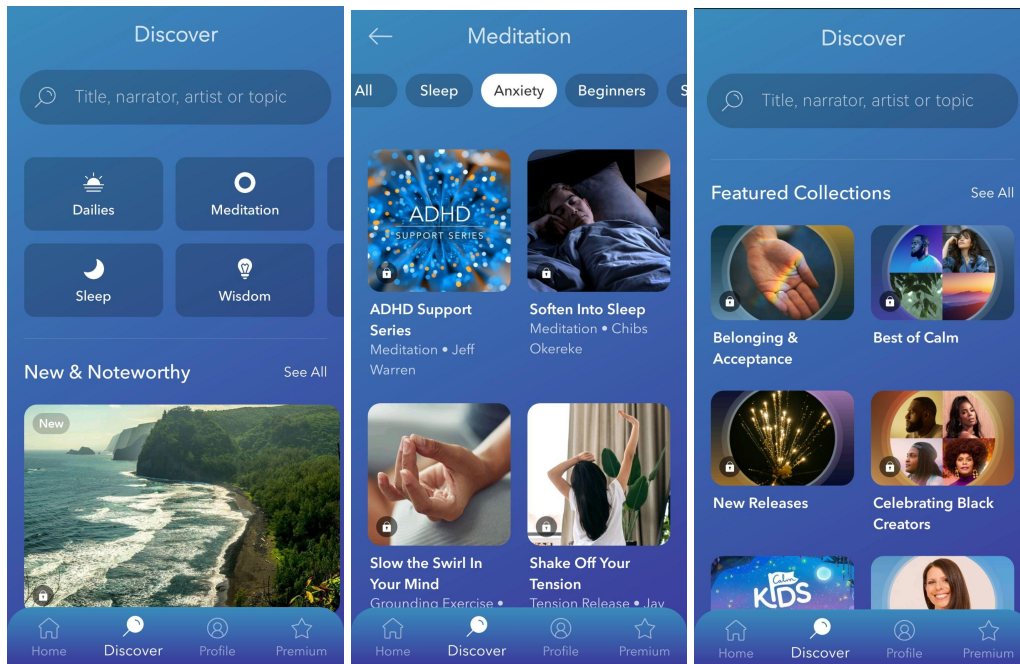
Figure 2.3.5.2: Screenshots Variety of Content of the Calm App

2.4 Conclusion

The literature review brought forward useful insights about our target group, feedback mechanisms and user retention strategies. By combining these findings with the competitor analysis, we gained a deeper understanding of our potential user base, their unique characteristics, and what sets them apart. Additionally, we obtained valuable knowledge about effective user feedback and got an idea of appropriate user retention strategy in the realm of migraine-related apps. These insights have equipped us with a solid foundation for developing our app and meeting the needs of our target users.

2.4.1 Target Group

The literature review confirms that migraines are more prevalent among women than men and are most common in the age group of 18-44. This aligns with the user demographics reported by Headspace and Calm, where their user base also falls primarily within this age range and is predominantly female.

The fact that our target group overlaps with the user demographics of popular migraine-related apps like Headspace and Calm suggests that there is a significant market demand for headache and migraine management solutions within this specific demographic. This indicates that there is a potential user base who may be interested in our app if it effectively addresses their migraine-related needs.

2.4.2 Feedback

To provide reliable feedback to users to ensure proper execution of the workout, a combination of visual and other feedback mechanism should be employed. Competing apps

like Headspace and Calm utilize audio and video guidance to ensure correct exercise execution, which can serve as inspiration for our app's feedback and coaching design. However, further user evaluation is necessary to find a fitting feedback solution, considering the visual nature of eye workouts.

2.4.3 User retention

Encouraging regular app usage for the eye workout method is crucial for its long-term effectiveness. Strategies to promote regular usage include setting goals to keep users motivated and engaged, providing personalized and timely feedback, implementing meaningful gamification elements, and generally ensuring a pleasing user experience. Competitor analysis shows that apps like Headspace and Calm utilize personalized reminders, streak tracking, gamification elements like batches, progress tracking, and a variety of content to encourage regular usage. Incorporating these strategies and tailoring them to the eye workout app could help foster user motivation and habit formation.

Chapter 3

3 Requirements engineering

This chapter describes the various requirements the final conceptualized system of the thesis needs to fulfill in order to satisfy users' needs.

3.1 Personas

Personas are essential tools in the user-centered design process, as they provide a representative and empathetic understanding of the target user group. The Persona "Melanie" was created as a part of a Bachelors' thesis at FHNW in cooperation with aisiiu. Figure 3.1: Persona "Melanie" visually captures the key characteristics and attributes of our user and serves as a constant reminder throughout the development process of who we are building this system for.
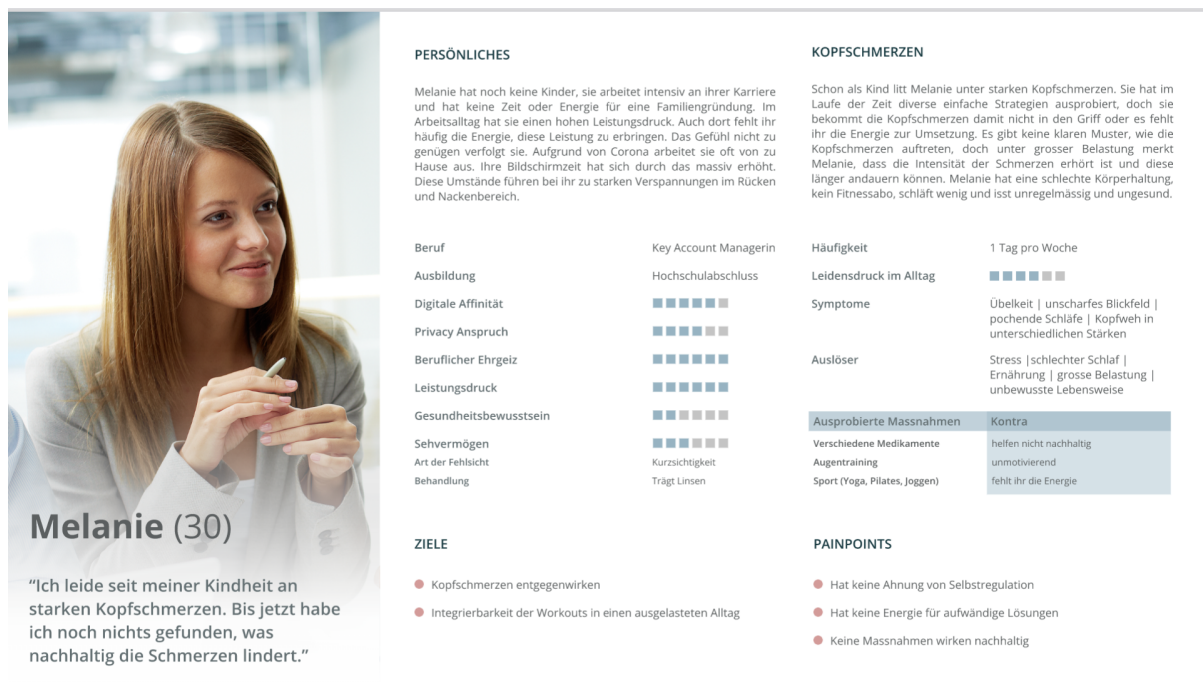
Figure 3.1: Persona "Melanie" Provided by aisiiu

3.2 Functional requirements

The functional requirements describe users expectations regarding the features of the system to conceptualize. To describe the desired functionality and features of our system in a user-centered manner, we captured the most relevant requirements as user stories. This allows us to shift the focus from technical details to the end user's perspective and their expectations towards the system. The user stories are derived from the insight yielded through the literature study of the previous chapter, while keeping our Persona "Melanie" in mind. Each user story references the insights it's derived from and can be found in table 3.1 below.

User Stories			
As a…	**I want to…**	**so that…**	**Insights**
User	Be guided through the Workout	I can execute them correctly and increase the chance of health benefits	Insight-09
	Start a workout on demand	I can benefit off its therapeutic effects at any time	Insight-04
	Receive informative and timely feedback on my performance during the workouts	I can execute them correctly and increase the chance of health benefits	Insight-09
	Be rewarded for regular and successful workouts	I have a short term enticement to use the app	Insight-11 Insight-13
	Get reminded to work out	I don't forget about it	Insight-04

Table 3.1: Functional requirements definition as user stories

3.3 Non-Functional Requirements

The non-functional requirements affect the user's experience directly and are usually defined, quantifiable, to hold a system up to a certain standard in performance and usability. Since our implementation will be prototypical, the listed NFRs are meant to represent the most relevant factors for users and their experience, rather than ready to use requirements for a productive system.

NFR-01: Functional Completeness	
Scenario	A user want to work out
Stimulus	The system allows users to go through a workout procedure
Expectation	The system provides all functionalities to successfully and correctly Execute a workout
Validation	Compare the system systematically to the requirements

Table 3.3.a: NFR-01: Functional Completeness

NFR-02: Functional Correctness	
Scenario	A user wants to perform a certain action
Stimulus	The system handles the action as expected
Expectation	The system provides the correct results with the needed degree of precision
Validation	User testing

Table 3.3.b: NFR-02: Functional Correctness

NFR-03: Usability and Learnability	
Scenario	A user wants to easily navigate the app to access the desired features.
Stimulus	The user taps on the app icon and enters the app.
Expectation	The app should have an intuitive and user-friendly interface that enables effortless navigation, reducing user frustration and facilitating an enjoyable user experience.
Validation	User testing

Table 3.3.c: NFR-03: Usability and Learnability

NFR-04: Easy-to-Read	
Scenario	A user wants to understand the interface despite minor visual impairment
Stimulus	A user with minor visual impairment uses the system
Expectation	If the font size is too small to see, it can be resized. Contrast of colors make it easy to read text.
Validation	User testing

Table 3.3.d: NFR-04: Easy-to-Read

NFR-05: Maintainability and code quality	
Scenario	A new developer wants to extend the code
Stimulus	A new developer enters the project team
Expectation	Any new developer can easily understand and extend existing code
Validation	Evaluate the use of consistent naming conventions, code modularity, and proper documentation

Table 3.3.e: NFR-05: Maintainability and code quality

NFR-06: Font and Text Accessibility	
Scenario	A user experiencing migraines wants to easily read text despite visual difficulties and pain.
Stimulus	The user opens the app and attempts to read various text elements despite experiencing pain and visual aura.
Expectation	The app should use clear and large fonts that are easily readable for users experiencing migraines. The font size should be adjustable to accommodate users with difficulty reading small text.
Validation	User testing

Table 3.3.f: NFR-06: Font and Text Accessibility

NFR-07: Contrast and Color Accessibility	
Scenario	A user experiencing migraines wants to navigate the app with ease despite visual difficulties and pain.
Stimulus	The user opens the app and attempts to distinguish and navigate through various interface elements despite experiencing pain and visual aura.
Expectation	The app should use high contrast but soft colors to improve visibility for users experiencing migraines. The contrast between text, icons, and background should be sufficient for easy identification and navigation.
Validation	User Testing and Dev tools contrast score

Table 3.3.g: NFR-07: Contrast and Color Accessibility

NFR-08: Intuitive Navigation	
Scenario	A user experiencing migraines wants to navigate the app without additional confusion or cognitive strain.
Stimulus	The user opens the app and attempts to navigate through various screens and features despite experiencing pain and cognitive difficulties.
Expectation	The app should provide intuitive navigation menus and controls to facilitate ease of use for users experiencing migraines. The navigation flow should be straightforward, minimizing the need for complex interactions or decision-making.
Validation	User testing with participants suffering from migraines

Table 3.3.h: NFR-08: Intuitive Navigation

NFR-09: Dark UI Theme	
Scenario	A user suffering from migraines wants to use the app in a dark environment or while experiencing increased sensitivity to light
Stimulus	The user opens the app and attempts to adjust the app's display settings despite experiencing pain and sensitivity to light.
Expectation	The app should provide a dark UI theme option that reduces the amount of bright light emitted from the screen. This feature should be easily accessible at every point in the app, so users can enable it at any time if needed.
Validation	User testing

Table 3.3.i: NFR-09: Dark UI Theme

Chapter 4

4 User Centered Interface Design

This chapter focuses on the iterative development and improvement of the conceptual design of the eye-workout application. Two iterations were carried out, resulting in the creation of prototypes for the concept. Each iteration concluded with a testing round, serving as a foundation for the subsequent iteration. By the end of this chapter, our aim is to have a thoroughly refined concept that is ready to be transformed into a functional prototype.

4.1 Developing the Initial Prototype: Iteration one

In the first iteration of our user centered design process, we conceptualize and build the initial prototype and find out how users perceive our interpretation of the requirements.

4.1.1 Designing the Initial Prototype

This subsection outlines the specific steps and considerations taken during the design and construction of the initial prototype. Its purpose is to describe the undertaken process and emphasize the key factors that ensured the prototype accurately met the requirements and user needs.

4.1.1.1 Sketching and Wireframing

To explore design concepts quickly and efficiently, an array of rough, hand-drawn sketches has been made to capture visual decisions and ideas. Through the sketches shown in figure 4.1.1.1, we could develop a rough idea of what elements will be important for the users to reach their goal.
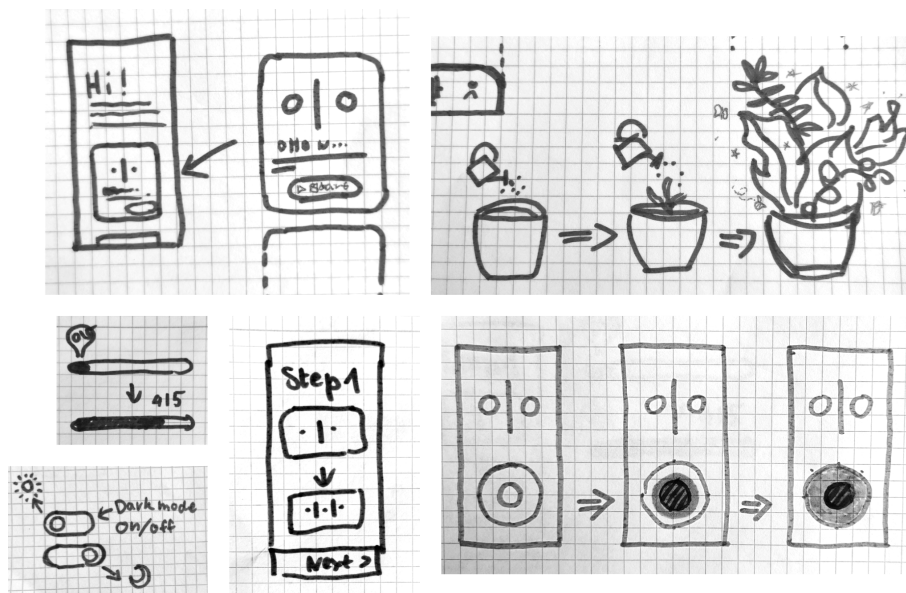
Figure 4.1.1.1.a: UI sketches

Based on the few small design decisions, we already were able to extract from the loose sketches, we refined the concept idea by sketching the workout scenario (figure 4.1.1.1.b) and the reward scenario (figure 4.1.1.1.c).
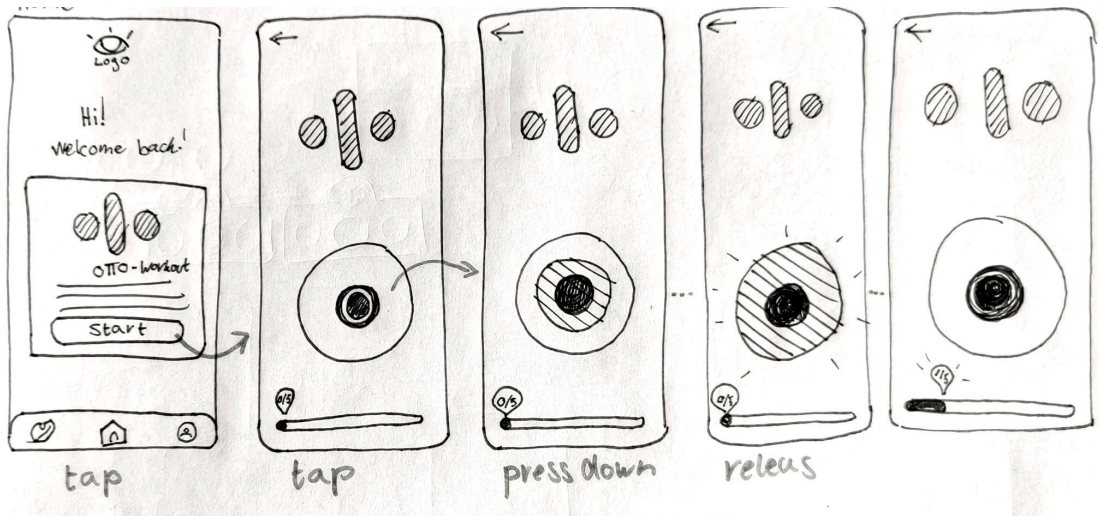
Figure 4.1.1.1.b: Workout Scenario Sketch

Figure 4.1.1.1.c: Reward Scenario Sketch

After that, the most relevant layouts were implemented as wireframes to capture the general design concept and act as a cost-effective way to test and validate our initial design ideas. The UI wireframes can be found in figure 4.1.1.1.d.
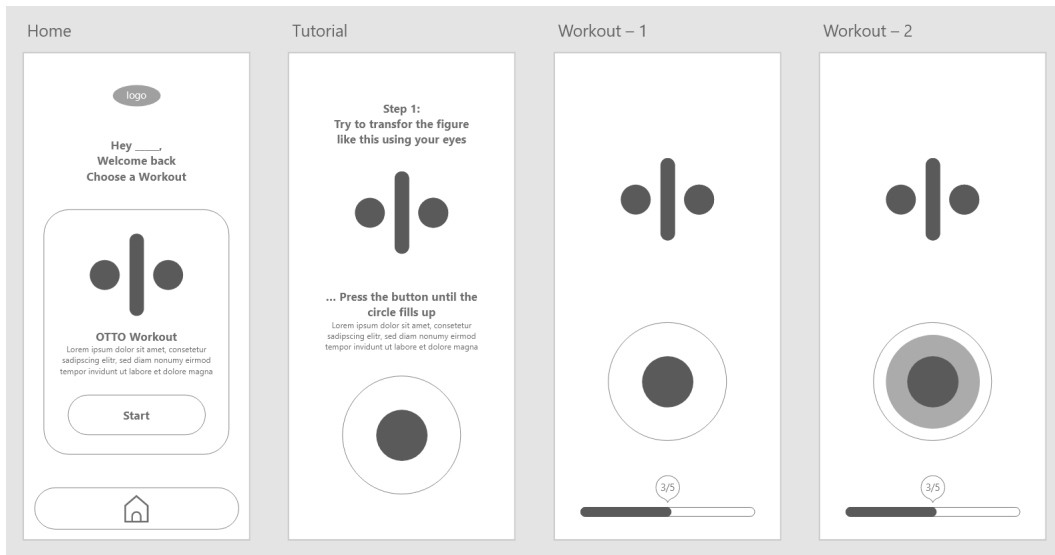
Figure 4.1.1.1.d: UI wireframes

4.1.1.2 Building the Prototype

Building the initial mockup-based prototype not only offers an opportunity to refine the UI design and user experience, but also uncovers any potential inconsistencies in the requirements. The tool of choice for prototyping and mockup creation is Adobe XD because we utilize it since its release in 2016 and are very familiar with its many features.

