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A system to help motivate obese adults to adhere to their lifestyle intervention program

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Creative Technology

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Abstract

Background:
15.1% (2.5 million people) of the Dutch population are obese. About 82.000 people have started a lifestyle intervention program in the years between 2019 and 2023. Most participants claim to have a healthier lifestyle after participating in the program. However, only half completes the program. Reasons provided by patients and healthcare professional say it is due to a lack of a tailored program which leads to a lack of motivation. Studies involving only male participants within eHealth and obesity literature are minimal. Literature shows that social support and insight makes eHealth technologies efficient in terms of weight loss.

Objective:
This thesis aims to create a technological system that uses social support and insight to help obese male adults adhere to their lifestyle intervention program to, in the end, live a healthier lifestyle.

Methods:
This thesis uses co-design involving three target users and the Creative Technology design process to create the system.

Results:
This thesis resulted in designing a high-fidelity prototype app. This app is an all encompassing hub-app that connects all user's devices to show insight and allows for receiving and transmitting audible messages to show social support. Evaluations has shown this app has potential amongst its target users.

Conclusion:
In conclusion, the design of an app that integrates social support and insight has the potential to motivate users to adhere to and complete their lifestyle intervention program and, in the end, live a healthier lifestyle.

Keywords: eHealth, co-design, obese male adults, apps, prototype, design, motivation, social support, insight

Contents

Chapter 1: Introduction

Obesity, a lifestyle illness, is the number five main cause of death in adults [1]. Around 650 million people of the global population who suffer from this illness are prone to its severe effects such as cardiovascular disease, cancers, and diabetes to name a few [2]. Specifically, 15.1% (2.5 million people) of the Dutch population are obese [3]. According to the Dutch National Institute for Public Health and Environment, about 82.000 people have started a lifestyle intervention program (LIP) in the years between 2019 and 2023 [4]. A lifestyle intervention program, or also known as a GLI (Gecombineerde Leefstijlinterventie), is a program that helps those with overweight or obesity to, among other things, exercise more and eat healthier. Furthermore, the program's aim is to encourage a healthier lifestyle that can be maintained in the long term [4]. The average person in the program loses 3.5% of their body mass index after around nine months.

Most participants claim to have improved their quality of life after participating in the program. Unfortunately, only half completes the two-year program [5]. The Dutch National Institute for Public Health and the Environment (RIVM) , the main reasons for yielding the program are lack of time and/or lack of motivation [6]. Cifuentes, et al. [7] state that a non-tailored lifestyle intervention resulted into patients feeling that the program did not suit them, which results in lack of motivation to complete the program.

This could be seen as unfortunate, as the GLI has been seen as one of the most effective ways to start leading a healthier lifestyle [6].

Verheijden, et al. [8] states that social support has shown strong correlation to patient's well-being and motivation. Furthermore, as shown in the report by Bos, et al. [6], social support contributes to an average of 3 kg of weight loss in the first 12 months.

It could be proposed that if patients had more access to social support, their motivation could increase. Perhaps, this could allow them to improve their level of motivation. Thus adhering to the program and subsequently completing it to lead a healthier lifestyle.

Moreover, studies on motivation and social support often focus on women and paediatric patients [9] [10]. McKenzie, et al. state that men tend to have more difficulties in opening up in a social setting within the healthcare context [11]. Yet these are often the ones that are least studied on when it comes to psychological barriers of lifestyle intervention programs [12]. In this particular section of literature, obese adult men are often either not included or are not the main focus of the study [13]. All the meanwhile, they represent 29% of the 82.000 people that take part in the program in 2022 [14]. Focusing on obese male adults could help fill this gap in literature.

Currently, there seems to also be a gap in consumer technologies that provide social support within the context of lifestyle intervention programs. As mentioned by Chayko [15], people tend to strengthen their social connectedness through digital communication technologies, and that it often prompts for face-to-face interaction. This interaction could lead to enhanced social support. Technology can thus be used as a means to enable and/or maximise social support.

This research aims to ultimately design a technological system to help male obese adults adhere to their lifestyle intervention program by means of social support. This research could tackle the problem of obese male adults not adhering to their lifestyle intervention program and thus being prone to obesity's side effects and leading an unhealthy lifestyle.

Co-design will be used to design this system. Co-design aims to involve future target users in the design process, because they will be the ones using the system in the end. This allows the design to be tailored to the users. Jøranli, et al. states the importance of having tailored approaches to better support patients with obesity [16]. This is due to their diverse needs and diverse personalities that need to be addressed. Moreover, by using co-design as a tool, it allows for growth in intrinsic motivation where the co-designer gets attached to the system that they have helped to build.

1.1 Research Question

In order to design such a system, the following research question is formulated:

> How to co-design a technological system that motivates obese adults to adhere to their lifestyle intervention program?

To answer this research question, four sub-questions are formulated:

1. Which components make health technologies effective for weight loss in obese adults, according to literature?
2. What other co-design sessions have been done with obese adults?
3. What are the state-of-the-art technologies which help obese adults lose weight?
4. What are barriers and facilitators for obese adults to start with and adhere to a lifestyle program, according to patients and lifestyle intervention coaches?

Chapter 2: Background

This chapter provides the background needed to design the system. First, a literature review is conducted, based off 12 peer-reviewed articles. This is followed by a state-of-the-art research. Finally, an expert interview is conducted with an ex-lifestyle intervention coach. This chapter addresses all four sub-questions.

2.1 Literature Review

The introduction shows the need to build a system that can be co-designed which motivates obese adults to adhere to their lifestyle program at home. To do so, existing technologies that have proven to help obese adults in their lifestyle intervention must be researched to further create a base of knowledge in order to design the system. Therefore, the goal of this review is to gain insight in the different technologies that have proven to help within lifestyle intervention for obese adults. Thus leading to the main question in this review:

> Which components make health technologies effective for weight loss in obese adults, according to literature?

The first part of this review will discuss the definition of health technologies, also known as eHealth. Second, the characteristics that make the technology effective and ineffective will be described. Third, the technologies which encompasses these effective characteristics will be presented.Lastly, as a conclusion, recommendations will be made for the system's design.

2.1.1 Method

This review focuses on gaining insight in the different technologies that have proven to help within lifestyle intervention for obese adults. Structure needs to be gained to find relevant articles on the topic. First, databases were used with specific search queries. Refer to Table 1 for the various databases and Table 2 for the various search queries. The search query was created by collecting each relevant keyword and combining it with a Boolean AND and Boolean NOT. Second, articles found in the database are filtered through. Only papers from 2010 until 2024 are used. Third, the papers will be input into a Literature Matrix, see appendix. This matrix contains the sub-questions to this review, the authors to the articles, search queries and a summary of the articles. Fourth, the summary of articles that belong to one sub-question will be joined to form the answer to the sub-question.

Google Scholar	https://scholar.google.com/
Scopus	https://www.scopus.com/search/form.uri?display=basic#basic
PubMed	https://www.ncbi.nlm.nih.gov/
ScienceDirect	https://www.sciencedirect.com/

Table 1: Overview of databases and their adresses

Obesity	AND	eHealth	NOT	Eating Disorder
Obesity	AND	Technology		
Obesity	AND	Technology	NOT	Children
Obesity	AND	Management		
Weight-loss	AND	Design		
Lifestyle	AND	Intervention	AND	Technology

Table 2: Overview of search queries

2.1.2 Definition of eHealth

eHealth, or electronic-health, is a term that does not have a globally accepted definition. The purpose of utilising eHealth is to improve the quality and efficiency of healthcare using technologies [17]. Within the context of this review specifically, eHealth is used to help motivate obese adults to adhere to their lifestyle intervention program (LIP). LIP is designed by a group of healthcare professionals often combined of dieticians, psychologists, physiotherapists, or bariatric doctors [18]. Often, these LIP's are designed in a way that it could only be effective if the patient adheres to it for a long period of time [19]. This could be a challenge to those

who have difficulty adhering to it, due to lack of motivation or fear and various other reasons. It is in this gap where technology could help to motivate these adults. To, in the end, lose weight or to live a healthier lifestyle in general. To do so, one must understand the different types of eHealth. However, eHealth deems to be a broad definition, in this context eHealth is given the definition of "technologies that help patients reach their pre-established health goals". Characteristics of past eHealth which are considered effective needs to be researched in order to establish a new design to help these patients.

2.1.3 Effective usage of eHealth

eHealth can likely be effective when it has characteristics rooted in two components. First, eHealth has to be rooted in providing insight to its patients during their usage period. Batsis, et al. [20] observe that the usage of eHealth help patients lose weight when it provides them with insights to their health, thus motivating them to further change their habits. This in turn assures accountability within themselves to continue. Their research is strengthened by 40 interviews done by the authors. Furthermore, Vuorinen, et al. [21] showed that when 10,000 participants, who are smart scale users who weigh themselves frequently, lost a favourable amount of weight. The device not only provides self-monitoring but also provides counsellor feedback and communication, social support, and use of an individually tailored structured program.

Second, in combination with insight, social support has been shown to be a vital component in efficiency. Alencar, et al. [22]'s research on eHealth based coaching indicates the apparent relation between adherence to LIP's and rate of weight loss with frequent health coaching using eHealth as a medium. When patients receive both human and number-wise (weight count) feedback, it increases their likelihood in achieving their weight-loss goal. Alencar, et al. continue to maintain that even remote social support from other patients and professionals can contribute largely to the weight loss goal. Combining insights and social support within eHealth has shown to increase the effectiveness towards weight-loss in the past.

Of course, the scope of this review does not cover all articles regarding this topic. There is a possibility more crucial elements are not mentioned. However, based on the amount of papers included in this review, insight and social-support are often recurring elements.

2.1.4 Ineffective usage of eHealth

Although, eHealth has had many improvements and developments through the years, it can be still ineffective when it used as a standalone device. A standalone device, is a device that is used without any professional support happening simultaneously. Sithole, et al. [23] affirm that eHealth is to be used as a tool and cannot be used as a standalone device. They continue to explain that caution should be taken when eHealth is implemented into healthcare, since patients should not be left alone in their health program. They clarify that eHealth should be combined with traditional face-to-face sessions with healthcare professionals as well as non-technologically based interventions such as regular check-ups at the general practitioners. Although, previously mentioned Alencar, et al. [22] argue that face-to-face sessions could also be effectively done in a remote setting. Resulting in the emphasis of the inclusion of healthcare professionals and their feedback regardless of the location and setting.