Using Adobe XD, we crafted a series of mockups, forming the first prototype, see figure 4.1.1.2. To enhance the user's experience and bring their journey through the app to life, we extensively employed XD's auto-animation feature, creating smooth transitions and animations.
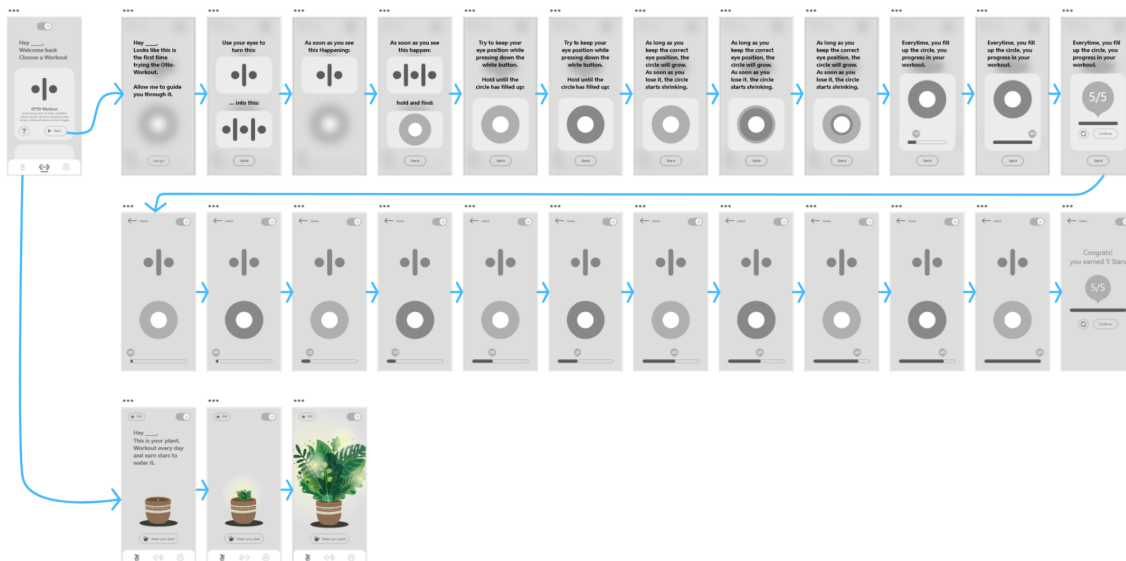
Figure 4.1.1.2: User Journey

4.1.1.3 Final Mockups

The final mockups were thoughtfully built and designed with Adobe XD, as already stated in the previous subsection. The experience was enhanced by linking certain UI elements to other mockup slides to simulate a navigable application and utilize animations.

Entry Point

This section of the prototype serves as starting point for users. It welcomes users with a personalized greeting and call to action. As pictured in figure 4.1.1.3.a, the user finds a list of workouts on the home screen, where the OTO-workout is listed on top and another workout item is hinted at below, keeping expendability in mind.

The workout card should provide the user with basic information about the workout featured and provide a way to start working out or learn more. To give users an idea about the goal of the workout, the associated symbol is animated to mimic the effect the workout tries to achieve.
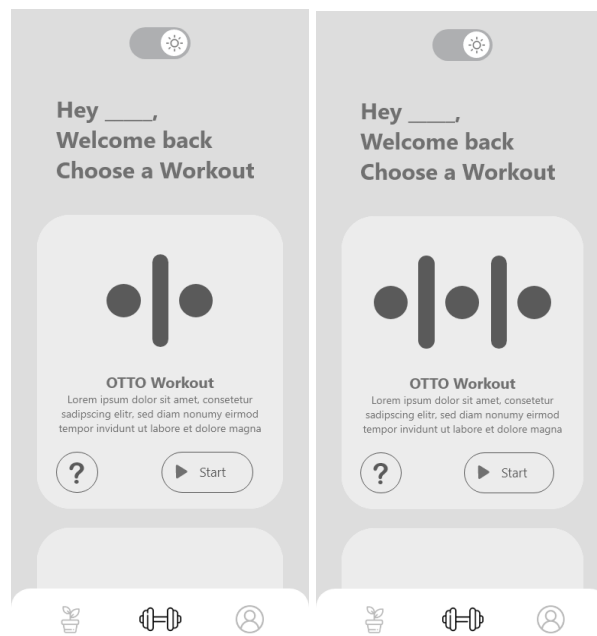
Figure 4.1.1.3.a: App entry point (animated)

Workout Instructions

When starting a workout for the first time, the user gets served a guide through the workout. The goal of this section of the prototype is to introduce the workout process and explain the needed controls. In general, this section tried to utilize animation as much as possible while trying to minimize text based instructions.
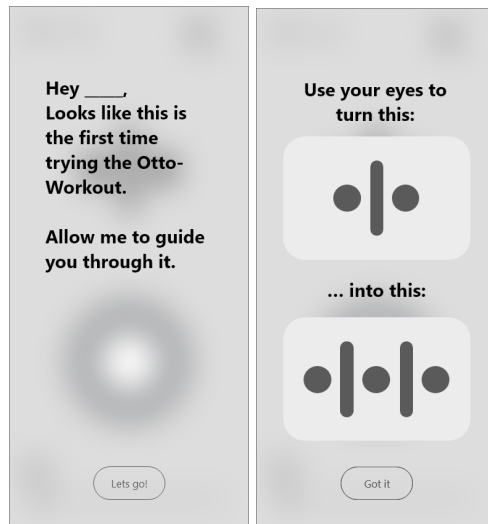
Figure 4.1.1.3.b: (left) Tutorial screen 01: entry point

Figure 4.1.1.3.c: (right) Tutorial screen 02: introducing the goal of the workout

Users start the tutorial at the entry screen, depicted in figure 4.1.1.3.b. The entry point mockup aims to provide users with information about their current location in the application, how they arrived there, and what they can expect moving forward.

When users click on the button reading "Let's go!", they proceed to the next state, depicted in figure 4.1.1.3.c. The Goal of that state is to introduce the users to the effect they are trying to achieve.
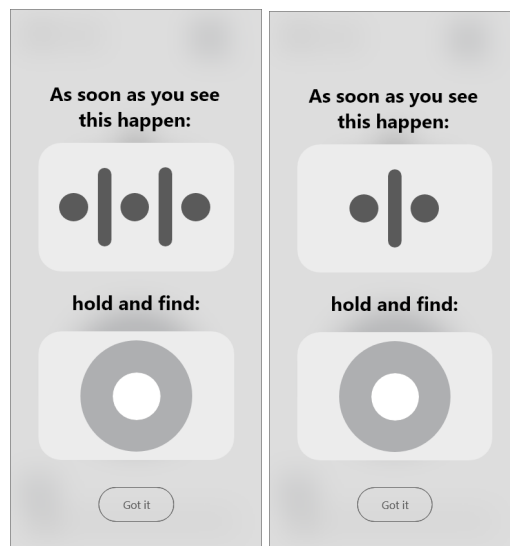
Figure 4.1.1.3.d: Tutorial screen 03: introducing the verification button (animated)

The next step of the tutorial, as shown in figure 4.1.1.3.d, aims to introduce the verification button to users. In figure 4.1.1.3.e users are informed that upon reaching the depicted effect,

they are instructed to find and hold the round button to verify their achievement. We once again employ animation to demonstrate the effect of the OTO-workout.
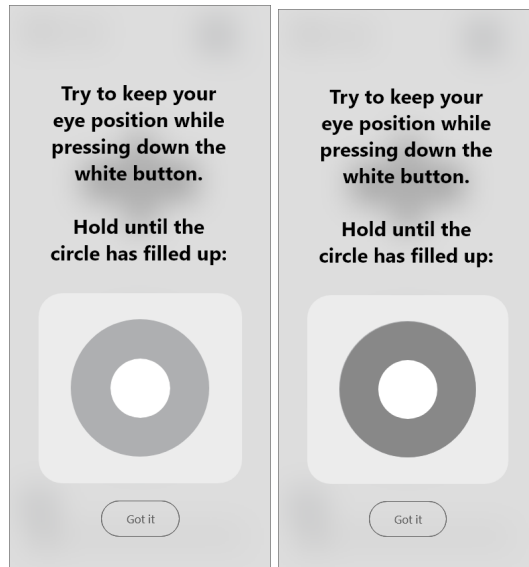
Figure 4.1.1.3.e: Tutorial screen 04: introducing the button's mechanics (1/2) (animated)

While users press and hold the white button, a gray circle appears that grows over the span of three seconds until it fills up the big circle surrounding the button. During that period, the future system is verifying the user's eye position. Figure 4.1.1.3.f depicts the part of the tutorial which informs users about these mechanics.
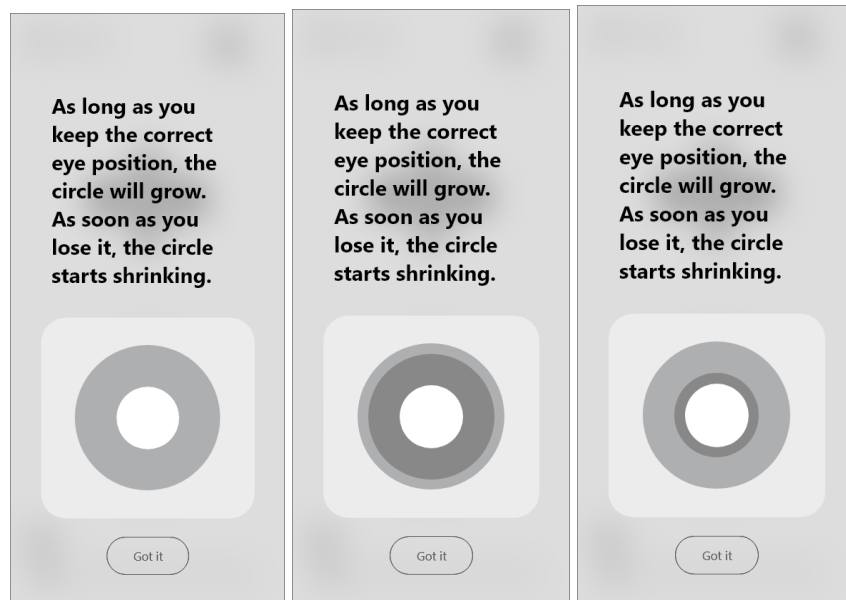
Figure 4.1.1.3.f: Tutorial screen 05: introducing the button's mechanics (2/2) (animated)

The verification button not only handles performance confirmation, but also acts as a feedback mechanism. As shown and explained in figure 4.1.1.3.f the gray circle grows while users keep the correct eye position, and shrinks if they fail until they catch the right position again.
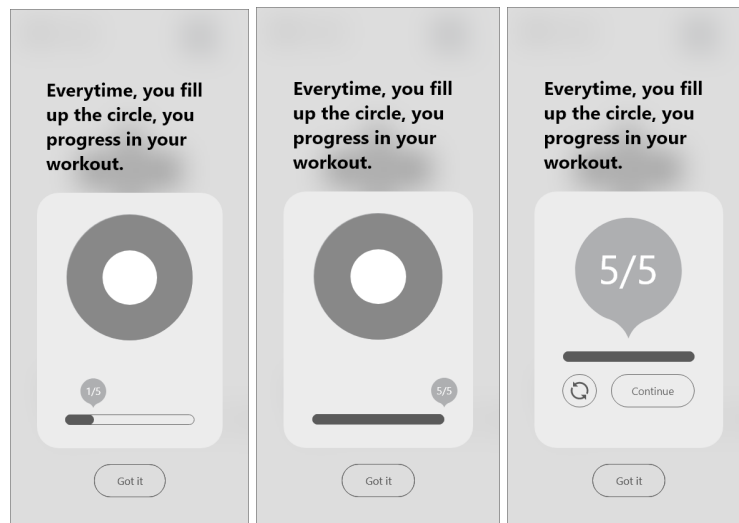
Figure 4.1.1.3.g: Tutorial screen 06: Introducing progress and concluding the tutorial

When users manage to fill up the outer circle, they progress in their workout. The figure 4.1.1.3.g explains to users how they advance through the workout and demonstrates progressing until the end of the workout through animation.

OTO-Workout
The workout itself purposely contains as little UI elements as possible. Since users need their visual attention to work out, we try to avoid distracting them with unnecessary elements in their sight.
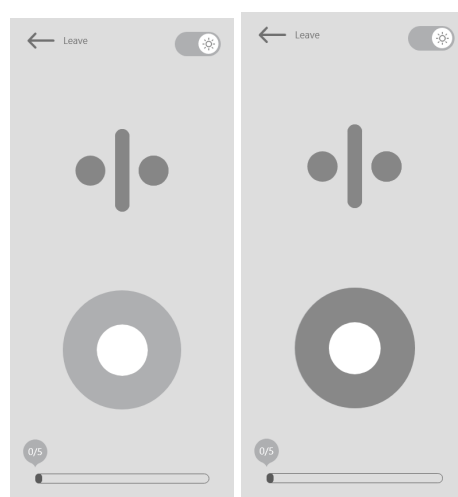
Figure 4.1.1.3.h: Workout first round: staring the workout and triggering button (animated)

As shown in figure 4.1.1.3.h the layout consists of our OTO-symbol, the verification button we introduced in the Tutorial section, a progress bar we also previously sparsely introduced, a "Leave" button and a dark-mode toggle button. Most of these elements are featured because they have a fixed role in the workout itself and therefore, are, at least for now, indispensable, like the OTO-symbol, verification and progress bar.

While it seems that, the dark-mode toggle button is the most unnecessary element in this layout, it is crucial for the user's experience. By placing the toggle button that prominently, we want to enable users to switch to a more easy on the eye color theme at any time in the workout.
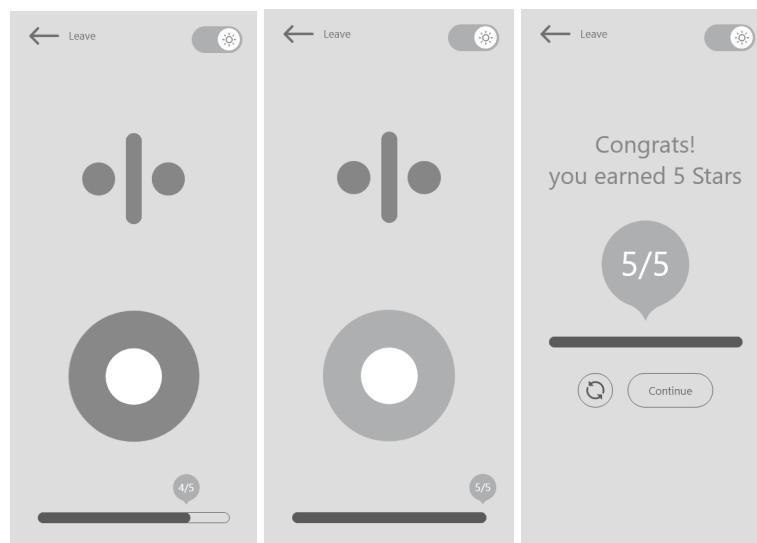
Figure 4.1.1.3.i: Workout final round: finishing the workout (animated)

When the user progresses past the final round, the workout ends. As depicted in figure 4.1.1.3.i, users earn stars when successfully finishing a workout, hinting at the gamification element of the prototype which we will discuss later.

Gamification and User Motivation
Introducing a gamification element to the app can enhance user engagement and motivation. One fitting choice could be implementing a virtual plant that users can nurture and grow using stars they earn through completing eye workouts. We chose a plant for our first concept idea for multiple reasons.

Plants are often associated with growth, vitality, and health. By incorporating a plant that grows over time, the app visually represents the user's progress and reinforces the idea of personal growth and improvement through regular use of the app.

Also, just like eye workouts, growing a plant is a gradual process that requires patience and ongoing commitment. By incorporating a growing plant, the app emphasizes the importance

of long-term commitment and motivates users to continue using the app over an extended period.

To demo our idea, we shortened the growth process into three steps to showcase the effect it should later have over a longer period of time. These three stages can be found in figure 4.1.1.3.j. The transition between the stages is animated to make the growth of the plant feel more natural.
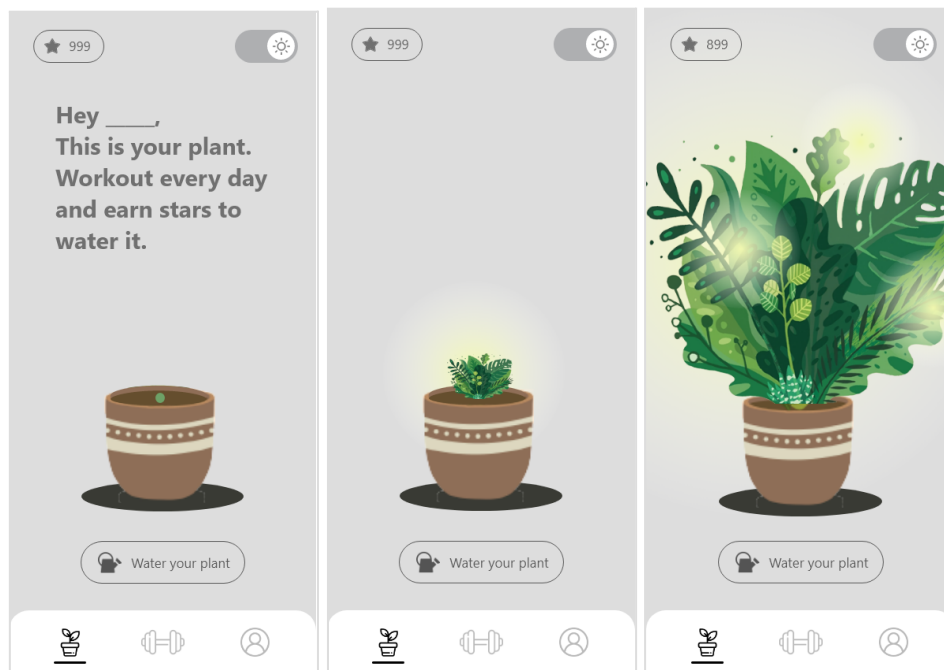

Figure 4.1.1.3.j: Gamification: Demonstrating a potential user retention concept (animated)

4.1.2 Hallway Usability Testing

A Hallway usability test was conducted to evaluate the user interface of the iterations prototype. The research questions were focused on the effectiveness and perception of the tutorial section of the prototype and the overall navigability and understandability of the information architecture. As this testing round is the first time we actually meet potential users, the usability test was supplemented with some user centered question one could ask during a user interview. This additional questions aimed to gain further insights into the users' motivations, expectations, and preferences, and to better understand their behaviors and attitudes in general.

4.1.2.1 Participants

The Participants for this study were recruited through targeted outreach efforts conducted on the campus of the pedagogical college Thurgau. The Campus was chosen as a recruitment sight since the educational sector is known to be particularly susceptible to migraines and headaches. To be eligible for participation, individuals had to report experiencing headaches regularly and be enrolled as a student at the campus.

Participants were informed about the nature and purpose of the study, and were given the opportunity to ask any questions before being asked to provide informed consent. A total of 5 participants were recruited for the study.

All participants reported experiencing migraines or headaches at some point in their lives, but only two of them claimed to experience such pains regularly (almost daily). The majority of participants were female (4 out of 5) and ranged in age from 21 to 27 years old.

4.1.2.2 Testing Protocol

The usability testing was conducted using a think-aloud protocol, in which participants were asked to verbalize their thoughts and actions as they interacted with the prototype. After some additional questions, participants were encouraged to discuss and speak their mind to provide further feedback and insights about their experience.

4.1.2.3 Findings

The findings of this study were structured into the three main sections of the prototype; Tutorial, Workout, and Gamification. Each section shortly describes its main findings and contains a summary of all issues raised by the testers.

Tutorial
The tutorial section revealed to have several weaknesses and a lot of room for improvement. Most testers struggled to understand the purpose and mechanics of the workout. Many described the explanations given in the tutorial as not detailed enough and too abstract for new users who are not familiar with eye workouts. While three out of five testers were able to successfully transform the figure, the other two needed additional tips to reach this goal.

Besides insufficient explanations, testers discover further weaknesses and flaws. All the issues raised by testers regarding the tutorial section, can be found below in table 4.1.2.3.a.

Findings Tutorial Section		
Issue ID	**Issue Title**	**User Feedback**
Issue-01	Hidden Button Visibility	The button to proceed was hidden due to the small test device size, leading participants to expect an Instagram or Snapchat-like tapping behavior to continue.
Issue-02	Inadequate Explanations	Explanations provided in the tutorial were not detailed enough, resulting in confusion and lack of understanding.
Issue-03	Additional Tips for Image Transformation	Half of the participants required additional tips to successfully transform the image.
Issue-04	Phone Positioning Demonstration	Tester suggested incorporating videos or images to demonstrate the process of positioning the phone.
Issue-05	Poor Introduction of Verification Button	The verification button requires better introductions and explanations of its functionality and mechanics.
Issue-06	Clear Beginning and End Screen	Participants expressed the need for a clear beginning and end screen in the tutorial
Issue-07	Accessing Tutorial after Completion	Participants were unsure where to find the tutorial once they had completed it.
Issue-08	Prototype's Impact on User Experience	The nature of the prototype broke the user experience, with certain actions not being simulated as intended. Auto animations disrupted the flow and blocked actions.
Issue-09	Insufficient Feedback	Participants requested additional feedback elements, such as sounds, vibrations, or color indicators.

Table 4.1.2.3.a: Issues raised by testers regarding the tutorial section

Workout

The workout section received mixed feedback from the testers. Once they made it through the tutorial, they were able to understand the mechanism and controls and successfully complete the workout. However, one participant experienced a headache during the procedure, which was surprising as she claimed to have headaches infrequently. This issue needs to be

addressed to ensure a headache-free experience for all users. Overall, testers were satisfied with the workout section and could not find any particular usability problem. Therefore, only the headache issue requires further investigation to boost user experience, which we will further look in to with our project partner, later in this iteration.

Findings Workout Section		
Issue ID	**Issue Title**	**User Feedback**
Issue-10	Headache Trigger	One participant experienced a headache during the workout procedure, despite claiming infrequent headaches. This issue needs investigation and resolution to ensure a smooth and headache-free experience for all users

Table 4.1.2.3.b: Issues raised by testers regarding the workout section

Gamification

The gamification section received mixed feedback from the testers. While some described the implementation as cute fun, others questioned if gamification or any kind of user retention mechanism is even needed or appropriate. To quote one of the testers, doubting the need of gamification: "Being in pain all the time is motivation enough to use something that promises relief". Since this statement was made by one of our first participants, we had the chance to ask other testers about their opinion on this statement, and most of them disagreed. Overall, the elements of gamification seems to appeal to most, but not everyone in this context. All issues testers took with the gamification section and other feedback can be found below in table 4.1.2.3.c.

Findings Gamification Section		
Issue ID	**Issue Title**	**User Feedback**
Issue-11	Boring Execution	Testers found the idea of gamification cute but felt that its execution was boring.
Issue-12	More Options for Spending Earned Stars	Testers desired additional options for utilizing the stars they earned in the gamification system.
Issue-13	Element of Surprise	Testers suggested incorporating an element of surprise to make the gamification more engaging.
Issue-14	Consequences for Missing a Day	Testers provided feedback on the consequences of missing a day, recommending that the plant should not die but also should not grow or retain its magical glow.

Issue-15	Motivation and Reminders	Testers mentioned that desperation from chronic pain serves as sufficient motivation, but they need a way to remember to perform the workouts. They recommended asking users for downtime to schedule daily workout reminders.
Issue-16	Inspiration from Water Drinking Apps	Testers referenced water drinking apps and their approach to a similar case, questioning how they make a seemingly boring activity with only long-term effects more engaging.
Issue-17	Love Forest App and Consequences	Testers mentioned the Love Forest app positively but expressed that it feels terrible if a tree dies.
Issue-18	Necessity and Satisfaction	Testers debated the necessity of the gamification element. Some believed it was essential as long as it gave a sense of accomplishment, was fun, colorful, creative, or satisfying. Others felt that users in this case are driven by a need rather than a reward, and milestones and graphs like those in fitness apps would be sufficient.

Table 4.1.2.3.c: Issues raised by testers regarding the gamification section

4.1.2.4 Conclusion

The hallway usability testing uncovered many weaknesses in the prototype, and introduced us to our target group and their attitude towards our concept. Overall, the findings emphasized the need for more detailed and demonstrative explanation in the tutorial section and highlight that further investigate into potential headache triggers is a must in order to make our system accessible to all users. Furthermore, the game section shows itself to be more controversial than expected. Despite receiving constructive improvement ideas from testers intrigued by the gamification element of the prototype, we made the decision to refrain from further developing the gamification section in order to align with the project scope.

4.1.3 Evaluation in Cooperation with Aisiiu

To gain further insight into the prototype's weaknesses, we traveled to Zurich Stadelhofen to meet up with the inventor of the method, Pascal Abegg and other members of aisiiu.

During our visit, Pascal Abegg provided valuable feedback and suggestions for improving the prototype. He emphasized the need to optimize the workout experience by implementing landscape orientation, which would allow for larger symbols and potentially reduce headaches for users.

Additionally, to the Prototype review, we found out more about the method itself by going through our own therapy session.

Furthermore, Pascal Abegg pointed out that there are two elements missing from the prototype in order to mirror the in person workout.

The first element, that is missing, is the separation of each workout round into two phases: divergent and convergent. These phases involve different eye positions, specifically straight and crossed, to enhance the effectiveness of the workouts.

The second element that is missing, is the workout goals for each phase. In each phase, the user should try to reach three goal in the given order. In order to proceed to the next phase, the user has to successfully transforming the OTO-symbol, perceive the figure in 3D, and achieve clear visual perception of the figure. By introducing these goals in our prototype, we further improve our adaptation of the in person therapy and can also provide users with a sense of accomplishment and progress in their eye workouts.

These findings can be found below in table 4.1.3.

Findings aisiiu		
Issue ID	**Issue Title**	**User Feedback**
Issue-19	Workout Orientation	Project partners suggested changing the workout orientation to landscape mode to allow for larger symbols and potentially reduce headaches.
Issue-20	Two Phases per Workout Round	Project partners recommended introducing two phases, divergent and convergent, which involve straight and crossed eye positions, respectively, to enhance the effectiveness of the workouts.
Issue-21	Phase Goals	Project partners proposed incorporating goals that users have to verify themselves, such as successfully transforming the figure, perceiving the figure in 3D, and achieving clear visual perception of the figure.

Table 4.1.3: Issues raised by aisiiu

4.1.4 Concluding Iteration one

Overall, the first iteration of the user-centered design process helped us develop the initial prototype, gather user feedback, and identify areas for improvement. The findings from the usability test and collaboration with Pascal Abegg will guide our next iteration to refine the prototype and address the identified issues and missing elements.

4.2 Refining the Prototype: Iteration two

In this Iteration, we shrink our focus from the whole application to the tutorial, and the workout section, since the scope of the project is limited.

4.2.1 Prototype Revision

The Prototype revision is based on the feedback provided by our testers and our project partners at the end of the first iteration. This section aims to provide insight into the changes that were made to the prototype and the reasoning behind them. The revision focused on the workout and the tutorial section. To address the issue of hidden button visibility (Issue-01), the prototype's format was adjusted from 390×844 pixels to 487×844 pixels.

As figure 4.2.1.a shows, the prototype grew a lot in complexity and, especially the tutorial section, is now much more extensive.
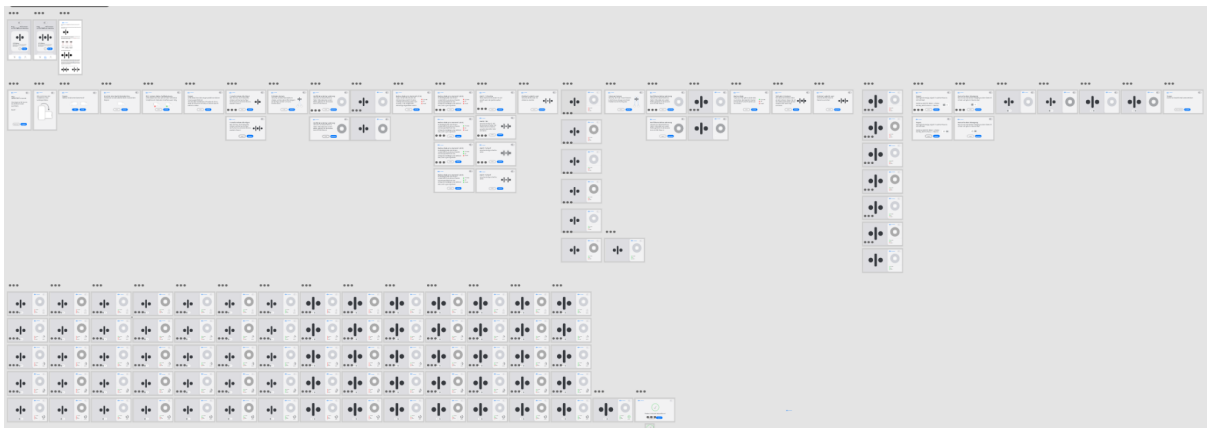
Figure 4.2.1.a: Mockups overview

Since the prototype is quite big now, we provide a concise depiction of user's journeys in figure 4.2.1.b.
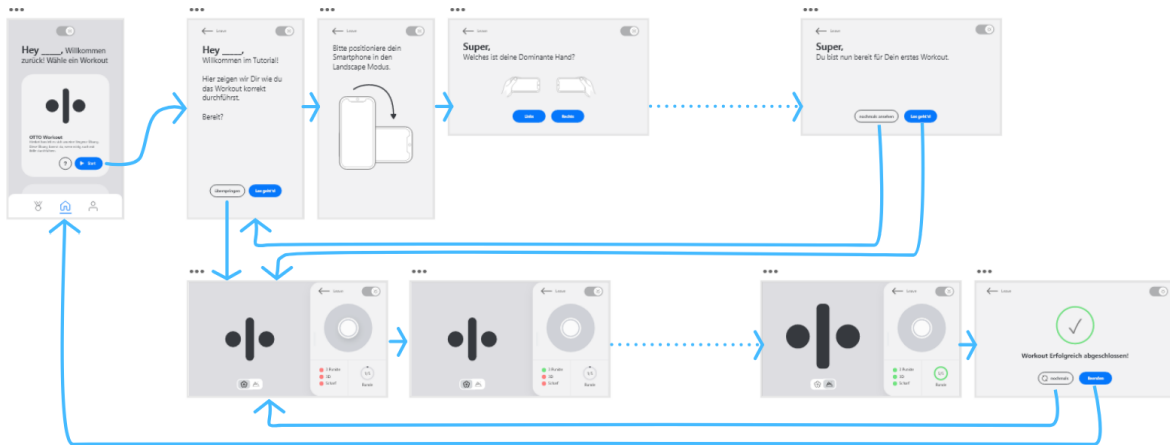
Figure 4.2.1.b: User Journey

4.2.1.1 Tutorial

The updates and enhancements made to the tutorial content aimed to provide more detailed explanations (Issue-02) and incorporate the concept of two phases per workout round (Issue-20) and phase goals (Issue-21). By addressing these specific issues, the tutorial now offers comprehensive guidance and better supports users in understanding and utilizing the app's features effectively. As figure 4.2.1.1.a shows, the tutorial now requires users to go through a multistep process switching between explanation, demonstration, and hands on exercises.

Figure 4.2.1.1.a: Tutorial mockups overview

Adding a clear starting and end point
To clearly signal the beginning and the end of the tutorial as requested by testers (Issue-06), we added a start and finish step to the tutorial as shown in figure 4.2.1.1.b and figure 4.2.1.1.c.
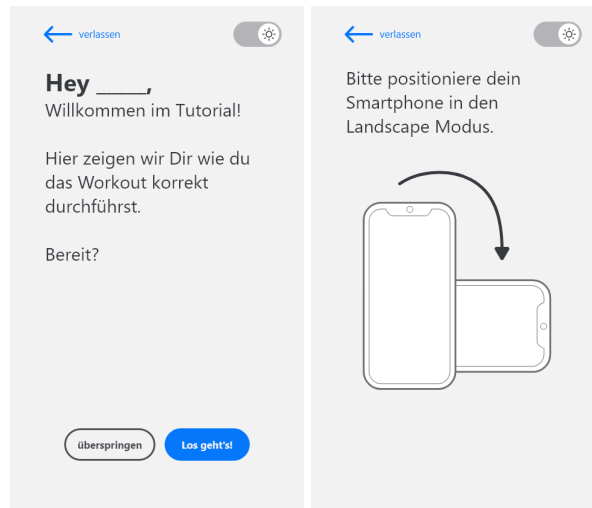
Figure 4.2.1.1.b: Tutorial start and prerequisites
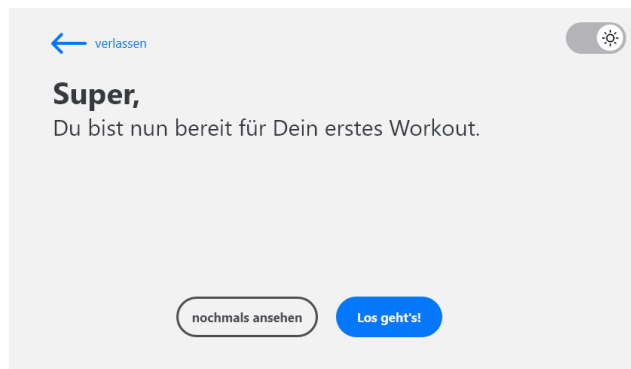
Figure 4.2.1.1.c: concluding the tutorial

Both, tutorial start and conclusion, aim to instruct the user about their current location, what will be the next steps and give the users the choice to proceed or skip or restart the tutorial.