Concerns regarding the inequality are raised with regard to accessibility of eHealth devices when looking at socio-economic backgrounds (SEB). Sithole, et al. claim that patients from a low SEB might not be able to understand the device well in order to use it to its full potential. They recommend support from local healthcare professionals to guide patients while using the device, instead of replacing the professionals with such devices. To further touch upon the lack of accessibility, Batsis, et al. emphasize the importance of avoiding a complicated infrastructure within a eHealth device. They describe the ineffectiveness of a device that results when patients are required to undergo a steep learning curve. This could further demotivate patients, and in some cases, prevent them in reaching their weight-loss goal.

Not only does the device need to be combined with the involvement of healthcare professionals, designers of the device also needs to consider unique barriers within the patients themselves. Seungmin, et al. [24]'s literature review of over 2276 articles identified a number of previous research finding patients who have psychological and physical barriers when it comes to eHealth interventions in regards to obesity. The unique combination of both barriers can be manifested in patients feeling too fat to exercise or too embarrassed when seeking physical activity. Within the literature review Atlantis, et al. [25] is mentioned and recommends public health strategies to overcome weight perception. While, also in the review, Mohseni, et al. [26] highly recommends cognitive behavioral therapy in combination with an LIP to help patients with their weight perception. The review continues to address that there are limited research conducted that investigates which method of barrier

acknowledgement proves to be the most effective. Nevertheless, by designing a device that takes patients' physical and psychological barriers into account the eHealth device can increase its likelihood in helping patients adhere to their LIP.

Thus, eHealth can be ineffective when it (1) is used as a standalone device (2) is required to undergo a steep learning curve (3) does not consider a patient's psychological and physical barriers.

When and if all these characteristics are combined, a design could be made that could show potential to be effective. Which leads to determining which particular eHealth devices or protocols have been designed that has shown to be effective.

2.1.5 Examples of Effective Technologies

The technologies that have proven to be effective in helping patients reach their goal is rooted in their characteristics to being insightful and have an element of social support. The following existing technologies is divided based on these two characteristics. Insight, in which Batsis, et al. [20] provide the example of the FitBit, a device that provides real-time motivating and personalised feedback with sensor technology. The interviewees within this qualitative research emphasise their satisfaction with the device and how it has helped them with their LIP in the past. Furthermore, as mentioned previously, Vuorinen, et al. [21] used smart scales that were used in a home setting. The scale provided longitudinal weight data, that could be shared with the patient's healthcare team. This provides flexibility in modifying their LIP along the way. Sithole, et al. [23] also indicate other wearables such as pedometers and mobile apps whether web-based or app-based are also tools used to convey health-related insight to the patients. These devices have shown to work in the past to convey clear numbers and insights.

As mentioned previously as a second component to create such effective technologies; social support. Both Alencar, et al. [22] and Cavallo, et al. [27] agree that support from other patients, either through video conferencing or a private social media group (respectively), can effectively help patients in reaching their common goal. Myers-Ingram, et al. [28]'s systematic review show that when patients visit websites that promote physical activity, patients (n=24) lose 1 kg of weight during the intervention period. The website provided personalised physical activity coaching and advise. It also provided videos that were adapted to the patient's culture (taking into account of unique barriers). Furthermore, the website also provided patients with pedometers to link the website to their real-time data. The website also had a function that allowed patients to speak to other patients in similar situations. The website's usage and effectiveness had been carefully created and investigated by Benitez, et al [29]. The review continues to highlight the usage of an interactive voice response where patients receive 12 interpersonal counseling calls with a healthcare professional. This method showed a drop of an average of 1 kg of weight sampled from 185 participants within the intervention time frame. This shows that social support, does not only have to come from family and friends, but healthcare personnel alike. Also, Griffin, et al [30] implemented a 12-week text messaging initiative in which patients received a fixed calorie meal plan, daily text messages that included goals settings and reminders to encourage physical activity. The texts also included weekly eNewsletters that provided tips and healthy recipes. This initiative recruited 109 participants with an average of 1.81 kg of weight-loss in 3 months. Support from heatlhcare professionals, specifically in the aid of planning and encouragement, can be reffered to as functional support according to Verheijden, et al [8]. Behr, et al [31] adds by stating that nutrition focused weight management programs combined with cognitive behavioural therapy can improve overall health promoting behaviours, because it not only provides the patient with knowledge regarding health but also gives an understanding to their psychological self in working with a therapist. This means therapists can also be included in the functional support circle. To conclude, social support from both professionals and patients alike can increase the effectiveness of eHealth used in the obesity treatment context.

2.1.6 Conclusion

The goal of this literature review was to gain insight in the different technologies that are successful in helping patients with their lifestyle intervention program.

This has lead to two characteristics that make a certain eHealth device effective: insight and social support. Next to these characteristics, there are also three elements that need to be taken into consideration when designing such a device. First, the device should not be used as a standalone. Second, patients with a low socio-economic background should receive guidance from healthcare professionals when using the device. Third, designers need to consider unique barriers such as physical and psychological barriers and address them accordingly.

2.2 State of The Art

The following section will discuss the current practices and technologies that are relevant to co-designing a system to help obese adults adhere to their lifestyle intervention program. To do so, this section discusses previous research on co-design, existing consumer items, discussions with lifestyle intervention coaches and how a standard lifestyle intervention program is designed.

2.2.1 Background on Co-Design

The concept of co-design usage within the context of developing eHealth interventions for obese adults is known within the eHealth design domain. Co-design has been used in recent years by researchers, who believe that involving relevant stakeholders could contribute to improving the design of eHealth applications [32]. They emphasise by stating that co-design methods allow researchers/designers to understand a user's tacit knowledge and latent needs as well as experiences. This is further supported by the Co-design Framework by Sanders & Stappers [33]. Sanders and Stappers' framework explains the phases during design: pre-design, generative, evaluative, post-design. These phases all use different methodologies, because, according to Noorbergen, et al. (2021a) [32], there is no consensus on co-design methods so far in literature. As an overview, however, Noorbergen, et al. (2021a)[32] provided tables that showcased the different phases and their respective methods. Table 3 shows an adapted version of it. test [34]

Pre-Design	**Generative**	**Evaluative**	**Post-Design**
Interviews	Paper prototyping	High-fidelity Prototyping	Interviews
Personas	Wireframes	Interviews	Focus Groups
Focus Groups	Sketching	Questionnaires	Questionnaires
Cultural Probes	Storyboards	Pilot testing	
Questionnaires	Journey Maps	Usability testing	
Storytelling	Scenarios	Randomized control trials	
Observation			

Table 3: Adapted table of methods for every phase in co-design from Noorbergen, et al. [32](2021a)

Noorbergen, et al.(2021a) explains the definitions for these phases:

1. Pre-Design: Understand the user's experiences in the context of their lives: past, present, future
2. Generative: Produce ideas, insights, and concepts that may then be designed and developed
3. Evaluative: Assess, formatively or summatively, the effect or the effectiveness of products or systems
4. Post-Design : Investigate how users actually experience and use the products and systems

Similarly, the Design Thinking method can also be used in eHealth design. Altman, et al. [35]'s review shows how the Design Thinking method can be applied in healthcare, but this could also be applied towards eHealth specifically. They find that while there is no definite definition of the Design Thinking method, it is considered commonly as an iterative process that goes through multiple iterations of empathizing, defining, ideation, prototyping and evaluation. The key principles behind every phase are:

1. Empathize: Research and develop an understanding towards the users. It prevents designers from having assumptions about their user's needs.
2. Define: Analysis of the observations made on the user and create problem statements.
3. Ideate: Brainstorm different solutions to the problem statement
4. Prototype: Make the ideas tangible to allow for further exploration
5. Evaluate: Test prototypes with real future users

These particular principles are originally introduced by Hasso-Platner [36].
One could say that there is some overlap between the methods of co-design and the Design Thinking method, being the pre-design phase and empathize phase, respectively. Both emphasize the importance of understanding the user from their own experiences. In the end, the design should be used by them, so including them in the process deems relevant. Asbjørnsen, et al. [37] conducts the empathizing phase within the context of eHealth intervention design for long-term weight loss maintenance. They, among other things, identify persuasive design principles that users and field experts have claimed to be helpful and effective when interacting with eHealth technologies. They identify the values and needs of obese adults aiming to maintain weight after weight-loss. The values are:

- Self-management
- Personalized care
- Feel supported
- Positive self-image
- Motivation
- Humor
- Health

2.2.2 Co-Design with Obese Adults Within eHealth

Asbjørnsen, et al. affirm that knowledge about end user values and needs are essential to design effective eHealth technologies. [insert info on the research] They continue to recommend, among other things, the following things to consider when planning to design such technologies:

1. New designs should investigate how to meet the key values identified and capture expectations and uncovered, or potentially latent, user needs.
2. New designs should examine the role of personalized and emerging eHealth technologies, supporting the integration of identity-oriented approaches with habit formation and self-regulation strategies to help users with their goal.
3. New designs should include elements which facilitates autonomous motivation and creates a positive experience.
4. New designs should contribute to making healthy behaviors enjoyable, and improve self-efficacy and positive self-image.