Guidance trough demonstration
As highlighted in Mayer and Moreno's (2003) paper, reducing cognitive load is crucial for effective instructional design [19]. By incorporating animations and illustrations, we provide visual demonstrations to help users process information more easily, leading to improved comprehension and retention. More on, animations and illustrations can help users grasp complex or unusual concepts, like our verification-button, more intuitively. Besides learnability, our visual instructions also aim to make the tutorial more engaging and enjoyable for users.
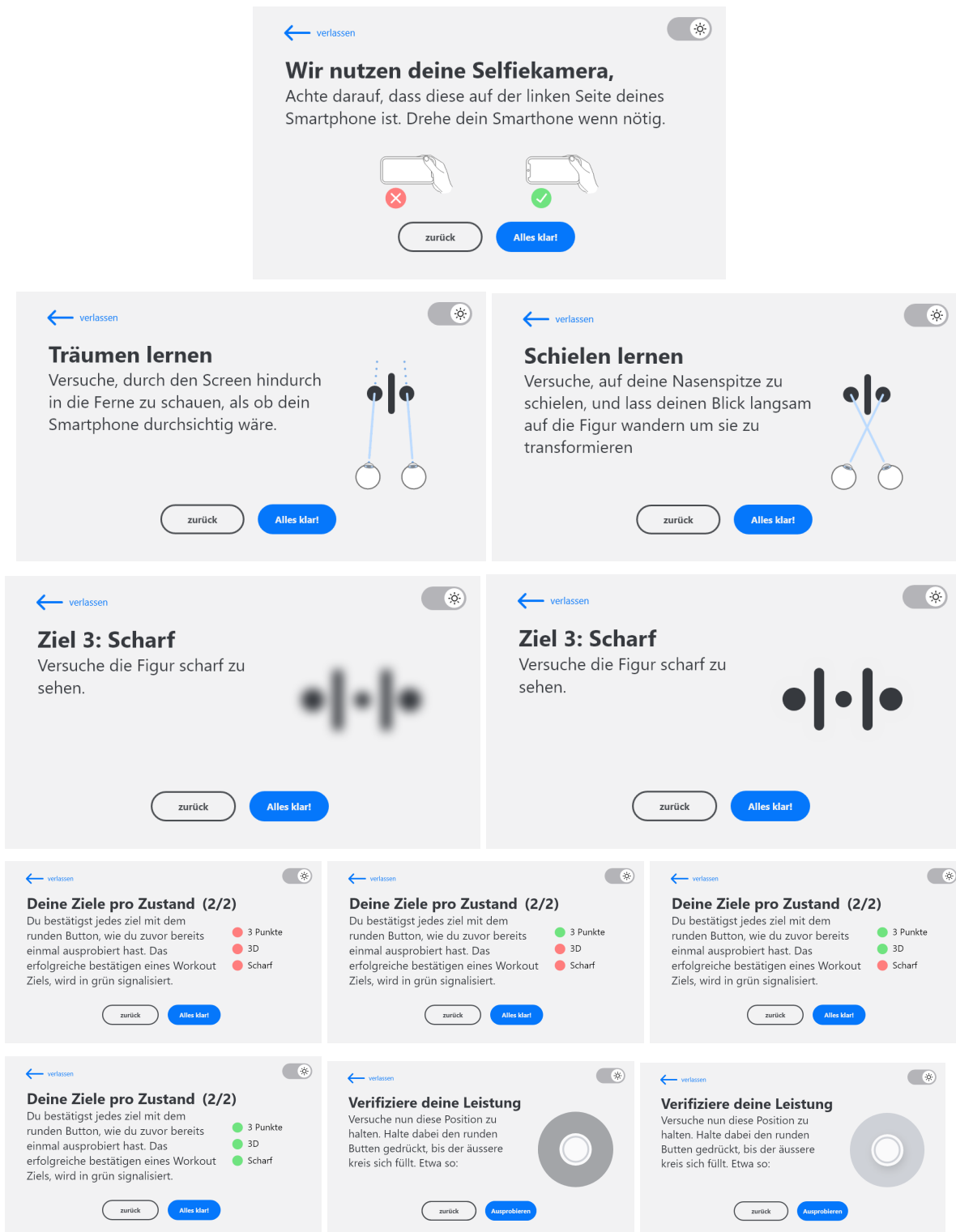
Figure 4.2.1.1.d: Examples where users are instructed through illustration and animation

Figure 4.2.1.1.d shows many examples where we employed illustration and animation to instruct users and further promote learning (Issue-02) [20]. All illustrations, used in the tutorial, are our own creations and were thoughtfully put together to match the theme of the app.

Additional Tips for Image Transformation

To help users successfully transform the OTO-symbol, we added steps introducing the technique to reach the desired eye position. As shown in figure 4.2.1.1.e, each eye position is demonstrated by an illustration and accompanied by a short text giving instructions.
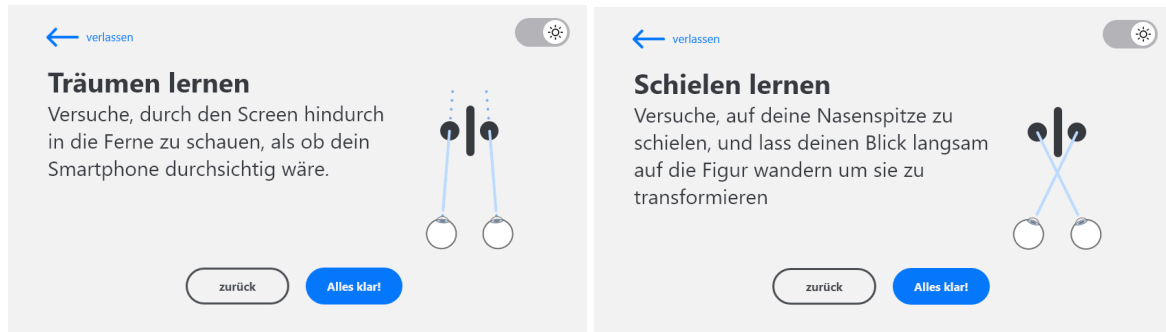
Figure 4.2.1.1.e: Introduction of dreaming and squinting

Since divergence and convergence aren't the most common terms in everyday language, we adopted Pascal Abeggs aliases of dreaming and squinting.

Improved Introduction to the Verification Button

Many testers expressed confusion when confronted with the verification button (Issue-05). To address this issue, the button gets introduced as an animation loop showcasing the mechanics of it. Users see this slide actually two times through the tutorial, the first time after squinting gets introduced, and the second time after dreaming gets introduced. Both times, users enter a demo when proceeding from the step shown in figure 4.2.1.1.f, giving them a chance to try the verification button in a sandbox and get familiar with it.
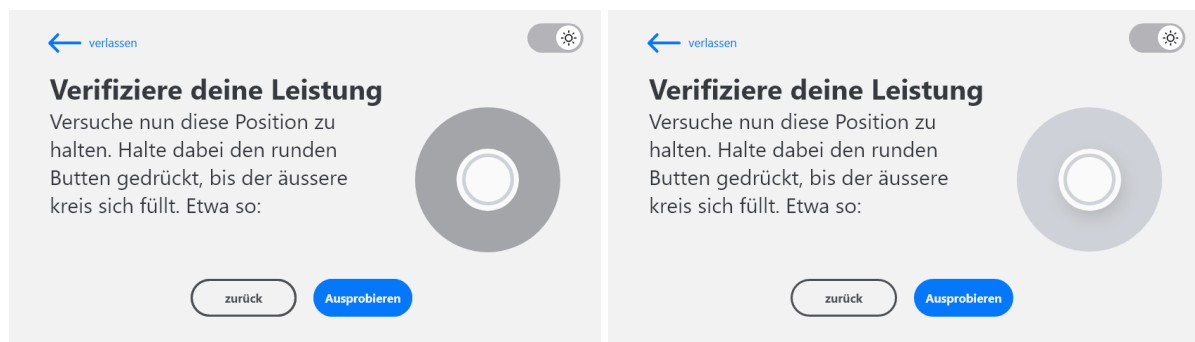
Figure 4.2.1.1.f: Introducing the verification buttons mechanics through animation (animated)

Let the user practice

It is fairly known that a great way to retain knowledge is to apply it. To utilize this fact in our users' favor, we made a big effort to conclude every introduction with a hands-on demo, as shown in figure 4.2.1.1.g.
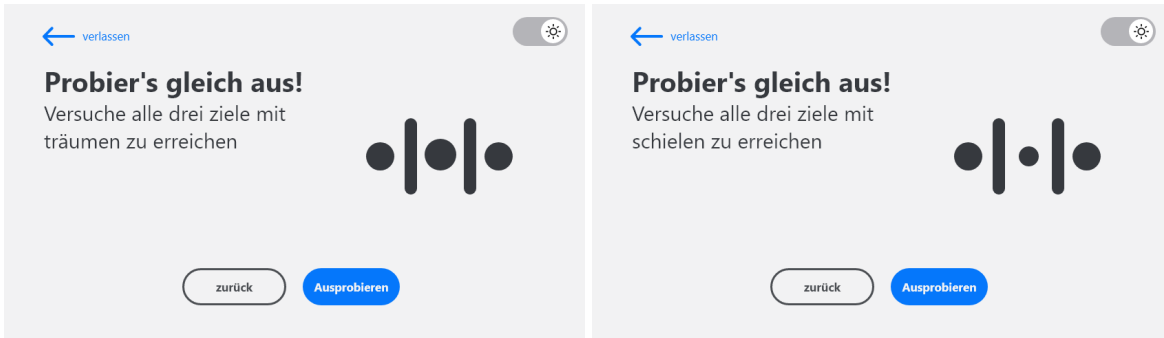
Figure 4.2.1.1.g: Calling users to try out their newly gained knowledge

As figure 4.2.1.1.h shows, users are invited to practice the introduced goals in a sandbox.
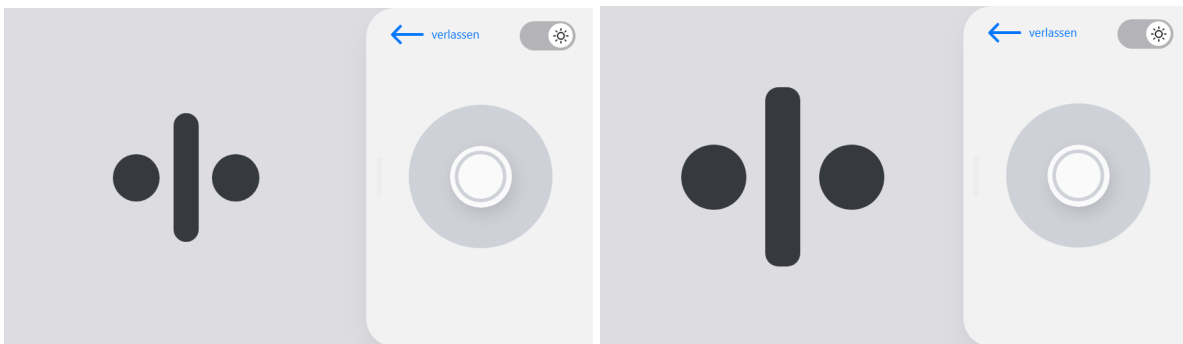
Figure 4.2.1.1.h: Workout demos squinting (left) and dreaming (right)

To ensure users are not overwhelmed by the demo and can concentrate on the specific introduced element, the demo UI only includes previously introduced and essential elements relevant to the demo's goal. For instance, as depicted in the figure 4.2.1.1.i, both demos exclusively feature minimal controls despite the user being already aware of other elements like goals.
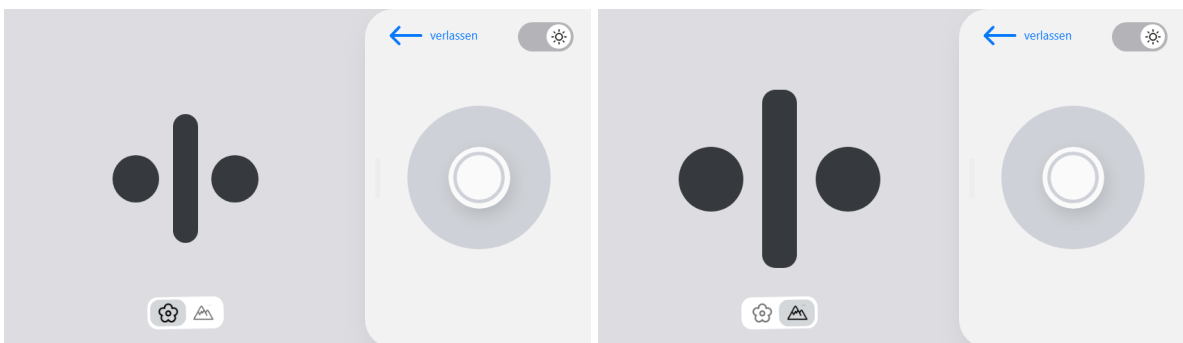
Figure 4.2.1.1.i: Workout mode demo

For instance, figure 4.2.1.1.i shows how users are encouraged to practice the transition from squinting to dreaming without worrying about goals or any other tasks they have been introduced to.
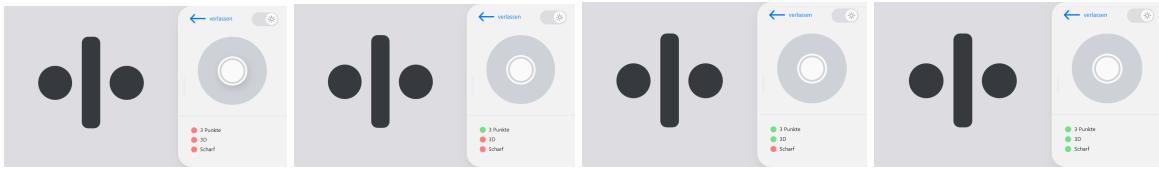
Figure 4.2.1.1.j: Workout goals demo

Speaking of goals, as we can see in figure 4.2.1.1.j, users have to reach the goals in a demo too to complete the tutorial. Both the goals of the squinting and dreaming phase have their own demo, since the goal to see in three dimensions differ in execution.

4.2.1.2 Workout

The revision of the workout section of the prototype was mainly influenced by the discussion we had with our Project partners. As requested by aisiiu, we changed the orientation from horizontal to vertical (Issue-19). This way, we could increase the size of the OTO-symbol in an attempt of mitigating the headache problem we discover during our hallway testing in iteration one.
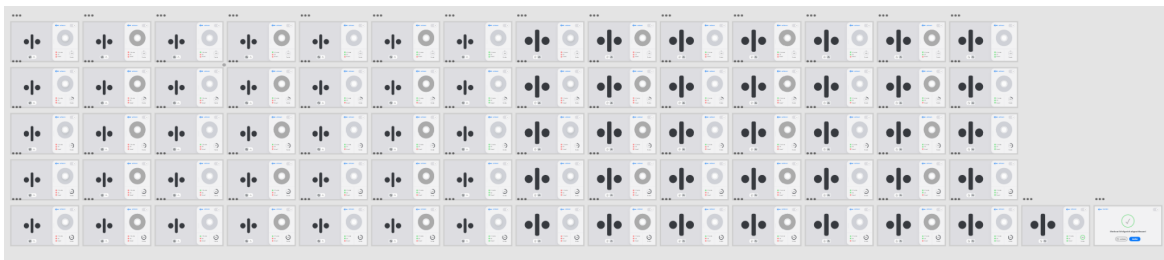
Figure 4.2.1.2.a: Workout mockups overview

As figure 4.2.1.2.a clearly shows, the number of mockups composing the workout drastically increased since our last prototype. This is the result of addressing the previously missing steps (Issue-20 & Isssue-21) we discussed with aisiiu.
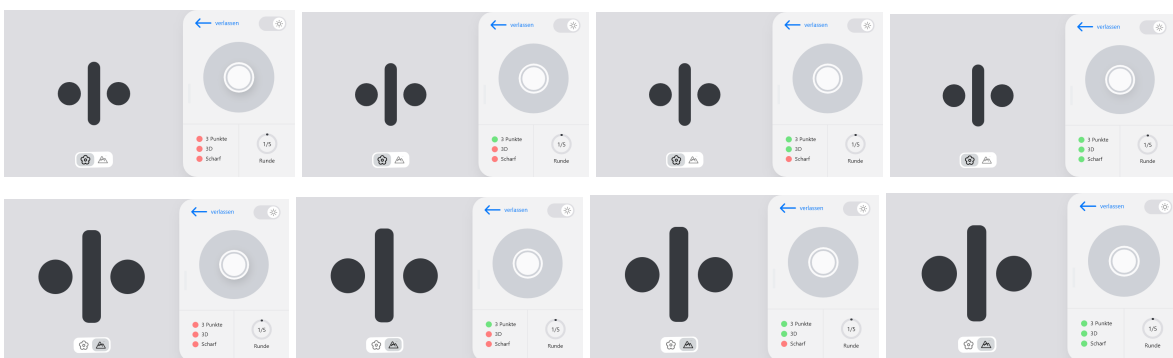
Figure 4.2.1.2.b: Workout Round One

One Workout round consists of multiple steps and goals, as figure 4.2.1.2.b shows. The user starts out with the squinting phase, trying to transform the figure by going cross-eyed. To proceed to the dreaming phase, users need to successfully transform the figure, see it in three

dimensions and get a clear and sharp view of it. Each of this goal get verified through the user by pressing the dedicated button for two seconds. Users can spot if a goal is met or not by the color of the round circle next to it. When all goals are met, the user moves on to the dreaming phase where they have to meet the same goals again, but this time by staring straight through the screen. This procedure focuses on the rhythmical transition between squinting and dreaming and repeats itself five times to make a full workout. Every time a round gets completed, the circular round display proceeds.
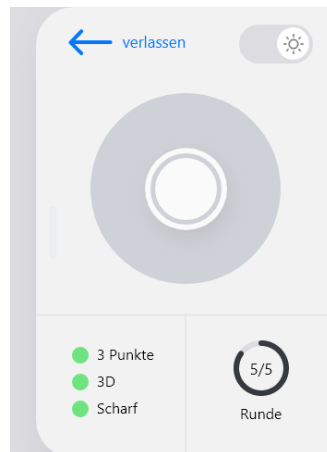
Figure 4.2.1.2.c: Workout controls-overlay

The controls-overlay, as shown in figure 4.2.1.2.c, houses all interactive elements like controls and most informative elements. It consists of three parts, the general controls like dark mode toggle and go-back-button, the verification button and the workout state displays. The state displays, goals, and rounds inform the user about the current task and their location in the workout procedure. Besides the purely informative purpose of the state-displays, they also aim to provide a sense of accomplishment and progress to users during their workout.