Along with these values, Asbjørnsen, et al. also provide functions or needs corresponding with their design elements that are deemed relevant when designing eHealth systems within the context of maintaining weight after weight-loss [37, p. 12-16]:

Relevant Functions in eHealth Design
1. Goal Setting • Set own goals (personalized) • Subgoals (eg, eat more fruit)
2. Planning • Build strategies and plans for different situations (eg, weekdays, weekends, holidays, and birthdays) • Crisis plan and support plan (eg, on “bad days” or periods) • Back-on-track strategy (eg, when drawback occurs, weight increases)
3. Motivating Messages • Personalized feedback when reaching goals or achievements (eg, self-selected rewards, motivational words, and reminders of personal drivers for losing weight) • On a “difficult” day or period • “Welcome back! What’s the status?”) • Show positive health effects • No negative feedback
4. Personalization • Personal goals, monitoring, plans, and reminders • Personal messages (praise) and self-selected rewards

5. Self-Monitoring
- Long-term monitoring of behavior, goals, and plans (eg, through visualizations)
- My diary (easy and quick self-selected registrations

6. Visualisation
- Understand own behavior: holistic insights health and (eg, weight, activity, emotion, sleep, and stress)

7. Tailoring
- Smart, tailored feedback related to individual lifestyle, goals, and behavior (eg, automatic activity trackers)
- Automatic adaptation: favorite modules and interests easily available

8. Feedback
- Health promoting (eg, positive spin-offs of maintaining weight and healthy behavior)
- Positive "boost" messages related to behaviors or habits
- Positive feedback on "bad days" (eg, personal values, positive goal focus, and earlier achievements)
- Tailored support (eg, related to crisis plan, tips and feedback, and timely)
- Smart, tailored feedback based automatic monitoring and registrations

9. Knowledge
- Competence and skills to regulate behavior, emotions, and thoughts

10. Decision Support
- Reflect on behaviors and decisions
- Support in making healthy choices

11. Suggestions
- The best evidence-based strategies and tips to maintain lost weight
- Focus on health and well-being (eg, how to reach goals and keep up with healthy habits)
- Practical tips (eg, self-regulation, when technology is not enough)

12. Rewards
- Rewards (eg, points, trophies) related to goals and targets (eg, weight and activity goals)
- Self-selected rewards for motivation

13. Reminders
- Show their goals, values, and plan
- Healthy habits to maintain weight and how the body works
- When it goes well and when "off track" (eg, reminders of past successes, trouser that is too big, before and afterpictures)

14. Wearables
- Automatic registrations and automatic behavior trackers (eg, weight, activity trackers, wearables, sensors, and smart devices)
- Ease of use, easy monitoring, and long-term storage of data
- Personal contact or helper (eg, family or friend for motivation and support)

15. Practice Habits
- Practice (new) healthy habits
- Keep up with daily routines and healthy habits in the long term)

16. Rehearse on situations or challenges
- Train and prepare for risk situations or tempting situations (eg, "what-if plans," impulse control, and self-regulation)

17. Social Support
- Contact with coach or health care personnel or general practitioner (eg, when technology is not enough)

• Support or personal helper (eg, family, friend, or other users or peers through social forum or chat or inspirational user stories) to share experience, learn about health-related behaviors from others, and cooperate

18. Gamification Elements
• Points and trophies when reaching goals and targets to keep focus and motivation
• Animated coach for motivation and joy

Table 4: Table of key values and their functions adapted from Asbjørnsen, et al [37], p12-16

These functions listed in Table 4 will create the foundation for the system that will be designed. Of course, not all functions are equally feasible within the system. Prioritising functions will be further discussed in Chapter 4: Ideation.

2.2.3 Co-Design with Obese Adults Outside eHealth

Asbjørnsen, et al's results (key values and their corresponding functions) have potential to be used as material in a co-design workshop. However, such sessions should be structured in a way that the result be fruitful. By allowing the participants to participate to the fullest, the workshop's results may be more effective. Power, et al. [38]'s method in their research co-designing a home-based exercise program for adults with overweight and obesity can be looked upon for reference. This method also acts as the answer to the third sub-question: *What other co-design sessions have been done with obese adults?*

They had two focus groups (in-person n = 6 and online n = 7). They started the focus group with a short introduction round of the participant's name, where they are from and what job they did. They continued with a short presentation explaining what the purpose of the session was as well as a demonstration of the idea of what they wanted to create. They explained the guidelines to the session, i.e. that there were no right or wrong answers and that the participants were urged to not hesitate for fear or offense. They continued to explain that they were interested in their views—positive, negative, or indifferent.

During the in-person event, the tables and chairs were arranged in a square so that the participants could see each other and the presentation screen. The session was recorded using a voice recorder. This version of the event took around 1.5 hours.

During the online event, participants were allowed to turn their cameras on or off. They could remain unmuted, if their background was quiet. The session was recorded using the Zoom platform and a voice recorder. This version of the event took around 1 hour. The researchers mentioned that the a 6 person in-person focus group was a good number of participants. 7 participants were also a good number of participants for the virtual event.

This co-design session focused on gaining feedback and refining an existing home-based exercise program curated for both overweight and obese adults. Although the specific content of this particular session is not relevant to the topic of this thesis, there are elements of the structure of the session that should be brought to this thesis' co-design session.

Other than discussing the structure of a co-design session, there is very limited existing research that discusses other co-designs of eHealth systems in the context of obese adults as end-users. Nevertheless, Noorbergen, et al (2021b) [34] created, amongs other things, a guideline to address common challenges when designing a co-design session in the context of supporting positive health outcomes. The guidelines and their description can be found in Appendix A.

Previous research on co-design with obese adults has shown, although limited, that co-design can be used as a tool to design a complex system by including end-users. The Design Thinking method can be used later on in developing the co-design session. Pre-established key values and functions should be used when developing the system. Structure and founded guidelines on co-designing eHealth systems should also be considered.

2.2.4 State of the Art Technologies

During the literature review, many technologies and existing systems were examined. However, there are also technologies that have not been described thoroughly within the review. These devices also have noteworthy characteristics that could help shape the new system this thesis will make. Technologies that are mentioned in the literature review, will be mentioned here once more, only with more detail to its characteristics. This section will help answer the third sub-question : "What are the state of the art technologies which help obese adults lose weight?"

QardioBase Smart Scale:

Figure 1: QardioBase X Smart Scale with App [39]

This smart scale, see Figure 1, has built-in Wifi and bluetooth. Which data syncing to the Qardio app. The phone does not need to be in close distance for it to work. The scale, next to weight also measures 14 metrics[1] which uses bioelectric impedance analysis. A method done by sending a low-level electric current through user's feet and measuring the resistance it receives. The current moves quickly through tissues that contain a large amount of fluids and electrolytes like muscle and blood, and faces resistance moving through fat. This method does pose a health risk to those that cannot tolerate this method (i.e pacemaker patients). Furthermore, the app provides extensive information on the user, however fails to display in an understandable manner. The app is considered to be bulky. [40]. This scale shows how the element of *insight* can be utilised.

[1]body fat percentage, heart rate, muscle mass, protein, subcutaneous fat, visceral fat, basal metabolic rate, body mass index, bone mass, fat-free body weight, metabolic age, protein percent, skeletal muscle, and water composition

Oura Ring

(a) Oura Ring (b) Oura App

Figure 2: Oura Ring [41]

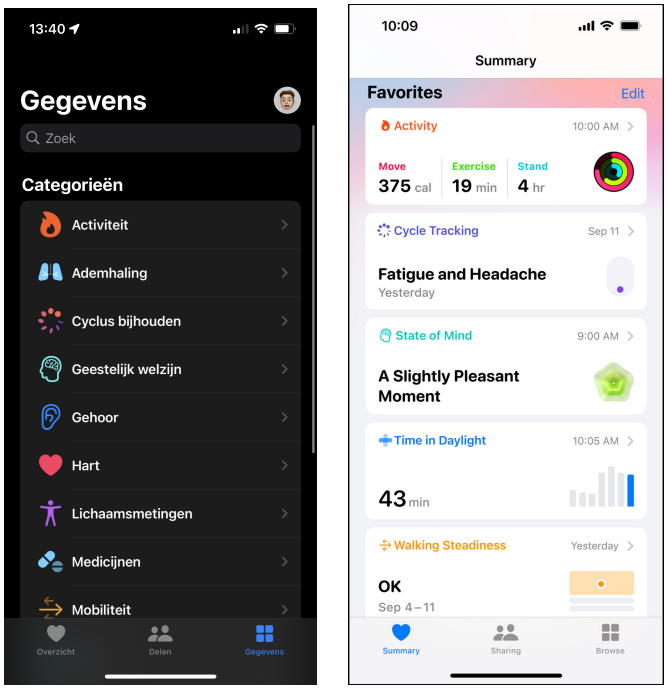
The Oura Ring, see Figure 2, is a new type of wearable, unlike watches or other wristband trackers. It could track sleep, heart-rate variability, blood oxygen rate and body temperature. The result of the data is provided through the app and provides conclusions. Such as: quality of sleep, activity detection and sickness detection.[41] The price range for the Oura Ring goes from $300 with a subscription to the app [42]. Although, similar to the smart scale, by providing insight, it does not fit within the target users of this thesis. The price amount is too large for the target users.

Fitbit

Figure 3: Fitbit [43]

The Fitbit is known wearable for its ability to track steps, heart rate and sleep. Since its release, it has shown the element of "tailoring-to-user". It has expensive options that include stress management tools and an electrocardiogram. It helps most users increase their physical activity, has a user-friendly interface and is comfortable to wear for most users. There are many different models and versions of the Fitbit that can be tailored to the user's needs. However, similar to the Oura Ring, the price (above $100) could potentially be demotivating towards the target users. However, less accurate watches are available in the market for a lower price. [44]