The placement of the round display in the overlays layout considers the fact that the user's finger may cover a part of the overlay when pressing the verification button. This strategic placement was chosen because the round display serves as purely informative rather than guiding, unlike the goal-display.
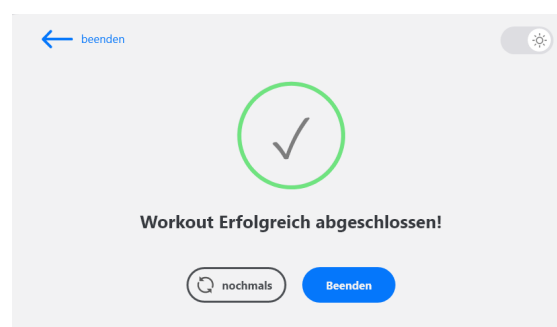
Figure 4.2.1.2.d: Workout concluding screen

The Workout ends with the screen shown in figure 4.2.1.2.d and provides the user with options to proceed. At this point, the user can either repeat the workout or go back to the entry point of the app.

4.2.1.3 Adding a Design Theme

To make the prototype appear more professional and attractive, we added a simple design theme. Since we want to reach a wide range of people with a lot of different preferences, the look and feel of the system needs to be universally appealing.

Aesthetics and use of color play a crucial role in usability and user retention. However, since our timely resources are restricted, we decided to get inspired by widely used systems and their aesthetic choices like iOS or Adobe instead of delving further into the science behind UI design.
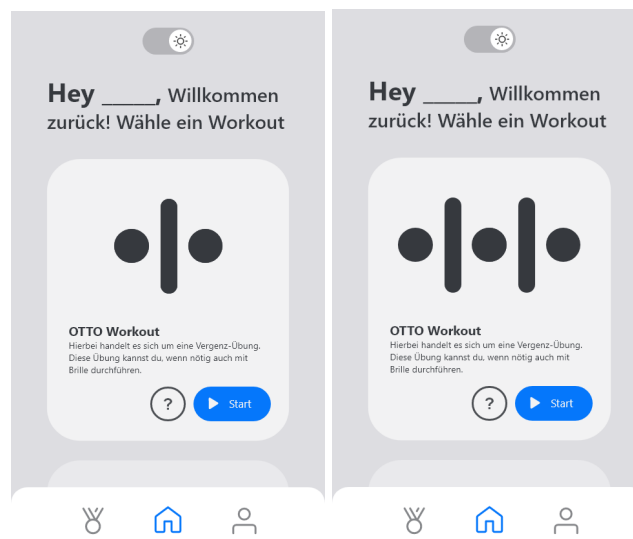
Figure 4.2.1.3: App entry point

As shown in figure 4.2.1.3, we chose a bright and vibrant shade of blue as our accent color while keeping the rest of the UI relatively simple. Eye-catching blue tones like this are often used in digital products to act as visual cues to hint on the most common action. Also, Blue as a brand color choice is widely established to convey a sense of trust, professionalism, and reliability.

4.2.2 Hallway Usability Testing

Before we can move on to the prototype implementation of our concept, we need to evaluate the revised prototype. To validate our concept and identify any usability issues, another hallway usability test was conducted. This time, we specifically focused on the issues brought up in the first testing round. The research questions aim to review the effectiveness of our countermeasures and the overall navigability and understandability of the newly expanded information architecture.

4.2.2.1 Participants

For the second round of testing, the same recruitment process and eligibility criteria were followed as in the first iteration. The participants for this study were again recruited through targeted outreach efforts conducted on the campus of the pedagogical college Thurgau. The campus was selected as a recruitment site due to its association with the educational sector, which is known to have a higher prevalence of migraines and headaches.

As in the previous round, individuals were required to regularly experience headaches and be enrolled as students at the campus to be eligible for participation. Before the study, participants were provided with detailed information about the nature and purpose of the research. They were given the opportunity to ask any questions and were asked to provide informed consent before proceeding.

In the second round of testing, a total of 6 participants were recruited for the study, ensuring a diverse representation of individuals who met the eligibility criteria. The majority of participants were female (4 out of 6) and ranged in age from 18 to 32 years old.

4.2.2.2 Testing Protocol

The usability testing for the second round followed the same methodology as in the previous iteration. The think-aloud protocol was utilized, requiring participants to verbalize their thoughts and actions while interacting with the prototype. This allows us to understand the participants' approach and way of thinking and get real-time insight on their experience.

Furthermore, after the testing session, participants were encouraged to openly discuss and express their thoughts, providing further insights and suggestions for improvement.

By maintaining consistency in the testing methodology, the second round of usability testing aimed to build upon the findings and feedback gathered in the previous iteration, ensuring a comprehensive understanding of user experiences and identifying areas for further refinement.

4.2.2.3 Findings

The findings of this study were structured into the two main sections of the revised prototype; Tutorial and Workout. Each section shortly describes its main findings and contains a summary of all issues raised by the testers.

Tutorial

All Participants were pleased by the tutorial, and generally describe it as easy to follow. They appreciated the bite sized pieces of information each slide fed them, which enabled them to grasp the concepts quickly and effectively without being overwhelmed.

Participants particularly liked the interactive nature of the tutorial, as it included many hands-on sections where they were encouraged to practice and memorize the goals of the workout. These mini exercises helped them become familiar with the controls and provided a comprehensive understanding of the workout as a whole.

The findings suggest that the improvements made to the tutorial section significantly enhanced its usability and understandability. Participants successfully completed the tutorial without encountering any difficulties, and they expressed a heightened sense of confidence and familiarity with the concept of eye workouts.

Workout

The testing of the workout section mainly brought up problems, we are already familiar with. Firstly, once participants completed the tutorial section, they were able to understand the mechanism and controls and successfully complete the workout.

Overall, participants did not encounter any issues with the process or execution of the workout. However, all participants experienced discomfort when attempting to reach the goals of the workout. Notably, three individuals developed headaches during the workout, and post-interviews revealed additional symptoms such as dizziness, nausea, and light sensitivity. We observed similar issues in our previous testing round. This issue needs to be addressed to ensure a headache-free experience for all users.

Furthermore, the participants suggested the inclusion of sound and haptic feedback into the workout. This feedback aligns with previous iterations of testing, highlighting the importance and relevance of incorporating sound and haptic feedback in future prototypes.

UI Design

The aesthetic aspect of the app received positive recognition during testing, with the UI design specifically being well-received. Some participants even remarked that it reminded them of their iPhones' user interface. Interestingly, participants voluntarily commented on the design multiple times throughout the testing process, eliminating the need for explicit questions about the UI design in the post-interview. Notably, one participant who did not spontaneously mention any graphic design aspects later expressed during the post-interview

that the design seemed acceptable to them, emphasizing that functionality was more important than aesthetics to them.

Conclusion

The findings of the usability test indicate that the revised prototype has brought significant improvements, particularly in the tutorial section. Participants found it easy to follow, appreciated the bite-sized information, and enjoyed the interactive nature of the tutorial.

In the workout section, participants did not encounter issues with the process or execution, but experienced discomfort while trying to reach the workout goals. Since we want a pleasant and pain free experience for all users, we need to give this problem further attention.

4.2.3 Concluding Iteration two

Overall, the concept proved itself to be ready for a functional prototype implementation. By addressing the headache issue and incorporating sound and haptic feedback, the concept will be further refined in during the functional implementation of the prototype.

Chapter 5

5 Technology Evaluation

In this chapter, we evaluate different technologies to find the right fit to implement our prototype. Since our concept is purely procedural and does not require any data persistency or any other client server communication, we can purely focus on evaluating front-end technologies.

5.1 Criteria

The criteria, the evaluation is based on, are derivate from the requirements engineering in chapter three and aim to find a technology that provides us with all the tools and features, to implement our prototype.

Evaluation Criteria		
ID	**Title**	**Evaluation Questions**
Criteria-01	Access to device and hardware features	- Can we access haptic feedback? - Can we access live video?
Criteria-02	Way of distribution	- What devices can we reach? - How complicated is the distribution process? - Who needs to approve our system for distribution?
Criteria-03	Estimated development time required	- Do we need specialized hardware? - What development overhead comes with these technologies? - How steep is the learning curve to master this technology according to the programming community?
Criteria-04	Level of expertise and previous experience	- Do we have any previous experience with this technology?
Criteria-05	User experience	- Do the technologies provide ready to use UI components that comply with modern UX standards?

Table 5.1: Technology evaluation criteria

While performance is not a significant factor for this prototype, the final product should be able to meet the minimum acceptable level of performance.

5.2 Native iOS vs. Progressive Web Apps

Since aisiiu requested a system that is either a progressive web app (PWA) or a iOS application, the contestants for this evaluation are already given. Both offer different trade-offs and have their own strength and weaknesses.

Progressive Web Apps (PWAs) are web-based applications accessed through a browser [21], whereas iOS apps are native applications downloaded and installed from the App Store on iOS devices [22].

To make an informed decision, it is important to compare each of the most relevant characteristics of iOS apps and Progressive Web Apps (PWAs) criteria by criteria.

Criteria 1 – Access to device and hardware features
Swift iOS apps have full access to all device and hardware feature, while PWAs are not permitted to access features like Touch ID, Siri, ARKit, and other apple services like Apple-Pay [22]. Since we are mostly interested in camera access and utilization of haptic mechanisms, both candidates fulfill the requirement.

Criteria 2 – Way of distribution for testing and accessibility
Native iOS apps require a iOS device to run on, therefore only iPhone and iPad users can install the app [22]. Besides the inconvenience that, iOS apps require a physical iPhone for testing, they can only be distributor from the app store, for which they have to undergo a strict approval process [23]. A PWA on the other hand can be accessed by any device with access to the internet, not having to comply by and rely on any thrift party distribution service [21].

Criteria 3 – Estimated development time required
In general, since iOS development requires multiple physical Apple devices and the use of apple's own programming language and tooling [22], getting started with iOS development can be very time-consuming. On the other hand, PWAs are build with widely used and well established web technologies, needing no specific hardware [21].

Criteria 4 – Level of expertise and previous experience
We generally have no experience with iOS development, and so does the organization responsible for the final productive implementation. However, we have experience with the technologies require for progressive web apps including HTML, CSS, JavaScript, or TypeScript [21].

Criteria 5 – User experience
iOS's apps offer a more native and consistent user experience with access to more device-specific features [22][24], while PWAs provide a more accessible and versatile user experience across different platforms and devices [21].

5.2.1 Evaluation Summary

A simple summary of the evaluation between the two frameworks can be found in table 5.2.1. The table aims to communicate the results and should help to justify our decision.

Evaluation Summary: Native iOS vs. Progressive Web App			
Criteria	Evaluation Questions	iOS Apps	Progressive Web Apps
01.a	Can we access haptic feedback?	Yes	
01.b	Can we access live video?	Yes	
02.a	What devices can we reach?	iOS devices only	Any device with internet access
02.b	How complicated is the distribution process?	Requires App Store distribution and approval process	No third-party distribution required
02.c	Who needs to approve our system for distribution?	App Store review process	No third-party approval required
03.a	Do we need specialized hardware?	Requires physical iOS devices	No
03.b	What development overhead comes with these technologies?	Significant, specific tools and programming language (Swift) required	Minimal, widely used web technologies
03.c	How steep is the learning curve to master this technology?	High	Moderate
04	Do we have any previous experience with this technology?	No	Yes
05	Does the technology provide ready-to-use UI components	Yes	Yes, with modern UX standards

Table 5.2.1: Evaluation Summary: Native iOS vs. Progressive Web App (color-coded)

5.2.2 Conclusion

Based on the evaluation criteria, we recommend using a PWA for the implementation. Both candidates meet the requirements for access to device features and hardware, but the ease of distribution for testing and accessibility, as well as the estimated development time, heavily favor PWAs. In addition, our level of expertise and previous experience aligns with PWA technologies. While iOS apps may offer a more native and consistent user experience, PWAs provide a more accessible and versatile user experience across different platforms and devices, which is also a key factor in our decision-making process.

5.3 Angular Framework vs. React JS Library

Now, that we found that a PWA meets our requirements best, we need to compare the different options to build PWAs. Since the angular Framework and the React JS Library are quite popular, it makes sense to decide between those two technologies.

Both, Angular and React fulfill the relevant criteria since, as table 5.3 shows, and the decision therefor can be mainly based on team preference.

Evaluation Summary: Angular Framework vs. React JS Library			
Criteria	Evaluation Questions	Angular	React
01.a	Can we access haptic feedback?	Yes	
01.b	Can we access live video?	Yes	
02.a	What devices can we reach?	Any device with a web browser	
02.b	How complicated is the distribution process?	Simple, trough Web accessible	
02.c	Who needs to approve our system for distribution?	No third-party approval required	
03.a	Do we need specialized hardware?	No	
03.b	What development overhead comes with these technologies?	Minimal, Framework/Library-specific tooling and concepts	
03.c	How steep is the learning curve to master this technology?	Moderate	
04	Do we have any previous experience with this technology?	Yes	
05	Does the technology provide ready-to-use UI components	Yes, with modern UX standards	

Table 5.3: Evaluation Summary: Angular Framework vs. React JS Library (color-coded)

5.4 Conclusion

Given that both Angular and React are capable of meeting the requirements for the prototype we want to build, we can base our decision on team preferences. Since the organization responsible for implementing the final concept as a productive system primarily uses Angular, we decide to use Angular to build the prototype. This will help ensure a smoother transition from the prototype to the final system, as the development team will already be familiar with the Angular framework and related tools.

Chapter 6

6 Implementation

In this chapter, we talk about the implementation process of the workout section of our previous prototype and showcase the resulting application.

6.1 Frontend

The UI is composed through components and driven by the angular framework. This allows us to keep concerns separated from each other. Each UI element was implemented in its own component and granted its own behavior through that. To keep the components flexible and simple, we tried to employ CSS and HTML native features as often as possible.

6.1.1 Workout

Figure 6.1.1.a shows the workout on an iPhone SE, which has a rather small screen compared to many other smartphones available in the market. For example, The iPhone SE (2022) has a 12 cm screen, while most phones start at 13 cm and can go up to 17.7 cm [25]. The figure 6.1.1.a shows the layout has no issue with the small screen size event with the increased spacing between the dots of the OTO-symbol.
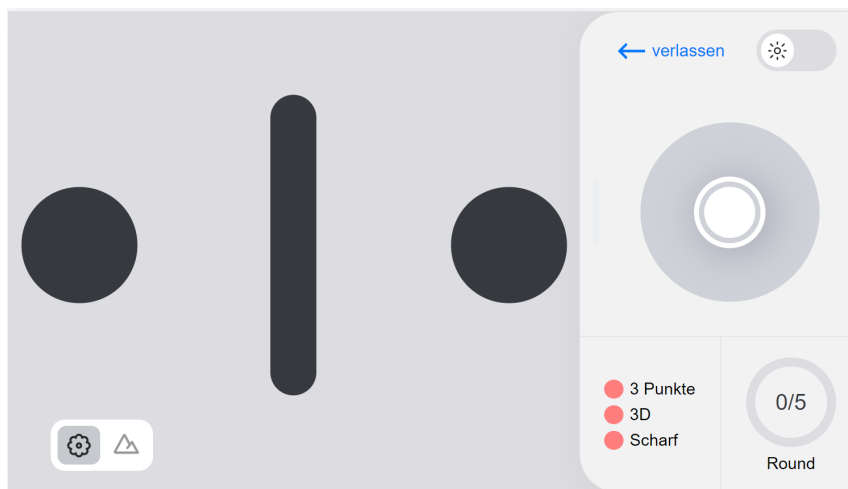
Figure 6.1.1.a: Workout on iPhone SE

Fortunately, since we chose a PWA as the right fit for our implementation, the prototype is not only accessible from smartphones but from all devices with browser access and gets proportionally scaled to the screen size, as shown in figure 6.1.1.b.
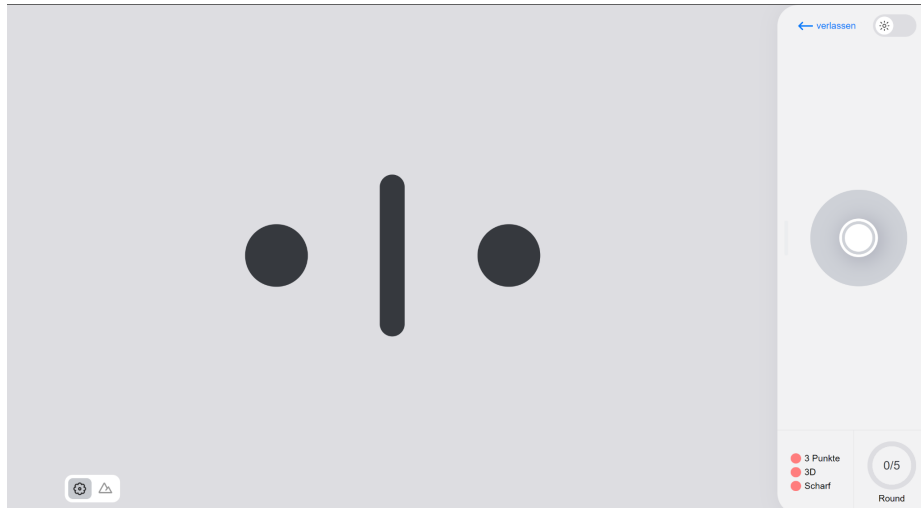
Figure6.1.1.b : Workout on desktop

Figure 6.1.1.c shows the dark theme of our UI. It consists of a dark color pallet with blue undertones in it, in order to make the shades look more alive, rather than ashy.
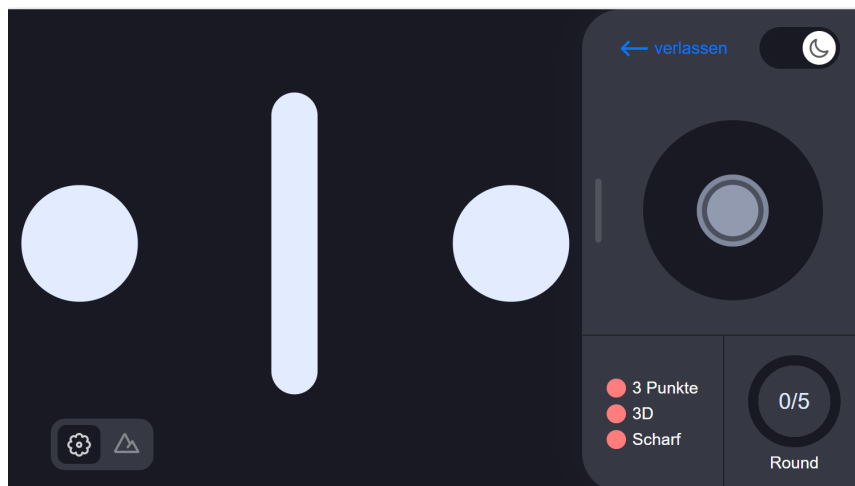
Figure 6.1.1.c: Workout in dark mode