Health app

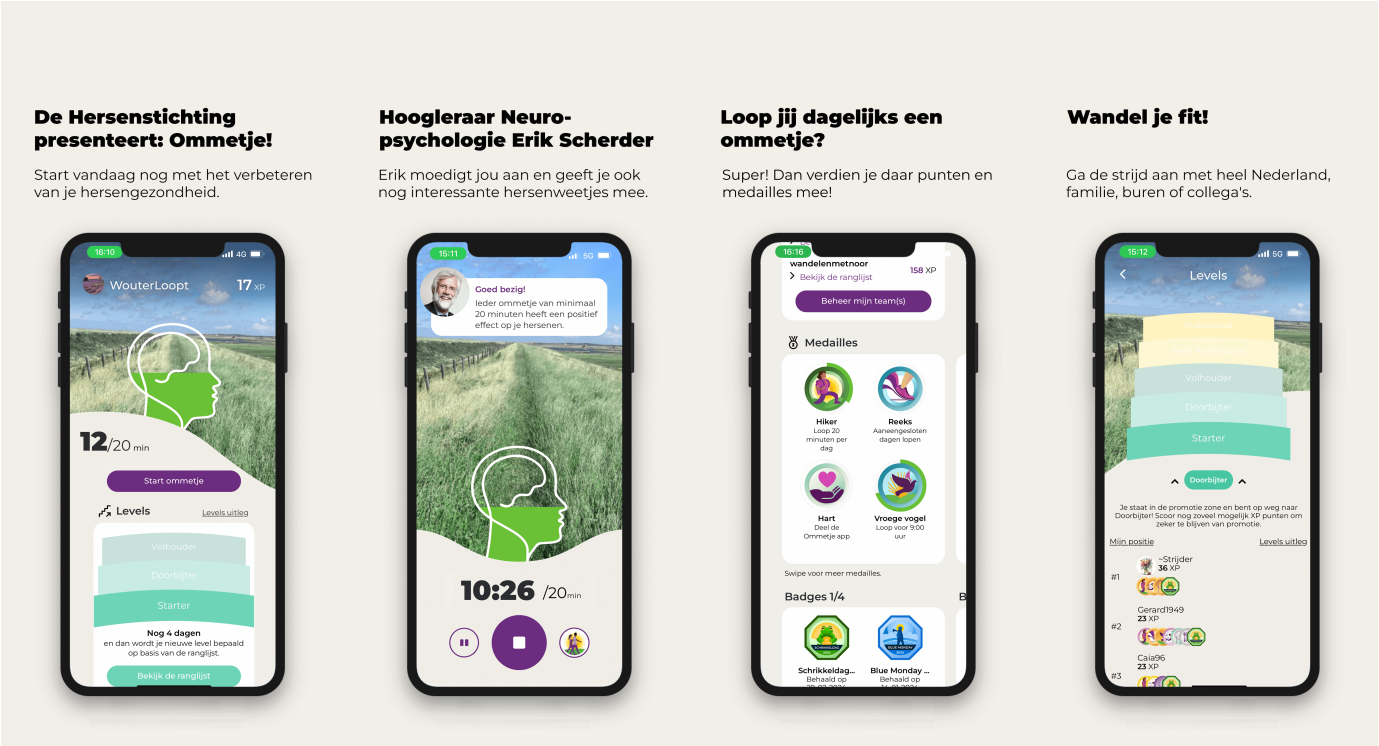


(a) Health App: Browse (b) Health App: Summary

Figure 4: Health App [45]

The Health App by Apple gathers user's data from their devices within the Apple environment (Apple Watch, iPhone etc) and displays them on the app. An example showing how insight can be taken further than only sleep, heart - rate and movement. It also provides information such as breathing, mental-health, nutrition etc, see Figure 4. The app provides insight without a high additional price, unlike the Oura Ring, although the user must be immersed into the Apple environment before able to fully utilise the app. It provides tips and has a function that allows users to connect their data to healthcare providers.

Ommetje app



(a) Home Page (b) Brain Facts & Motivating Texts (c) Badges (d) Social Support

Figure 5: Ommetje App made by the Hersenstiching [46]

The Ommetje app is an example of gamification to help against sedentary or an inactive lifestyle. Made by the Hersenstichting, a non-profit organisation to help research the human brain. They believe that walking everyday is important for one's mental and physical health [47]. The app motivates its users to walk distances. It uses a simple interface where users can create reach pre-determined goals, win badges and compete with other users for the most distance walked, see Figure 5. It has been known to help users with a competitive nature.

Preliminary Conclusion

All in all, the technologies that have been displayed in this section, shows how the element of insight can be used and take different forms. Insight has the potential to be effective to help users when displayed in a user-friendly way and it can be accessed within a reasonable price. Social support, although equally necessary, does not seem to appear that often in mainstream consumer technologies. The design for a system should then pay special attention to incorporating social support as well.

2.2.5 Types of Lifestyle Intervention Programs and Expert Interview

In the Netherlands, there are currently seven types of lifestyle intervention programs, further noted in this section as GLI (gecombineerd leefstijlinterventie). These programs are covered as per the base insurance, meaning that participants do not have to pay to participate. The aim of this section is to establish the different types of GLI's that are available. By understanding what these GLI's offer, it could offer some knowledge as to how to design the system. Since the system will be used during the duration of the program. The following are the different GLI's [48]:

1. BeweegKuur
2. SLIMMER
3. CooL
4. Samen Sportief in Beweging
5. X-Fittt GLI
6. Keer Diabetes2 Om
7. Keer Diabetes2 Om-GLI-Online

The last two types are targeted for overweight patients with diabetes type 2 on glucose-regulating medication [49]. These GLI's are outside of the scope of this thesis, due to its implication with diabetes.

The first four types have similarities and differences. Each will be shortly described.

BeweegKuur: This program focuses on adults with a medium weigh-related health risk and those with an inactive lifestyle. BeweegKuur accepts those with a BMI > 30 kg/m^2 (norm for obesity). As well as those with a BMI < 25 kg/m^2 whose health could be improved and treated with a lifestyle change.

BeweegKuur aims to have their participants 1) exercise more and be active 2)eat healthier, 3)change their current behaviour and 4) lose 5% of their original weight. The program provides a lifestyle coach who guides the participant in their personal and general goals. The program is personalised to the participant. Moreover, the lifestyle coach works closely together with movement-related professionals (trainer, physiotherapist) and with nutrition-related professionals i.e. a dietitian. [50]

SLIMMER: This program focuses on adults with an increased weight-related health risk. Similar to BeweegKuur, SLIMMER accepts those with a BMI > 30 kg/m^2 (norm for obesity). As well as those with a BMI < 25 kg/m^2 whose health could be improved and treated with a lifestyle change. SLIMMER focuses on sustainable behavioral change and aims to increase their participant's quality of life. SLIMMER provides an intensive nutrition and exercise program. This program is six months long. The duration of the total program is tailored to the participant. The participant is guided by a team consisting of a physiotherapist, dietitian and a lifestyle coach. [51]

CooL: This program focuses on adults with an increased weight-related health risk and with intrinsic motiation to complete it in two years. Similar to the other two programs, CooL accepts those with a BMI > 30 kg/m^2 (norm for obesity). As well as those with a BMI < 25 kg/m^2 whose health could be improved and treated with a lifestyle change. CooL highlights the importance of increasing intrinsic motivation, self-management and increasing knowledge on health. It aims to provide sustainable lifestyle change through weight-loss, building a healthier body and increasing quality of life. The program takes 24 months to complete. Consists of 16 group sessions and 7 hours of individual consulting with the lifestyle coach in two years. CooL provides a lifestyle coach to the participant. A program is then tailor made to the participant. [52]

Samen Sportief in Beweging: This program focuses on adults with a medium to high health risk towards chronical illness. Participanst need to have a BMI between 25 - 40 30 kg/m^2. Those who can join the program typically already present a unhealthy diet and lack of activity, as well as a low quality of life. This program aims to have participants reach a manageable healthier weight. It does so by providing a lifestyle coach for one year. The program also provides group support. [53]

X-Fittt GLI: Similar to the previous programs, it focuses on adults with a BMI > 30 kg/m^2 as well as those with a BMI < 25 kg/m^2 whose health could be improved and treated with a lifestyle change. Combined with an increased weight-related health risk. Participants are allowed to join if they show intrinsic motivation.

The program aims for weight-loss, behavioural change and an increase in quality of life. X-Fittt GLI provides 1) a combined approach to movement and nutrition, 2) an intensive two year help by a lifestyle coach, 3) tools to allow for sustainable behavioural change, 4) group sessions, and 5) a collaboration with a local gym. [54]

All in all, most of these GLI's are similar in their target group, goal and approach. The difference lies in the duration of these programs.

Expert Interview: Marloes Makkink is a former coach at X-fittt GLI. X-fittt GLI is a lifestyle intervention program provider in the Netherlands [55]. In order to understand how to design a system to help obese adults adhere to their program, an interview with a (former) coach could lead to potential insights. A coach has worked directly with patients from the beginning towards the end of the program. The following section will discuss the highlights and relevant information gathered from the interview.

Their lifestyle intervention program takes two years to complete. The goal of the program, is ultimately, to help these patients with self-managing their lifestyle. During the first session, a 60-minute appointment is made to understand the patient's wishes and to set their goal. Every two weeks since then, the patients receive a 50-minute consultation. After 12 weeks, a 30-minute consultation. Then every 4 weeks a 10-minute phone consultation. Then 4 weeks later, a 30-min physical consultation. Afterwards it is up to the patients and the coach to decide the intervals.

The program happens within a gym, and the coaches are also members of the gym as well as the participants. So, when the participants visit the gym, there is a possibility for the patient to contact their coach outside their contact moments. This short meeting has a tendency to be motivating for the patients. Often, they will receive attention and informal compliments. In between these appointments, the patients can opt for workshops that are given in the gym. Such as on health, exercising, nutrition, mindfulness etc. These workshops are done in groups. Because of this group-format, most patients that are, for example, not interested in exercising can be motivated to do so. Once the patient reaches the second year, their consultation decreases to once in six weeks. The patient can fill their time by participating in workshops. This format helps to slowly build the patient's self-management of their own lifestyle.

The program has workshops where multiple participants join. This effect of social-support helps create a feeling of community. Therefore, increasing their motivation. Makkink mentions that intrinsic motivation is an important characteristic to have before joining the program. This is to ensure that the participant sees the program through. Another characteristic is to have a supportive environment, either from partners or family that understand the importance of the program towards the participant.

Makkink also mentioned having done research about the program as well, 70% of the participants that completed the two-year program, stayed to be members of the gym. She also mentioned that weight is not the only measurement to whether the program has been successful or not. Since weight is a fluctuating matter, life-satisfaction can also be considered as a measurement. Often, these patients who start the program have a low satisfaction in terms of how they live their life. At the end of the two years, they might have not lost significant weight, but they have, for example, built a community, better knowledge on how to exercise, can eat more nutritious and all in all feel more satisfied with their lives. Finally, when asked what the most effective characteristic of a program is, she says that a program needs to be tailored to the patient. It can also be applied to tools that the patients use, such as apps to track their daily food intake. These also need to be tailored to the person's ability with technology, ability to track their intake etc.

All in all, the takeaways from this interviews are: there is a large period of time between the consultation hours, but this can be filled by participating in workshops. These workshops provide insights into how to live a healthier lifestyle. These workshops help motivate patients further by providing social support. Patients who will most likely reach their goal have a strong intrinsic motivation and a supportive environment.

Chapter 3: Methods

This chapter describes the methods used in designing the system. It is based on the Creative Technology Design Process [56]. First, the process will be described. Second, a detailed explanation of every phase in the process is provided. Within these phases, a specified approach to the design process is described. This chapter serves as a preface to the following in-depth chapters describing every phase during the actual design process.

The Creative Technology Design Process will be used as a method within this thesis. This process was developed by Mader & Eggink for the bachelor Creative Technology [56]. The process has four phases: Ideation, Specification, Realisation, Evaluation. This section will mainly describe the definition and workings of every phase.