When users successfully complete all five rounds of the workout, they get awarded with a small message, depicted in figure 6.1.1.d, and the option to restart the workout.
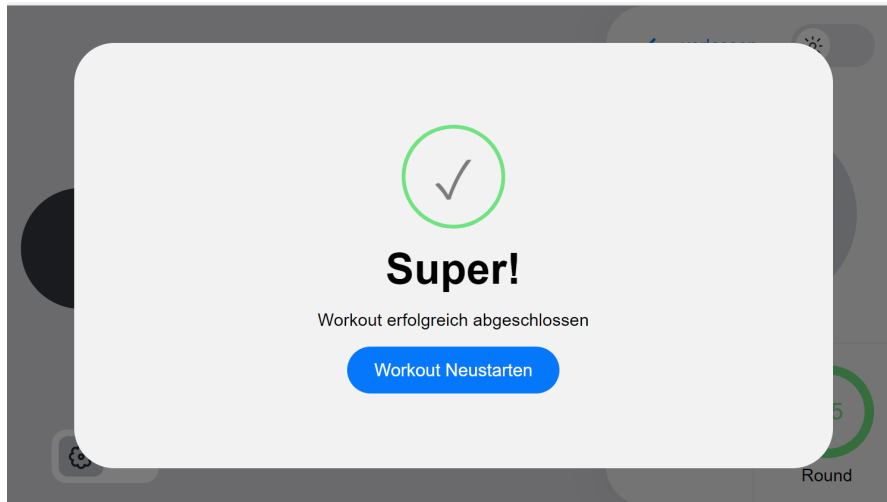
Figure 6.1.1.d: Finish component

6.1.2 Verification Button

The verification button component, as shown in figure 6.1.2, is made up of three div elements siting inside a button element layered on top of each other. The innermost div represents the button that users have to keep in an active state in order to grow the middlemost circle to the size of the outermost circle. To get this effect, we used the element state "active" to trigger the CSS animation who scaled the circle over a span of two seconds.
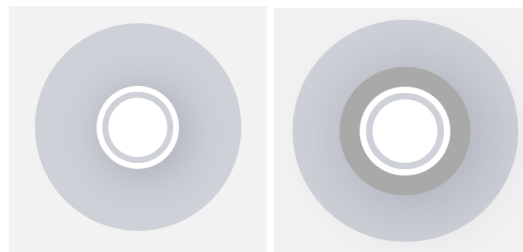
Figure 6.1.2: verification-button components

6.1.3 Goal Display

When users verify a goal, the goal display component shown in figure 6.1.3 reflects that accomplishment. It provides a single function that progresses its state and style circularly.
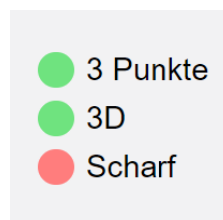
Figure 6.1.3: goal-display components

6.1.4 Mode Toggle

To make sure, users are aware of what phase they currently are in, the mode-toggle component shown in figure 6.1.4 symbolizes the current mode. We borrowed the imagery from photography, where the flower icon is highly associated with a close-up while a mountain icon is associated with photographing objects that are further away. When the mode gets switched, the display moves its highlight accordingly using a transition animation.
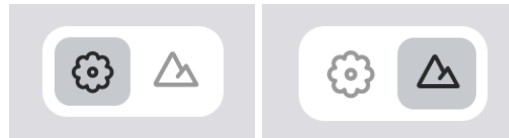
Figure 6.1.4: mode-toggle components

6.1.5 Round Display

Another purely informative component is the round display shown in figure 6.1.5. It consists of a div in the role of a progress bar. It purely uses CSS properties to control its appearance and behavior.
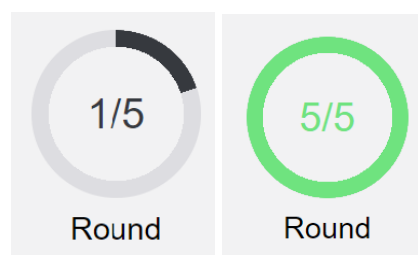
Figure 6.1.5: round-display components

Additionally, the round display includes a pseudo-element (::before) to show a counter indicating the current round (e.g., "1/5", "2/5", etc.), which is based on a custom --value property.

6.1.6 Style Toggle

The toggle switch, as depicted in figure 6.1.6, acts as a style toggle to switch between a dark and a light UI. This control is crucial to make the system useful for our migraine prone user group, since bright screens can worsen or sometimes even trigger headaches.

Figure 6.1.6: style-toggle components

However, although the dark version of our UI could be described as superior since it aims to be easier on the eye, the light UI still serves its purpose by making the system usable in bright environments.

6.1.7 Request Landscape Mode

In order to make sure, users keep their phones in a horizontal position, a message will pop up if users attempt to put their phone in vertical mode anyway, as shown in figure 6.1.7.
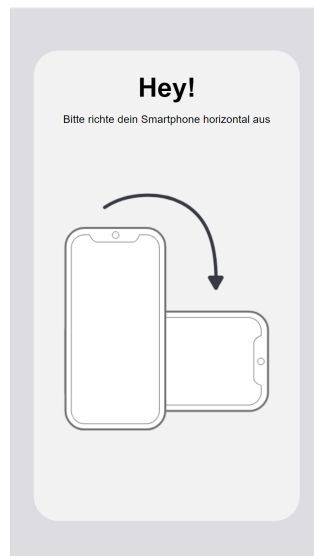
Figure 6.1.7: Request landscape mode

6.1.8 Request Full-Screen

Another important factor for our application is full screen mode. As shown in Figure 6.1.8, we craft a little message that advises the user to activate the full screen mode. We used the full screen API [26] for an asynchronous request to make the HTML-body be displayed in full-screen mode when the blue button is clicked.
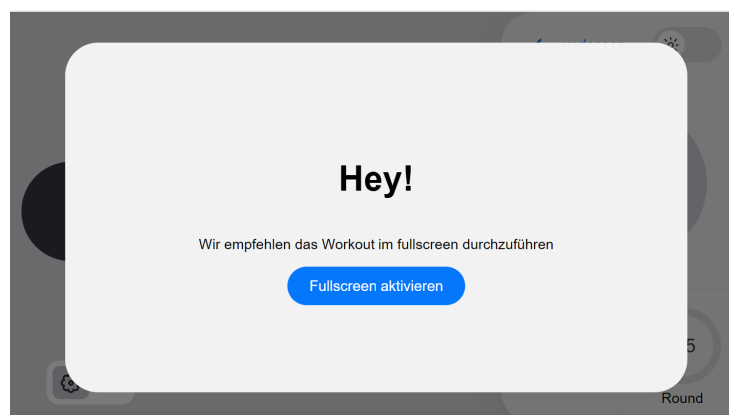
Figure 6.1.8: Request full-screen

6.2 Feedback Mechanisms

Now that we are implementing a functional prototype, we finally have the tools to incorporate haptic and audio feedback into our app. The audio feedback is implemented in the form of a xylophone scale. Audio feedback follows a xylophone scale, where reaching each goal produces a short sound with increasing pitch to convey progress. Once all six goals have been reached, a distinct check sound indicates the successful completion of a round. Similarly, for haptic feedback, devices with vibration units emit a pulse for each goal reached and two pulses for completing a round.

6.3 External Components and Libraries Used

Given the distinct nature of our project, we did not utilize any external libraries or components. Since our design is build upon rather unique elements and controls, we decided against delving deeper into ready-to-use Components. Instead, we relied on the power of CSS and a touch of JavaScript to develop all functionalities, tailoring them precisely to our requirements.

6.4 External Assets Used

In the development of this project, various external assets were utilized to enhance the user experience. These assets include icons, sounds, and other multimedia elements that contribute to the overall functionality and aesthetics of the application.

To ensure proper attribution and acknowledgement, all external assets used in this project are listed and linked in the Appendix section of this documentation.

Chapter 7

7 Final Evaluation

This chapter, describes the final evaluation and reflection of the project.

7.1 Final Evaluation in Cooperation with Aisiiu

For our final evaluation, we once again traveled to Zurich Stadelhofen to meet up with the inventor of the method, Pascal Abegg and other members of aisiiu.

During our visit, we tested our prototype thoroughly and discussed our findings and improvement suggestion. This section contains a detailed description of the feedback received and solutions discussed, and ends with a summary of our suggested changes.

7.1.1 Enhancing Personalization

Introducing customizable features in our app can greatly enhance user experience and might greatly contribute to overall success. By empowering users to personalize their workouts, we not only foster a sense of ownership, but also enable a tailored experience for everyone. When consulting with Pascal Abegg, we identified multiple aspects of the workout that could greatly benefit from user customization. We learned that, when it comes to eye workouts, people's needs and triggers can be very different, which is why customizability is crucial to make the app useful and accessible to a vide variety of people.

7.1.1.1 Symbol Spacing

According to Pascal Abegg, the spacing and sizing of the OTO-symbol play a crucial role in preventing headache triggers and ensuring successful symbol transformation during the workout. If the Symbol is too small, users might experience difficulties in transforming the Symbol or even trigger a migraine attack. As we learned from Pascal Abegg, transforming the Symbol works best while the space between the two dots is equal to the user's Pupillary distance. However, it's important to note that while this holds true for most patients, individual variations exist. To cater to all users and provide optimal spacing, the system could incorporate a pupillary distance measurement feature to adjust the Symbol accordingly. Additionally, for users who still face challenges with spacing, implementing a simple slider that allows manual control of the dot spacing could be a helpful solution.

7.1.1.2 Symbol Dot Styles

When consulting with Pascal Abegg, he emphasized that not only spacing can be crucial for the success of users. According to Pascal Abegg, the choice of dot styles in the OTO-Symbol holds significant importance for users. Offering a variety of dot styles allows them to personalize their experience based on their unique needs. Different styles of dots can vary in terms of ease or difficulty in transformation, depending on the user's individual situation. By providing users with the option to select from various dot styles, we give them another highly personalized way to adjust the difficulty level of their workouts. This empowers users to

explore different styles and discover the option that works best for them, ultimately enhancing their overall workout experience.
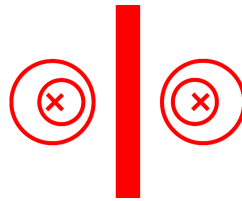
Figure 7.1.1.2: Example Dot Style provided by aisiiu

7.1.1.3 Uploading Custom Images as Dot

As we already discussed earlier, the style of the symbol can have a big impact on users' success. The style of the symbol for some not only influences the transformation process, but also how well they can stay focused. When working with individuals with autism, children or other people who can have a hard time staying focused, Pascal Abegg says, it can be helpful to tailor the activities to their interests and strengths. This principle, known as "special interests" or "affinity-based learning," takes advantage of an individual's intense focus and fascination with specific topics or objects [27]. By enabling users to upload their own dots, they can customize their experience into a more engaging and motivating activity, that keeps them focused.

7.1.1.4 Color Theme

Another aspect that could profit from Customizability is the color Theme. Some users might not be satisfied by the two color theme options the prototype provides. Pascal Abegg discovered through his patience that color and brightness contrasts can influence the transformation process too. He has worked with a few different styles that he found supported his patients well. Users should therefore be able to pick between multiple color themes, besides light or dark UI.
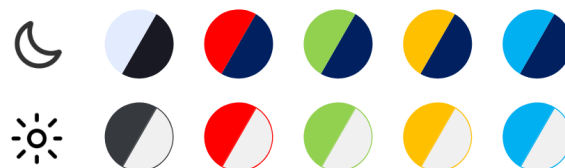
Figure 7.1.1.4: Example Color Themes

7.1.1.5 Audio Feedback

As Pascal Abegg learned from his patients over the years, the perception of sounds and pitches differ significantly from person to person and is also dependent on mood and well-being of the individual. Besides that, people might perceive sound differently during a headache or a migraine attack, and certain pitches or sounds may be uncomfortable or

aggravating for them. To make sure, the sounds used for audio feedback is pleasing to users, we can provide a slider for users to choose a for them pleasant pitch. Also, we could provide different options for the type of sound, so users could decide for example between different instruments.
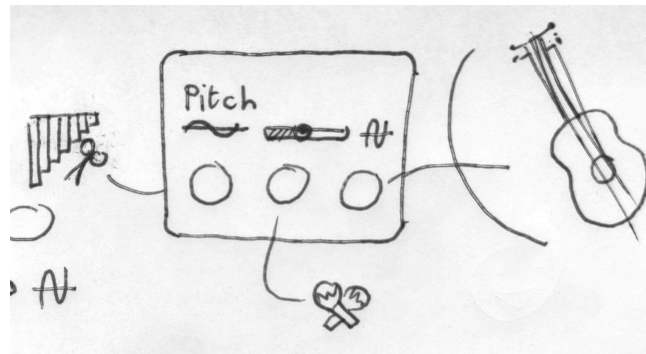
Figure 7.1.1.5: Example Audio Settings

7.1.2 Minimizing Visual Distraction

During testing, Pascal Abegg observed that when transforming the symbol, the controls became intertwined with the new image. He suspects, this issue could potentially distract users and interfere with their ability to successfully execute the workout. To mitigate this problem, we could provide an option for users to hide all controls. This change aims to allow users to focus solely on the task without visual distractions, further increase the chances of achieving the workout goals.
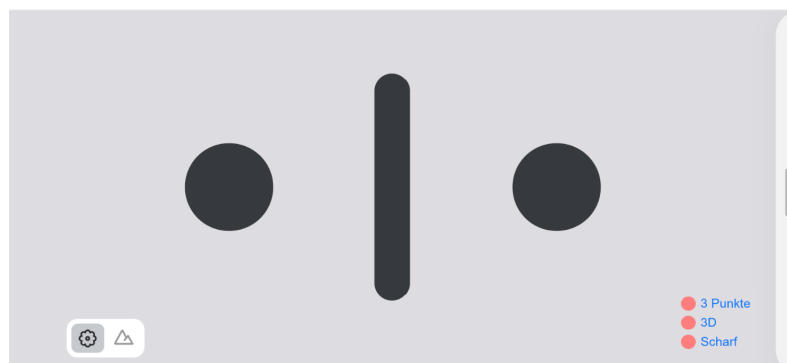
Figure 7.1.2: Example Minimized Controls

7.1.3 Adding Hardware Controls

Another way to reduce distractions within the user's view is to incorporate Hardware buttons as controls. Users would no longer have to worry about covering a part of the UI with their fingers, and we can provide more space for the OTO-symbol.

7.1.4 Increase Dot Size

As figure 7.1.4 shows, the proportions of our current version, are somewhat off. Since we want to mimic the paper workout as close as possible, increasing the dot of the OTO-symbol

is highly recommended by Pascal Abegg. By increasing the dots, we aim to provide the user with a more balanced UI and further imitate the original method.
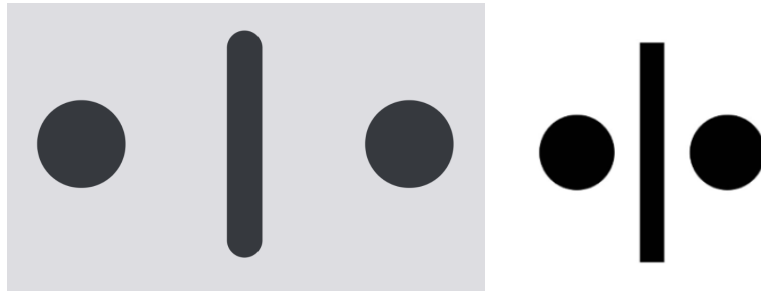
Figure 7.1.4: App Version (left) vs. Original (right) OTO-Symbol

7.1.5 Recommendation Summary

Table 7.1.5 summarizes all our recommendations for the further development of the prototype and conceptual design. Every recommendation consists of a title, a concise issue-style description and the problem it is trying to address.

Recommendation Summary		
Title	**Description**	**Problem Solved**
Symbol Spacing	Adjust symbol spacing based on pupillary distance.	Unfitting distance between the two dots of the symbol can lead to migraine and headaches
Symbol Dot Styles	Offer a variety of dot styles for users to personalize their experience.	Different dot styles can vary in terms of ease or difficulty in transformation, depending on the user's individual situation.
Uploading Custom Images	Enable users to upload their own dots.	Some people might struggle to stay engaged during the workout, such as those with autism or difficulty staying focused.
Color Theme	Provide multiple color theme options to cater to users' preferences and optimize color and brightness contrasts.	Color and brightness contrasts can influence the symbol transformation process, depending on the user's individual situation.
Audio Feedback	Implement a slider for users to choose a pleasant pitch and offer different sound options, such as different instruments.	Individuals perceive sounds differently, and certain pitches or sounds may be uncomfortable or aggravating, particularly during headaches.
Minimizing Visual Distraction	Add an option to hide all controls and use the whole screen as a button to proceed.	Controls becoming intertwined with the OTO-symbol can potentially distract users and hinder successful execution of the workout.
Adding Hardware Controls	Incorporate hardware buttons as controls.	Some users might get distracted by the UI controls and their own fingers when transforming the figure.

Increase Dot Size	Increase the size of the dots in the OTO-symbol.	The proportions of the OTO-symbol do not match the ones from the original paper based workout.

Table 7.1.5: Recommendation Summary

7.2 Heuristic Evaluation

As a part of our final evaluation, we want to take a closer look at our concept from the perspective of Jakob Nielsen's heuristics [28]. We chose Nielsen's heuristics to evaluate our UI because they provide a well-established and widely used set of guidelines that allow us to assess the usability of our concept from a user-centered perspective. By going through each of these heuristics, we can systematically identify potential usability issues and ensure that our design aligns with recognized principles of usability.