3.1 Ideation

Divergence and convergence models allow starting the process with an open and large design space which will be narrowed into a certain solution. This solution is then narrowed based on design requirements. This model is found within the ideation, specification and realisation phases. Furthermore, the spiral model is also used as a basis for this process. The model provides design steps that design professionals take [56]. It has nested problem solving, in the sense that each design problem unfolds sequence of questions. In this case, the starting problem results in to design questions, which nests towards a knowledge question which can nest towards a different design question etc.

Design questions are answered by making something, for example: How to design a smart-watch for older adults with memory problems? or What is a good algorithm for solving X? [57]. Knowledge questions are answered by collecting and analysing information from interviews, observations, or literature. For example: What is the state of the art in the design of smart-watches? or What are the aids that older adults use to help with their memory problem? These questions are regularly asked mainly in the ideation phase.

The ideation phase is the beginning of this technological design process. The first step within the ideation phase is a design question. This often stems from of a product idea, or sourced from scientific motivation. Ideation aims to bridge the gap between technology and user needs. The design question is then posed, but not yet answered. Similar to the Design Thinking process from Hasso Plattner [36], ideation also embodies the empathize phase. Here, ideation uses empathizing techniques such as interviews, observations and literature to gain more insight into their target users. Insight in to user needs, requirements and understanding the existing technologies within the problem context. In this action, a knowledge question is then posed and subsequently answered. This action of empathizing form the divergent part of the ideation phase. In the convergent phase, the answer to the knowledge question is formed. User needs and requirements are more specified and there is an understanding of the current technologies.

In the case of this thesis, the ideation phase will start by gathering a scientific motivation that allows technology to bridge a gap within a given problem context. Next, a design question will be formed. This question will serve as the main research question. As part of the nested problem solving, a knowledge question will result from the design question. This question will mainly focus on empathizing with the target users through interviews, observations or literature. Then a supplemental knowledge question will be asked that can help answer the design question from a technological standpoint. This will be a state of the art literature review and searching for technologies that may not have been covered by literature yet. From these questions, answers will be formed. These answers form the foundation to the following specification phase.

3.2 Specification

The specification phase is where ideas from ideation are developed. The answers that were found in ideation are made tangible through making smaller and fast-to-make prototypes. Every prototype has a short evaluation and can either be discarded or improved or altered upon. Early prototypes can be tested by users and/or/with the designer which could lead to further changes. These prototypes are created in a way that it only tests one or two functions of a whole system, rather than the entirety. This way, evaluation can be faster and easier. The prototypes often contain electronic components, such as microcontrollers, and use 3D printed components to show some dynamic behaviour [56]. It also displays a start to the look and feel of the device.

The specification phase in this thesis will start by recalling the final idea from the Ideation chapter. From this, a list of requirements can be made. This list is made using the MoSCOw method. The MoSCOw method is a prioritisation technique. This technique allows components within a list to be categorised based on must-have, should-have, could-have, and won't-have, or will not have right now [58]. This will help in realising the idea in the next phase.

Next to that, a PACA analysis will be conducted. PACA: People, Acitivities, Contexts, and Technologies. This analysis describes with the relation between a user interface with the type(s) of user (people), what components are there to interact with or actions that need to be done (activities), where (context) and what technologies the user will encounter (artifacts/technologies). PACA and PACT analysis are often interchangeably used. Doing a PACA analysis also helps in refining the requirements of the system. This will also help in realising the idea in the next phase.

Of course, the Creative Technology Design Process, is an iterative one. Meaning that these requirements are flexible and are subject to change. After the requirements are established, from both MoSCow and PACA, low-fidelity prototypes will be made. These prototypes will be tested by the users who have also participated in the co-design session. This smaller evaluation, only tests the likeability of the idea to the users. It simply gauges whether the users are open and welcoming of the idea. Once that is established, the next phase can begin.

3.3 Realisation

The third phase in the process is realisation. This phase is characterised by decomposition of the start specification, realisation of the components, integration of the components and evaluation [56, p. 5]. This means that the specification (list of requirements) is decomposed into analysing which physical components are needed to build the idea. This can be listing components such as electrical components, specific microcontrollers, collecting wood for laser-cutting, creating design files etc. Then building will occur (realisation and integration of components). During building, design decisions will be made. These decisions will be made based on grounded decision-making. This means that every decision needs to have a reason and a goal. The goal will often be for technological practicalities and improved user experience. Often during realisation, a log is made with reasoning to these decisions. This allows the building process to be done methodologically.

A high fidelity prototype is then made. This prototype is an improved version of the Lo-Fi (low fidelity) prototype. It has integrated functions, in contrast to Lo-Fi. There can be different versions of this prototype, depending on the amount of solid ideas that were left after comparing to previously set requirements. After these prototypes are built, they can be evaluated.

3.4 Evaluation

The last phase is evaluation. There are two types of testing that can happen within an evaluation: functional and user evaluation. Both will occur respectively. Functional testing addresses the practicalities of the prototype to ensure its technological workings. This includes, but not limited to, software bug fixes, re-soldering, reprint 3D models etc. This is often done by the designer themselves. User evaluation is done to verify whether decisions previously made satisfy the requirements and results into the experience intended. This is done by calling previous participants to evaluate the prototype. In order to assess user experience, specified tests will be made. These tests are in the form of short interviews and likert scales. If the prototype seems undesired, or does not meet the requirements, the process will reiterate. Once the prototype has successfully been evaluated, a reflection will be done. This reflection serves as the basis for understanding the design process and to make the designer's implicit decisions explicit. This aids for those seeking to do future work. Thus concluding the design process.

In Figure 6 the design process is visually represented. The relevant bridging components within this figure for this thesis are:

- experience idea, interaction idea, product idea
- experience specification, interaction specification, product specification
- experience prototype, interaction prototype, product prototype

Other bridging components are not relevant for this thesis.

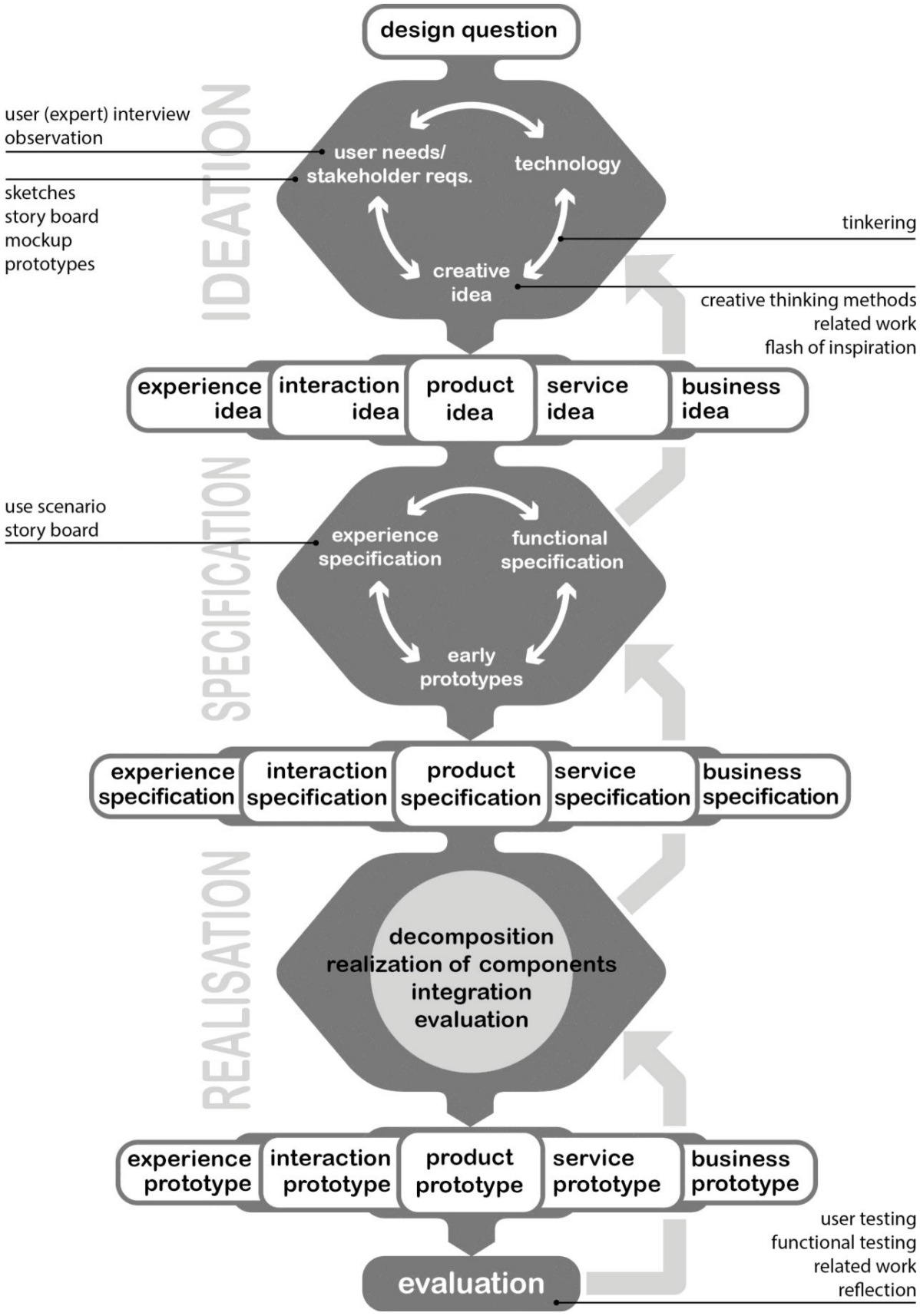


Figure 6: A Creative Technology Design Process [56, p. 3]

Chapter 4: Ideation

Ideation starts with gathering scientific motivation that allows technology to bridge a gap within a given problem context. Obesity is the number five cause of death worldwide [1], and in the Netherlands about 2.5 million people of the Dutch population are obese [3]. 80.000 of those follow a lifestyle intervention program [4]. In that program, only about half finish the program [5]. Those who yield the program state that it is due to lack of time and/or motivation. This thesis will focus on the lack of motivation. Which leads to the first design question in the nested problem solving:

"How to co-design a technological system that motivates obese adults to adhere to their lifestyle intervention?"

which acts as the main research question. This leads then to the knowledge question which also acts as the fourth sub-question:

"What are barriers and facilitators for obese adults to start with and adhere to a lifestyle program according to patients and lifestyle coaches?"

Ideation will answer this sub-question and result in ideas. In this chapter, users will first be defined. Then, a method must be found to gather their input. Subsequently, a conclusion will be drawn based on that input, this also acts as the answer to the first sub-question. Finally, ideation will take this a step further and generate ideas based on their input. This will also act as the preliminary conclusion of this chapter.

4.1 User Definition

The target user for this thesis are adult men who are obese. This is due to the complexity of helping women with motivation and weight-loss. Women are likely to struggle with weight loss due to their genetics, metabolism and hormonal fluctuations [59]. Many factors that are out of scope for this thesis. Furthermore, there are limited research in the domain of lifestyle intervention for men, since most are either a combined study of men [60] and women or only focus on women [9] or only on paediatric patients [10].

4.1.1 Preliminary User Interview

During ideation, the earliest steps are to reach out to potential target users and conduct either observations or interviews. In this case, an interview was conducted with an obese male aged 55. In this interview, he mentioned his current lifestyle. He is diagnosed with a binge-eating disorder that is connected to stress factors. Even though eating-disorders are out of the scope for this thesis, it is still important to understand how a patient deals with their weight nonetheless. Before developing his eating disorder, he used to frequent the gym and is knowledgeable on exercise and nutrition. Since reaching a BMI of 47.8, he has started to see a dietician. He has considered participating in a lifestyle intervention program. He found that he felt uncomfortable surrounded by other people while he exercised and would rather do it alone. Furthermore, he also mentioned that his dietician appointments were three months apart. During those three months, his motivation decreased, and he was gaining more weight. His weight loss happened when he realised his dietician appointment was two weeks away. He started fasting and exercising more. This lead to weight loss of 5 kilograms every time he did this. During the dietician appointment, he would get compliments on his weight-loss. This lead to a habit of, not doing much exercise and binge-eating (thus gaining more weight) and losing more weight when the appointment was nearing. His lack of motivation during those periods is the main reason for this behaviour, according to himself.

Examples like these show how important it is to empathise and work together with target users as designers. Co-design is a method that can be used to empathise with target users and allow them to work together with designers. Co-design can lead to (technological) solutions that could help the users more effectively. During background research, co-design guidelines were established and key functions of eHealth systems targeting weight-loss were found. The next step in ideation is then to design this co-design session. Followed by inviting target user groups to participate.

4.2 PACA analysis

Next, a PACA analysis will be conducted. This analysis describes with the relation between a user interface with the type(s) of user (people), what components are there to interact with or actions that need to be done (activities), where (context) and what technologies the user will encounter (artefacts/technologies). PACA and PACT analysis are often interchangeably used. Doing a PACA analysis also helps in refining the requirements of the system.

4.2.1 People

According to David Benyon [61], the People analysis requires designers to think about the physical, psychological, social and attitudinal differences and how these differences change in various circumstances and over time. First, the stakeholders are presented:

- Healthcare Providers
- Users (Adult males with obesity)
- Users participating in a GLI
- The family and friends (support system)

Second, the differences are presented: Physical: Large wrist could mean that watches might not fit them. 1 in 12 men are colour-blind [62]. Psychological: Spatial ability to navigate through the app could be difficult for some Social: The system could entice people that who do not know yet that they need this system Attitudinal: Most people want to be healthy.

4.2.2 Activities

According to David Benyon [61], the Activities analysis requires designers to think about the complexity of an activity. Whether the app has focused or vague, simple or difficult, few or many steps. He also requires designers to think about the temporal features (frequency, peaks, continuous, interruptible actions) and the nature of the data. This can be analysed as:

- Temporal: Frequent tasks should be easy to do
- Nature of data: Response time needs to short, do not frustrate users
- The app should remember where the users left off, and not direct them back to the home screen.

4.2.3 Context

According to David Benyon [61] the Context analysis requires designers to think about the physical, social and organizational setting.

- Physical: Environment will be at home, at the gym or another location where the user exercises
- Social: The social environment entails the people around the user. If the user is in a public social space, there could be an option to play the message at a later time.
- Organizational: The locations where the lifestyle intervention program takes place could also be a physical environment.

4.2.4 Technology

According to David Benyon [61], the Technology analysis requires designers to think about the inputs, outputs, and communication. The inputs are touch inputs. The outputs are sounds, the user's connected devices (Fitbit, scale), and a smartphone. The communications are immediate responses from the app, voice messages should not take large amounts of storage.

4.3 Creating a Co-Design Session

Using the co-design guidelines as a starting point, a small brainstorming session was held to create the session. This session was done by the researcher. A mind map was created with themes, such as (1) structure (2) ways of delivering ideas (3) ways of explanation. Mind mapping is a technique that helps visualise connections between these themes [63]. The aim is to find connections and try to create shape to the co-design session. The result of this brainstorm can be found in Appendix B. The result of the themes are as follows.

Structure: First, a short explanation on co-design will be given. Emphasis is made towards the aim of the session, namely to generate multiple ideas together. Then a small breakdown of the session, listing the times that each step will take. Second, an explanation on brainstorming rules. Most of the participants are likely to have none or limited experience with brainstorming. Rules such as: (1) Accepting all creative and wild ideas (2) No judgement on ideas (3) Giving their best effort (4) Build upon each other's ideas (5) Being open [64]. Third, participants will need to be able to open the creative part of their brain. Free writing is a mental exercise that allows for that. Participants are asked to write for two minutes without stopping to think [65]. The advantage of this technique is that participants are encouraged to free up their internal critic and allow themselves to write things they might not write if they were being too self-conscious [65]. Fourth, the idea generation will start. The session will end with every participant presenting their idea. Ending with thanking them for their participation.

Ways of delivering ideas: Based from the brainstorm, the session will use different mediums to convey their ideas, through writing, "block selection" and card selection. Every participant will receive a piece of paper to which they can use for free-writing. Then they will be asked to visualise a situation where they felt either a loss of motivation or they wanted to yield from the program. This could be in the form of words or drawings. Then they are given cards with values written on them, see Figure 7. Participants are asked to rank the cards from most-valued to least-valued. Then, the participant will choose a system. They can choose from either a wearable, an app, a device, or their own idea, see Figure 8. They are asked to explain the reason behind it. Then, the participants will receive "building blocks", see Figure 9. These blocks represent characteristics of their system. Participants will "build" their system based on these building blocks. These blocks are based on

the research done by Asbjørnsen, et al. [37]. Afterwards, the participants will receive cards. These cards have functions written on them that will be embedded in the system. See Figure 9 for a few examples of these cards. Finally, their system is created. The participants are asked to present their own system to the group.