7.2.1 Visibility of System Status

Our concept provide users with visual, audio and haptic feedback to communicate system status. Audio and haptic feedback indicate progress in the procedure, while users can always see their current location within the workout through the goal- and the round-display, as shown in figure 7.2.1.a and figure 7.2.1.b.

Figure 7.2.1.a: goal-display component
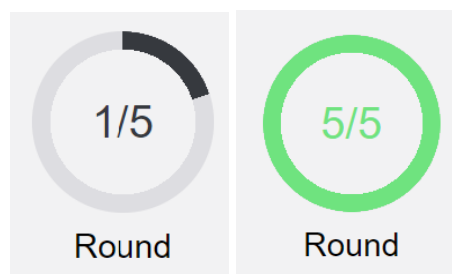
Figure 7.2.1.b: round-display component

7.2.2 Match Between System and the Real World

To indicate if we want users to execute the divergent or convergent exercise, we use a mode-display that switches between a flower and a Mountain icon, as shown in figure 7.2.2. We borrowed that pairing from photography, where the flower icon typically represents close-up shots and the mountain icon represents distant subjects.
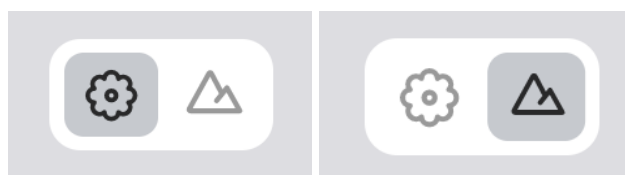
Figure 7.2.2: mode-toggle components

Similar to how photographers use the flower and mountain icons to capture different perspectives, we use them in our application to signify different visual focusing techniques. The flower icon signifies a convergent exercise, where users are encouraged to focus on a point closer to them, much like capturing a close-up image. On the other hand, the mountain icon represents a divergent exercise, prompting users to shift their focus to a distant point, similar to capturing a landscape shot.

7.2.3 User Control and Freedom

When looking at the Information architecture, users seem to not have many ways to get lost in our application. The tutorial, as well as the workout, sent the user through a linear procedure with barely any, to no branching options. Users can move back and forward during the Tutorial, in case they missed something, while the workout it'self follows a strictly unidirectional flow. Besides, its procedural nature, users can always return to the entry point of the app through an arrow button that is featured on every screen of the concept.

7.2.4 Consistency and Standards

We tried to establish a consistent design trough out the whole application with the aim to set a universal UI standard.

7.2.5 Error Prevention

Since our concept doesn't give users many choices anyway, there are also barely any opportunities for them to run into an error. The only case where somewhat of an error message is needed, is when users hold their phones vertically instead of horizontally during the tutorial or workout. In this case, a message will appear while any other content gets hidden. As shown in figure 7.2.5, we explain to users what went wrong and how to fix the issue, accommodate with an illustration.

Figure 7.2.5: Request correct phone position

7.2.6 Recognition Rather than Recall

When implementing the customization features named in our final evaluation with aisiiu, it's important to also add a preview of the picked option to every setting. This way, users won't have to remember the look of different styles or options, but rather recognize the right fit through the preview.

7.2.7 Flexibility and Efficiency of use

Through implementing our improvement recommendation named in our final evaluation with aisiiu, we could allow users to tailor the workouts to their needs to improve their overall experience. In order to fully comply with this heuristic, these settings need to be placed where they are mostly unseen by the casual rookie users who might get overwhelmed by the amount of options. However, we also have to place them accessible to expert users such that the system can cater to both inexperienced and experienced users.

7.2.8 Aesthetic and Minimalist Design

Our UI design follows and complies to the four principles of visual design.

Contrast

We created noticeable contrast between UI elements and used the many ways to do so to make certain elements stand out. Our Layout highlights common actions with a vibrant accent color and forms a logical structure through the use of monochromatic contrasts and shadows.

Repetition

As we already discussed previously in our heuristic evaluation, we establish visual unity and reinforce the overall design theme by sticking to consistent design principles we established.

Alignment

We made sure to respect spacing and alignment in our layout by using a grid in our mockup phase.

Proximity

Related elements should be close to each other. A great example where we grouped together similar elements, is the controls-overlay as pictured in figure 7.2.8. As the name already hints,   components houses the majority of controls and distinguishes itself as an independent container.
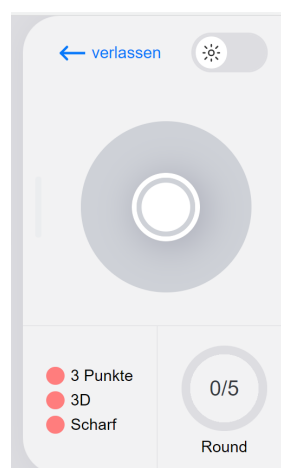
Figure 7.2.8: Workout controls-overlay

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7.2.9 Help Users Recognize, Diagnose, and Recover from Errors

As already discussed previously, our system doesn't leaf the user with many options to run into an error and the few cases where users can fail, are covered by a simple message. The message aims to recover from the error and get back to where the user left off.

7.2.10 Help and Documentation

We recognized early on that our system won't be one to explain itself due to the uniqueness of the eye workout method. Our conceptualization of a tutorial, proved it'self to help users understand the premise and the controls of the workout. The Tutorial can be skipped or repeated multiple times and focuses on enabling users to reach tier goals.

Chapter 8

8 Conclusion

This chapter provides an overview of the project's conclusion and outlines the future of our prototype. It offers insights into the general outlook and addresses the limitations encountered during the development process

8.1 Outlook

The current functional prototype implementation serves as a strong foundation for future research on the effectiveness of eye workouts. Although the prototype lacks a tutorial, it can still be utilized by Pascal Abegg's patients who are already familiar with the workout. The refined design concept can be further developed and tested to create a productive system. Additionally, the Institute of Software Rapperswil (IFS) is expected to leverage the knowledge, concept, and implementation of this thesis to develop a productive system for aisiiu.

8.2 Limitations

This section highlights the constraints, challenges, and shortcomings that were encountered during the course of the project. Overall, the project did not encounter any crucial limitations and went as expected.

8.2.1 Time Constraints

As given by the nature of a bachelors' thesis, we were limited in project time and resources. While we reached our goals and can proudly provide a working and refined concept, we would have liked to further investigate the app's effects and potential side effects with Pascal Abeggs patients.

8.2.2 Testing Constraints

During the testing phase, valuable insights were gained, and design weaknesses were identified. However, the testing process proved to be arduous when conducted by a single person. Given the limited size of our team, the responsibility of moderating the testing and taking notes fell upon one individual, which is typically not ideal. Juggling both roles simultaneously not only led to exhaustion, but also increased the risk of overlooking important information and conveying disinterest to the testers. To enhance future testing endeavors, it is strongly recommended to have a minimum team size of two to ensure more effective and comprehensive testing facilitation.

Part II

Project documentation

Chapter x

9 Project Overview

The Goal of the Project documentation is to give an overview of the project and provide insight into its organizational Strategies and Management processes.

Approximately 20% of the population's daily lives are impacted by headaches or migraine attacks. Despite medical progress, most forms of headaches are neither curable nor can their symptoms be suppressed by medication without encountering side effects.

Regularly practicing specific eye exercises can reduce the frequency, severity, and duration of headaches. The high demand for the practice of this method (by Sports Vision Pascal Abegg AG) can be seen as compelling evidence of its effectiveness. However, mastering these exercises is difficult and requires continuous personal feedback to optimize execution.

Through the development of a mobile app mentoring its users though these exercises, eye workouts can be made more accessible to a broader audience. The focus of this thesis, mainly lies on the research questions that arise during the development of the user interface and the user centered approach to the problem at hand.

9.1 Management Method

The choice of the management method is crucial to the success of a project. Since this project is not a typical software engineering project, elaboration goes beyond just picking one of the classics. Due to the project team's modest size and the main subject being research and design rather than implementation, it does not fit the frame of commonly used Management methods like Scrum or Kanban.

Since I have the most experience with the Scrum framework and appreciate its agile characteristics and straightforwardness, the management method of this project will be a custom derivation of Scrum.

Meetings like daily scrum and the sprint retrospective lose their purpose in a one-member team and therefore, are tossed completely.

The Concept of Sprints and Sprint Goals are kept in an agile derivative for flexibility and monitoring reasons. In this project, the Sprint Goal is always a Milestone and the issues leading to that milestone represent a Sprint. Sprint Review and the Milestone Meeting are therefore the same and will be held with the supervisor of this project. Sprint Planning takes

place as soon as a new milestone is reached. Sprints duration is therefore not fixed and lies between 1 and 4 weeks depending on the corresponding milestone.

9.2 Time Management

To stay true to the intended project scope, time estimation and time spent on the project are tracked via Git Labs issue management system. Finely-grained time management will be conducted after each milestone for each issue of the upcoming milestone.

9.3 Milestones and Project Timeline

This document provides only a rough overview of the project milestones, since deadlines are subject to change throughout the course of the Project.

Milestone overview			
ID	Milestone	Approximate deadline	Weeks
M00	Project Plan	February	1
M01	Literature Study	March	1
M02	Requirements Engineering	March	1
M03	User-centered UI Conceptualization	April	4
M04	Prototype Implementation	Mai	5
M05	Result Evaluation and Reflection	June	2

Table 9.3: Milestone overview

9.4 Risk Management

Risks are continuously assessed, and mitigation strategies are derived if possible. Mitigation strategies are based on ISO 27005 and tag each risk with reduce, retain, avoid or transfer.

Chapter x

10 Risk Analysis

To recognize and handle project risk, a risk analysis is conducted, and mitigation strategies are defined.

10.1 R1 – Unfitting Development Tools

The chosen development tools and technologies do not support the development process.
Mitigation: Tools and Technologies will be reviewed and compared before use.

10.2 R2 – Developing the wrong features

Wasting resources on unneeded features and characteristics.
Mitigation: Requirements are constantly reevaluated through regular user feedback and Prototyping

10.3 R3 – Overengineering

Designing the product in an overly elaborate manner.
Mitigation: Requirements undergo a cost-benefit analysis before they are implemented and will be dropped if they don't pass the bar.

10.4 R4 – Continuously changing requirements

Requirements changing fast and abruptly due to user feedback.
Mitigation: Setting a change threshold for requirements and pushing implementation to the next increment if they pass.

10.5 R5 – Staff deficits

Development comes to hold due to illness or exam preparations.
Mitigation: Communicating as soon as potential deficits are foreshadowed and adapting the scope of the project.

10.6 Risk Summary

The in the previous sections discussed risks and their mitigation strategies can be found in the table below.

	Risk Overview					
	Assessment			**Mitigation**		
Risk ID	**Damage**	**Probability**	**Danger**	**Strategy**	**Effectiveness**	**Remaining Risk**
R1	Moderate	Unlikely	Very low	Reduce	0.8	Very low
R2	Moderate	Remote	Low		0.8	Very low
R3	Moderate	Remote	Low		0.8	Very low
R4	Minor	Certain	Medium		0.8	Very low
R5	Moderate to major	Possible	Medium		0.5	Low

Table 10.6: Risk overview

Part III

Appendix

11 Mockups

11.1 Iteration one

The mockups are arranged as the typical user journey.
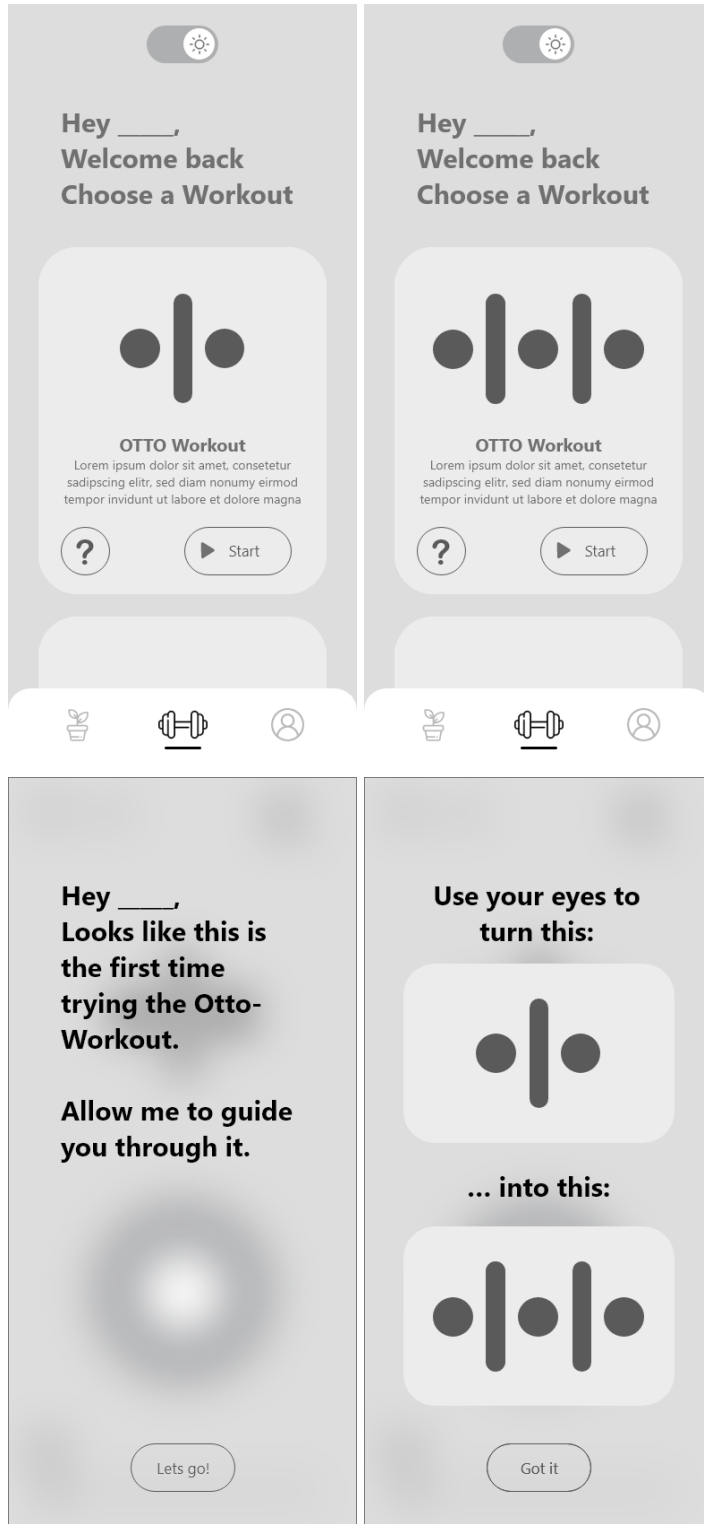
**As soon as you see
this happen:**

hold and find:

Got it

**As soon as you see
this happen:**
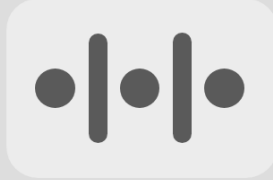
hold and find:

Got it

**Try to keep your
eye position while
pressing down the
white button.**

**Hold until the
circle has filled up:**

Got it

**Try to keep your
eye position while
pressing down the
white button.**

**Hold until the
circle has filled up:**

Got it

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As long as you keep the correct eye position, the circle will grow. As soon as you lose it, the circle starts shrinking.

Got it

As long as you keep the correct eye position, the circle will grow. As soon as you lose it, the circle starts shrinking.

Got it

As long as you keep the correct eye position, the circle will grow. As soon as you lose it, the circle starts shrinking.

Got it

Everytime, you fill up the circle, you progress in your workout.

1/5

Got it

Everytime, you fill up the circle, you progress in your workout.

5/5

Got it

Everytime, you fill up the circle, you progress in your workout.

5/5

Continue

Got it

Leave

0/5

Leave

0/5

Leave

4/5

Congrats!
you earned 5 Stars

5/5

Continue

5/5

★ 999

Hey ____,
This is your plant.
Workout every day
and earn stars to
water it.