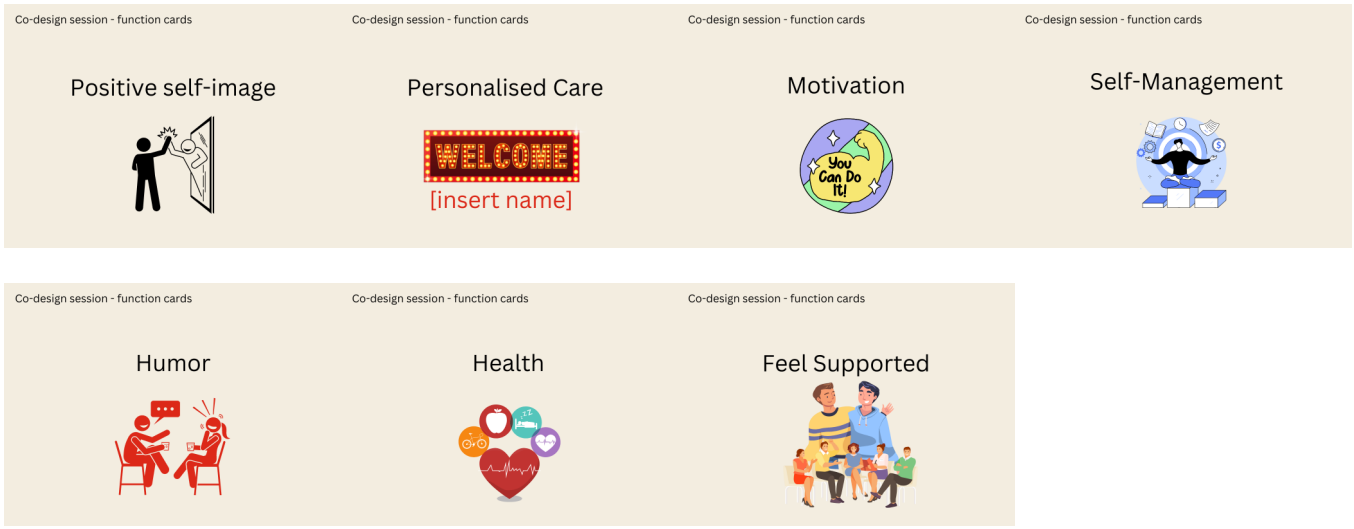


Figure 7: Cards portraying different values

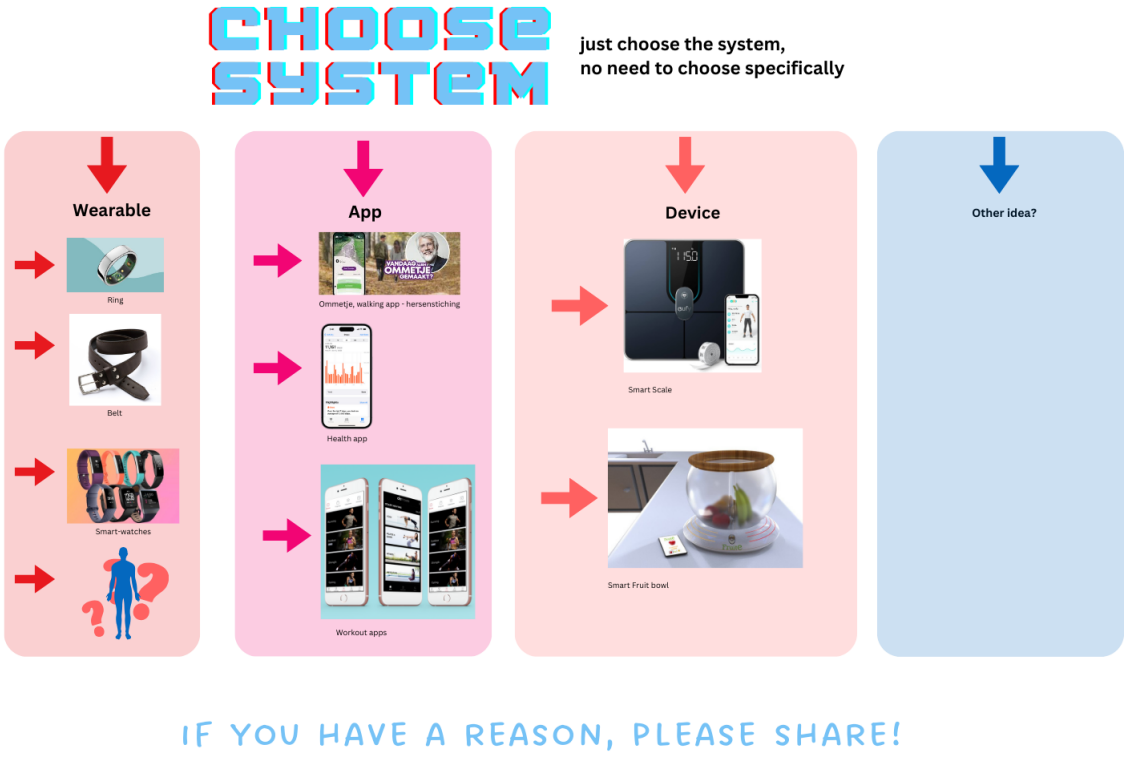
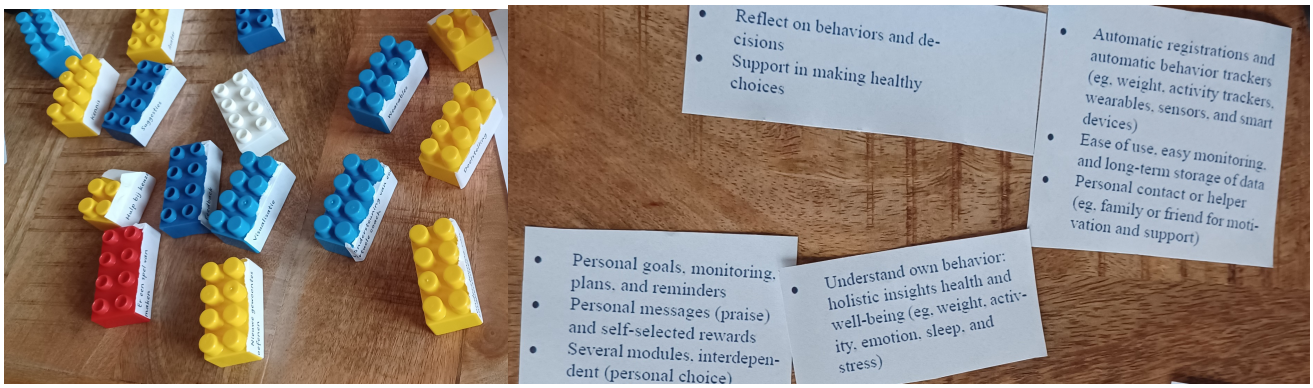


Figure 8: Systems participants can choose from



(a) Building Blocks (b) Function Cards

Figure 9: Items used during co-design

Ways of explanation: Based from the brainstorm, the easiest way to convey information is through visuals and audio. The presenter will explain the basic knowledge needed for the session with visual aids. See Figure 10 for the visual aid.

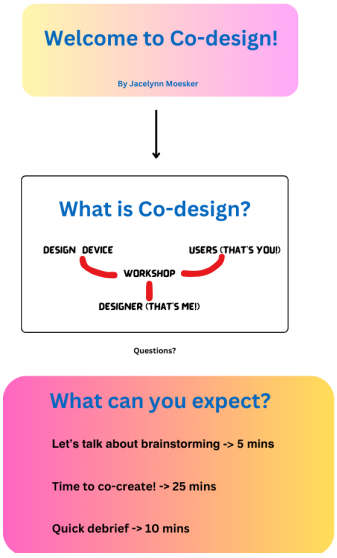


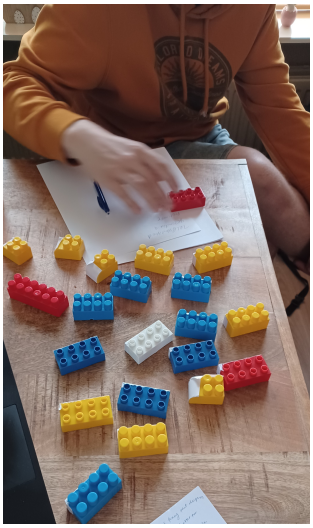
Figure 10: Visual aid for explaining co-design

4.3.1 Pilot co-design

Once the co-design structure had been created, a pilot session is held to improve the session. This is so that the actual session can be conducted effectively. One participant conducted the pilot test, see Figure 11. He is a 29-year-old male adult. Although he is no longer obese at the time of this pilot session, he had a BMI of 45 in 2015. In 2016, he had gastric bypass surgery. He and the researcher conducted all the steps mentioned above. These are suggestions for the final session:

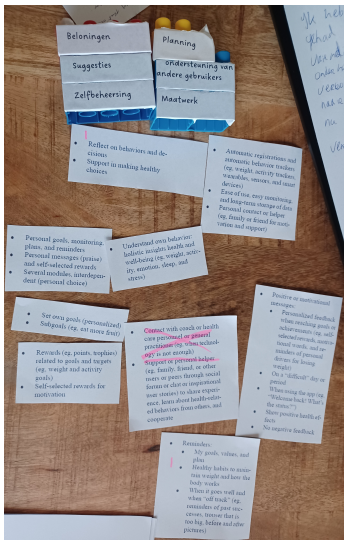
- Having the participant write on individual paper was considered unorganised. It was time-consuming to find back material written on paper. It was recommended that all participants should receive a small notebook instead.
- Function cards were seen as too long to read and had many complex wording. It was recommended to have shorter and simple sentences.
- Some function cards have multiple functions within, this caused confusion. Cards should contain a maximum of one function.

Other than the improvements above, the session was considered to be straight forward and easy-to-do by the participant. He enjoyed the element of being able to build his own system, see Figure 11.



(a) Conducting Pilot Session

(b) Final Building Block



(c) Full System

Figure 11: Pilot Session Results

4.4 Gathering Participants for Co-Design

After conducting the pilot co-design session, more participants should be recruited. This is done through the expert interviewee in *Chapter 2: Background*. She was a former lifestyle coach in the Netherlands. The recruitment starts with handing flyers, this can be found in Appendix C. Unfortunately, these recruitment flyers did not attract any participants for the session. Instead, recruitment was done by asking around local associations. Two participants were willing to participate. These are the following demographics: Participant 1 is 24, male, and was previously obese. Participant 2 is 55, male, and is currently obese.

4.5 Results of Co-design

The following section will discuss the results of the co-design session. The results are gathered from the two previously mentioned participants and from the pilot study. Results of values, system, building blocks and functions are presented.

4.5.1 Values

The participants were asked to rank their values from most important to least important, see Figure 7 for the selection of values. Table 5 shows their values.

	Participant 1	**Participant 2**	**Participant 3**
1.	Positive Self-Image	Self-Management	Motivation
2.	Health	Health	Humor
3.	Humor	Motivation	Positive Self-Image

Table 5: Ranked Values

Note that only "self-management" only occurs once in the top three values. This could mean that "positive self-image", "health", "humour" and, "motivation" are deemed most important by the participants. The system should then cater to these.

4.5.2 System

Participants were asked to select a system. They could choose from three different types of values: 1) Wearable, 2) App, 3) Device. See Figure 8 for the illustration. Participants were then asked to provide a reason for their choice.
Participant 1 chose **Wearable**. Specifically, he chose the smart-belt. His reasons were: 1) the belt provided ease of use. He already wears a belt, and switching for a different, smarter belt will not add any extra load to his routine. 2) The belt could track his behaviour and movements throughout the day without disturbing him.

Participant 2 chose **App**. He mentions that he is never home, because of his active job. This means that a home device would not work for him. He also mentions that he does not wear a belt or watch, instead he uses his phone very frequently. He likes that the app can also provide movement insights.

Participant 3 chose **Wearable**. Specifically, he chose the smart-belt. He was interested in having a device that could track his waist circumference. He wants to gain rewards if he goes a size down on his belt.

4.5.3 Building Blocks

Participants were asked to select building blocks from a total of 21 blocks. These blocks are characteristics of the system. Participants did not have to rank the building blocks. The characteristics were meant to be treated equally. Since they are supposed to be inherent to the system.

Participant 1 chose the following building blocks, see Figure 12.

1. Provide feedback
2. Practice new habits
3. Visualization
4. Provide knowledge
5. Include wearables

Figure 12: Building Block by Participant 1

Participant 2 chose the following building blocks, see Figure 11[b] :

1. Rewards
2. Suggestions
3. Self-management
4. Provide planning

5. Support from other users
6. Personalized

Participant 3 chose the following building blocks, see Figure 13:

1. Provide planning
2. Personalized
3. Visualization
4. Suggestions
5. Support from other users
6. Practice new habits

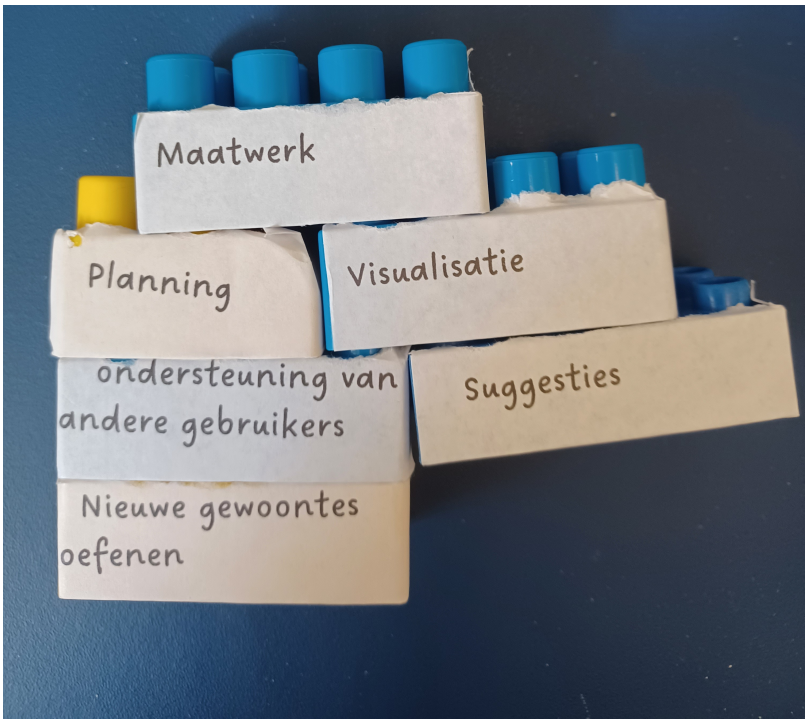


Figure 13: Building Block by Participant 3

The building blocks that has the most overlap between participants are:

Provide feedback	Practice New Habits	Visualization
Suggestions	Personalization	Provide planning
Support from other users		

Table 6: Building blocks results

4.5.4 Functions

The participants were given cards with functions written on them. The following are functions that the participants have selected and deem important to have in their system. Every participant has provided at least 10 different functions.Table 7 shows the results of the functions. The participant's answers has been divided among three elements: Insight, Social Support, and Intrinsic Support. These elements have shown to make eHealth systems effective according to the literature review, see Chapter 2.1.