Water your plant

★ 999

Water your plant

★ 899

Water your plant

84
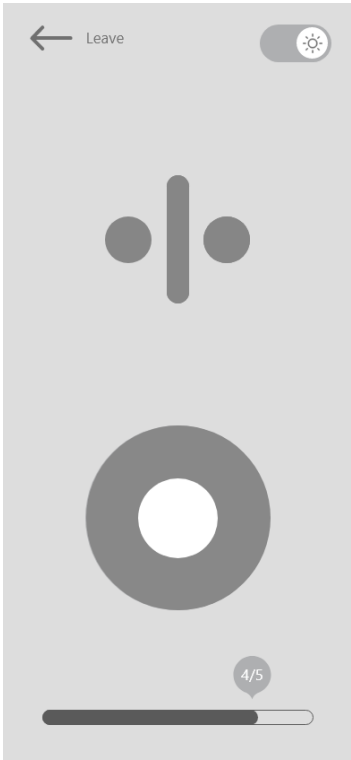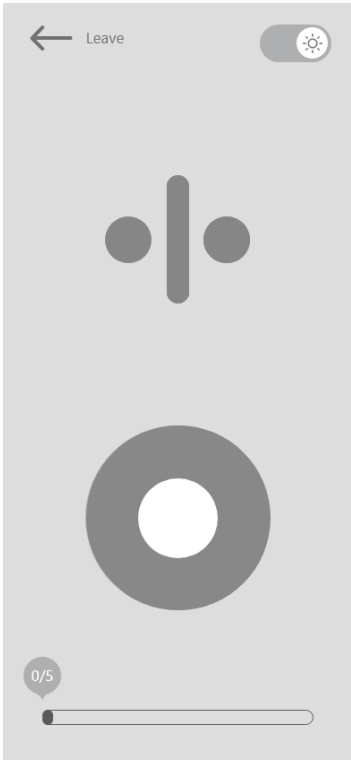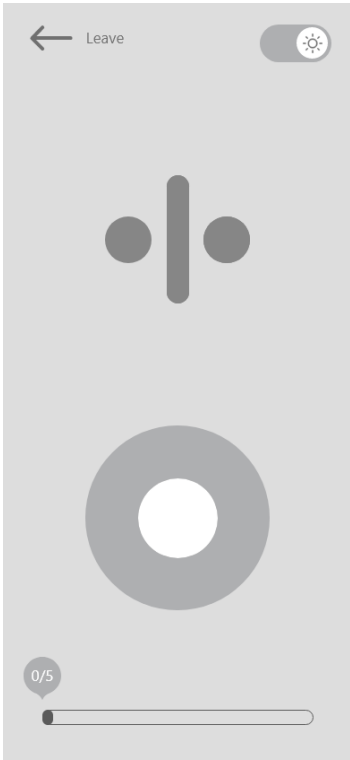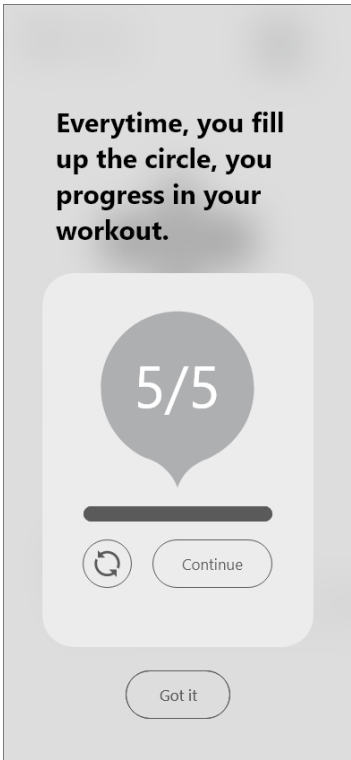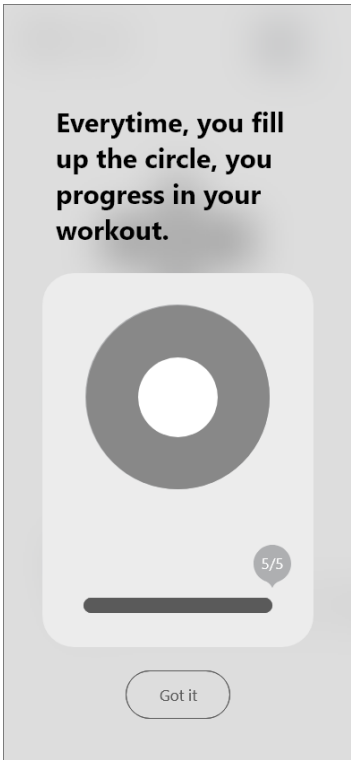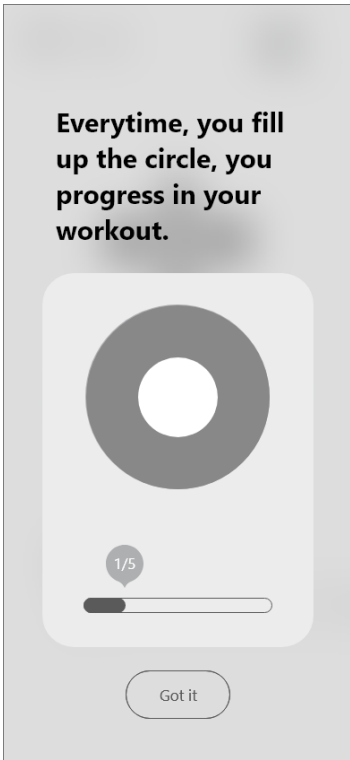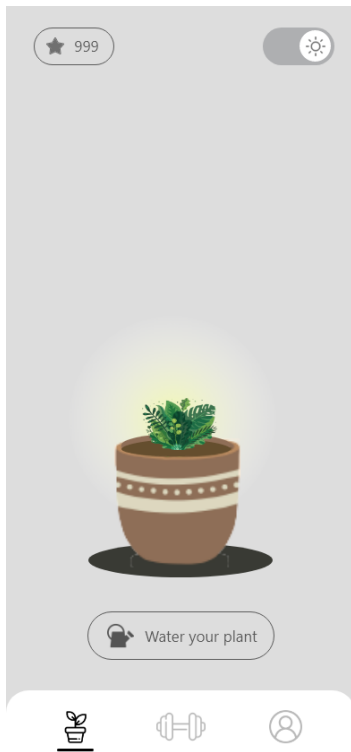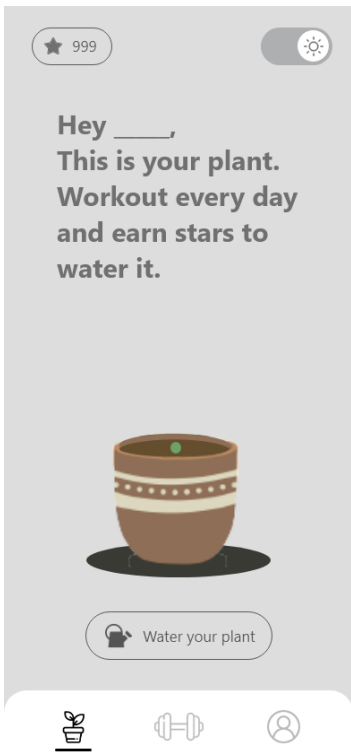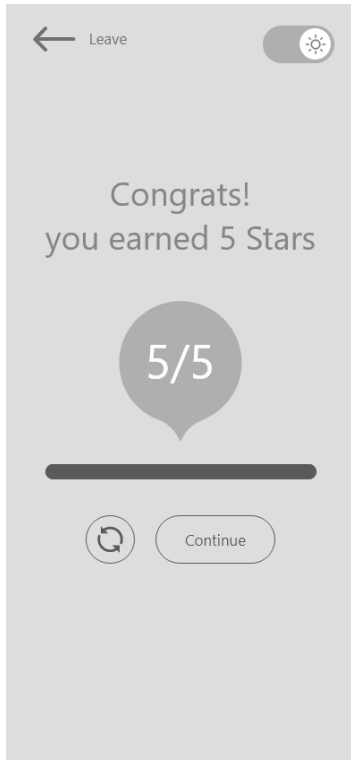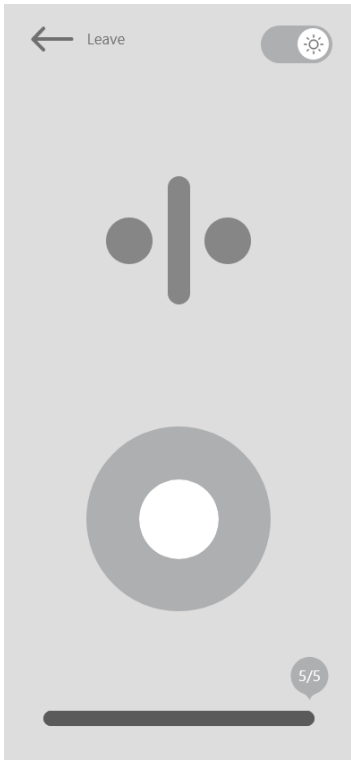
11.2 Iteration two

The mockups are arranged as the typical user journey.
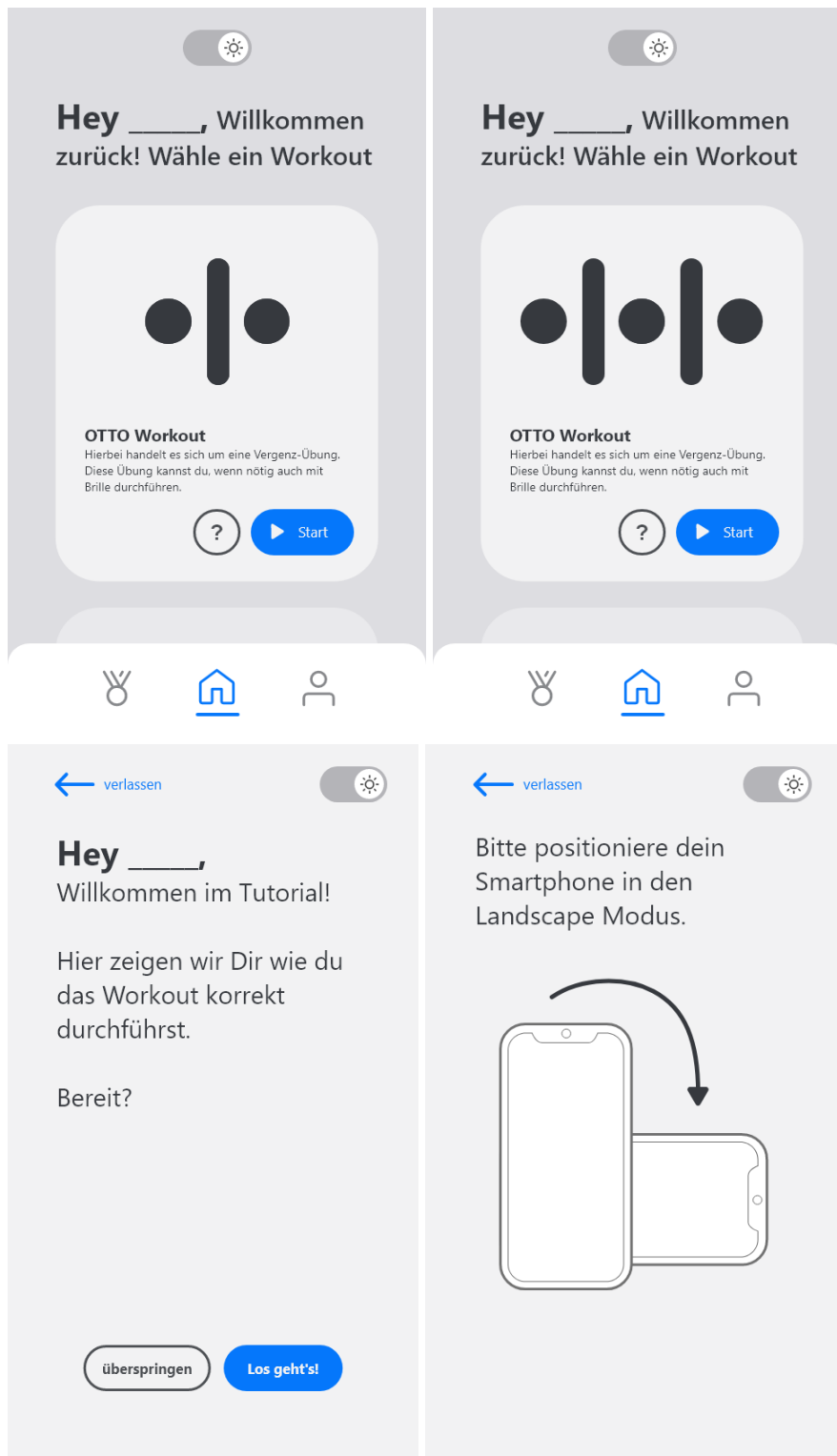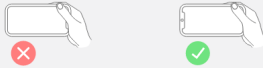
Du bist also Rechtshänder:inn,

Positioniere nun deine Rechte Hand so wie auf dem Beispiel:

zurück   **Alles klar!**

Wir nutzen deine Selfiekamera,

Achte darauf, dass diese auf der linken Seite deines Smartphone ist. Drehe dein Smarthone wenn nötig.

zurück   **Alles klar!**

Super,

Achte darauf, dass deine Augen parallel zum deinem Screen ausgerichtet sind.
Versuche dein Smartphone nicht weiter als 30 cm (etwa die höhe einer A4 Seite) von deinem Gesicht entfernt zu halten.

zurück   **Alles klar!**

Transformiere die Figur

Dein ziel ist es, durch bewusstes schielen und träumen die Figur durch eine Linie und einen Kreis zu erweitern. Etwa so:

zurück   **Alles klar!**

Schielen lernen

Versuche, auf deine Nasenspitze zu schielen, und lass deinen Blick langsam auf die Figur wandern um sie zu transformieren

zurück   **Alles klar!**

Verifiziere deine Leistung

Versuche nun diese Position zu halten. Halte dabei den runden Butten gedrückt, bis der äussere kreis sich füllt. Etwa so:

zurück   **Ausprobieren**

Deine Ziele pro Zustand (1/2)

Super, du hast das erste der drei Workout Ziele erreicht (3 Punkte sichtbar)! Die drei ziele sollen nach einander, in der aufgeführten Reihenfolge abgearbeitet werden.

- 3 Punkte
- 3D
- Scharf

zurück   **Alles klar!**

Deine Ziele pro Zustand (2/2)

Du bestätigst jedes ziel mit dem runden Button, wie du zuvor bereits einmal ausprobiert hast. Das erfolgreiche bestätigen eines Workout Ziels, wird in grün signalisiert.

- 3 Punkte
- 3D
- Scharf

zurück   **Alles klar!**

Panel 1 (top left)

☀

Deine Ziele pro Zustand (2/2)

Du bestätigst jedes ziel mit dem runden Button, wie du zuvor bereits einmal ausprobiert hast. Das erfolgreiche bestätigen eines Workout Ziels, wird in grün signalisiert.

● 3 Punkte
● 3D
● Scharf

zurück   Alles klar!

Panel 2 (top right)

☀

Deine Ziele pro Zustand (2/2)

Du bestätigst jedes ziel mit dem runden Button, wie du zuvor bereits einmal ausprobiert hast. Das erfolgreiche bestätigen eines Workout Ziels, wird in grün signalisiert.

● 3 Punkte
● 3D
● Scharf

zurück   Alles klar!

Panel 3

☀

Deine Ziele pro Zustand (2/2)

Du bestätigst jedes ziel mit dem runden Button, wie du zuvor bereits einmal ausprobiert hast. Das erfolgreiche bestätigen eines Workout Ziels, wird in grün signalisiert.

● 3 Punkte
● 3D
● Scharf

zurück   Alles klar!

Panel 4

☀

Ziel 1: 3 Punkte

Dieses Ziel kennst du bereits. Es wird erreicht wenn drei punkte zusehen sind.

zurück   Alles klar!

Panel 5

☀

Ziel 2: 3D

Versuche die Figur in drei Dimensionen zu sehen. Der mittlere Punkt soll kleiner aussehen aber dafür näher erscheinen:

zurück   Alles klar!

Panel 6

☀

Ziel 3: Scharf

Versuche die Figur scharf zu sehen.

zurück   Alles klar!

Panel 7

☀

Probier's gleich aus!

Versuche alle drei ziele mit schielen zu erreichen

zurück   Ausprobieren

Panel 8

☀

● 3 Punkte
● 3D
● Scharf

Träumen lernen

Versuche, durch den Screen hindurch in die Ferne zu schauen, als ob dein Smartphone durchsichtig wäre.

zurück   Alles klar!

Verifiziere deine Leistung

Versuche nun diese Position zu halten. Halte dabei den runden Butten gedrückt, bis der äussere kreis sich füllt. Etwa so:
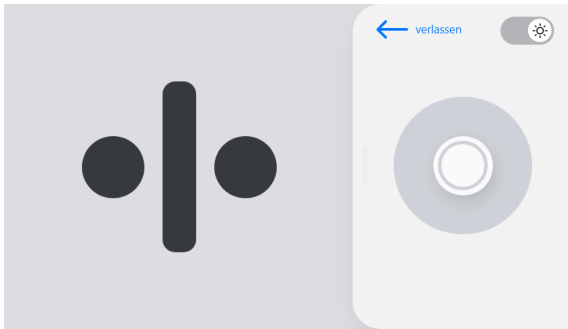
zurück   Ausprobieren

Deine Ziele

Super, auch hier gibt es wieder Ziele zu erreichen. Alle Ziele fürs träumen können ähnlich erreicht werden wie bei schielen.

● 3 Punkte
● 3D
● Scharf

zurück   Alles klar!

3D beim träumen

Nur dieses Ziel ist etwas anders als beim schielen. Dieses mal soll der mittlere punkt etwas grösser aussehen aber weiter weg erscheinen:

zurück   Alles klar!

Probier's gleich aus!

Versuche alle drei ziele mit träumen zu erreichen

zurück   Ausprobieren

● 3 Punkte
● 3D
● Scharf

Super,

Die folgende Anzeige, zeigt dir in welcher Phase du dich befindest.

Die Blume steht führ Nähe=> schielen.
Der Berg steht für Ferne => Träumen

zurück   Alles klar!

Versuche den übergang

Nun ist es an der Zeit den Übergang zu üben. Starte mit schielen und gehe ins träumen über.

zurück   Ausprobieren

Super,

Du bist nun bereit für Dein erstes Workout.

nochmals ansehen   Los geht's!

● 3 Punkte
● 3D
● Scharf
1/5
Runde

● 3 Punkte
● 3D
● Scharf
1/5
Runde

● 3 Punkte
● 3D
● Scharf
1/5
Runde

● 3 Punkte
● 3D
● Scharf
1/5
Runde

89

12 Time Tracking Report

The project used up all 360 hours of the budget and ended up requiring 16 hours more than expected.

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14 List of External Assets

- **Mountain SVG:** https://www.svgrepo.com/show/489052/mountain.svg
- **Flower SVG:** https://www.svgrepo.com/show/348357/flower.svg
- **Instrument Sounds:** https://www.noiiz.com/sounds/instruments/18
- **Plant-Based Design Inspiration:**
  https://dribbble.com/shots/4340924-Plant-Based?utm_source=pinterest&utm_campaign=pinterest_shot&utm_content=Plant-Based&utm_medium=Social_Share&utm_source=Clipboard_Shot&utm_campaign=thisoldmachine&utm_content=Plant-Based&utm_medium=Social_Share&utm_source=Clipboard_Shot&utm_campaign=thisoldmachine&utm_content=Plant-Based&utm_medium=Social_Share

15 Glossary

UI   User Interface – A part of a system where human-computer interaction occurs

UX   User Experience – A users' perception of an interaction with a system

XD   Experience design – Designing user experiences to improve user retention

DOM Document object model – defines the structure of an HTML documents

React A open-source JavaScript library build to develop dynamic user interfaces

Angular A open-source TypeScript-based frontend development framework

16 List of Figures

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17 List of Tables