Insight	Social Support	Intrinsic Support
Understand own behaviour and movements	Allow for positive messages/praise	Provide planning
Create and follow new healthy habits	Allow for messages to be heard, rather than read	Set goals
	Provide rewards	Provide crisis plans and back-on-track plans
	Share data with healthcare professionals	Provide self-made positive messages
	Receive support from family, friends, and other users	
	Provide reminders of positive change and past achievements	

Table 7: Results of functions divided into Insight, Social Support, and Intrinsic Support

4.6 Idea Generation

The next step in Ideation is to generate many ideas. These ideas are based on the previously acquired results from the co-design session. This section discusses the manner in which the ideas are generated. This is followed by three ideas, all representing their pro's and con's as to why they should(n't) be a main idea. This section concludes with a Lo-Fi prototype idea.

User Persona

The ideas need to be targeted towards a certain user. A user persona can be used to create a representation of the target user. It represents the user's demographic details, personality traits, needs, goals, background, and future 15. It helps designers to resonate and empathise with the user. Data to create the persona is gathered from observations, interviews and literature. During the co-design session, observations and smaller questions are asked throughout to get acquainted with the user. The persona can be found in Figure 14,15, and 16.

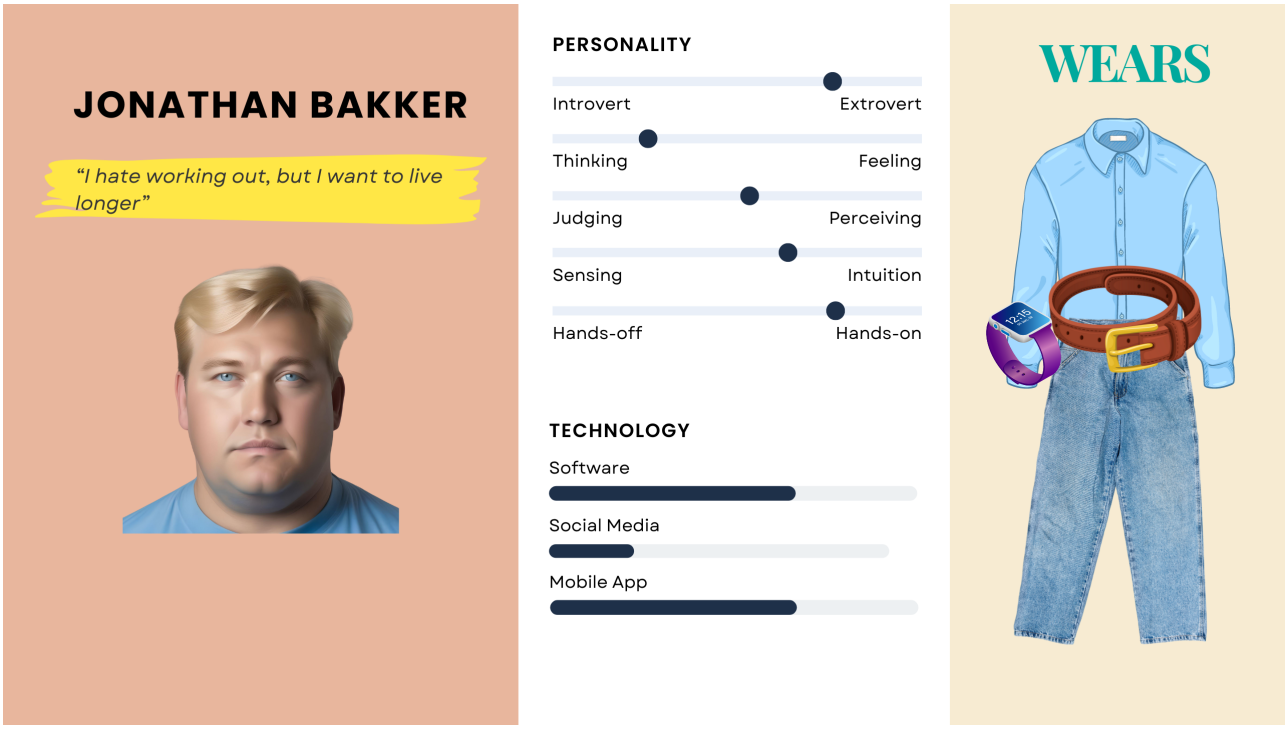


Figure 14: User Persona: Jonathan Bakker's Personality

Figure 14 shows Jonathan Bakker, a male adult with obesity. He is an extrovert, tends to think more, uses

more intuition and likes to be hands-on. He wears his belt and smart-watch daily. A user that is an extrovert helps with being open to social support from others. Those who tend to think more could be open to the idea of a tool that is not currently standardized or mainstream. A user that uses their intuition more, can perhaps understand the system without having any external instructions. Lastly, a hands-on user is more open to be active.

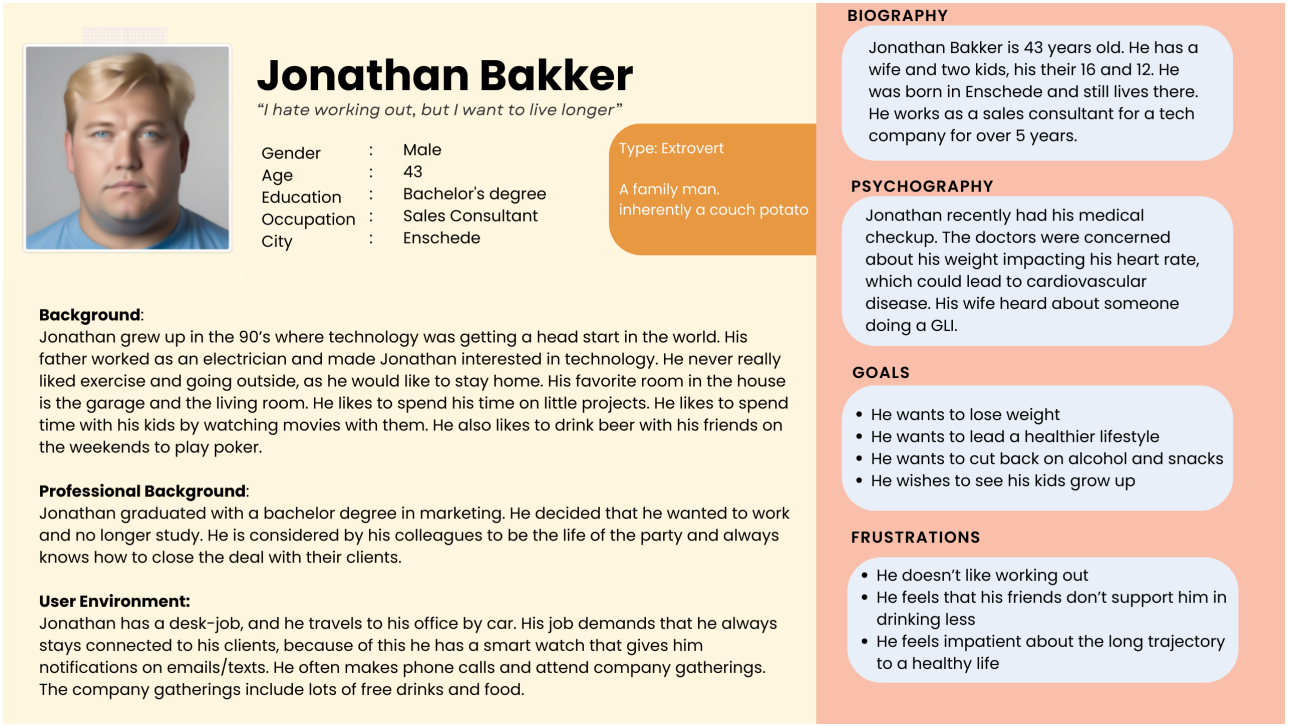


Figure 15: User Persona: Jonathan Bakker's Background

Figure 15 shows the user persona. The persona can be reflected in a past, present, and future. Figure 16 reflects this in a visual way. Jonathan's past shows that he grew up in the 90s where technological development is popular. His father was an electrician, so technical knowledge runs in the family. He enjoyed watching TV and meeting with friends growing up. After he graduated, he married and had two kids. The present shows Jonathan's current house. He enjoys fixing stuff around the house and working on side-projects. During the day he is a sales consultant at a company where he mostly sits on his office chair. During the weekend, he enjoys playing cards and drinking beer with his friends. Recently, he'd gain weight and his wife urged him to go to the hospital for a yearly full check-up. The doctor mentions that he should change his lifestyle if he wants to continue living a longer life. His heart requires Jonathan to change his lifestyle. In the future, Jonathan wants a more active life, so he can watch his kids grow up. He wants to replace his beers with more water. He wants to eat healthier and join a fitness group. All in all, he wants to live a healthier life.

The persona has now been established. The following ideas are targeted to this persona and based on the result of the previously gathered data from the co-design session.

4.6.1 Idea #1: Connect watch and app

The first idea, see Figure 17, explores the notion of combining the user's smart-watch and combine that with an app that provides some kind of social support. The watch would then provide insight, the app would allow the user to connect with other users. Through a platform, they could connect and motivate each other. It could influence the user's intrinsic motivation. See Figure 17.

The advantage to this idea is that it could provide the two of the elements: insight and social support. However, this is assuming that users already have a watch and that they will actively be using the app to communicate with others. There are already many communication apps available. Adding one more with decrease the ease

Figure 16: User Persona: Jonathan Bakker's Past, Present and Future

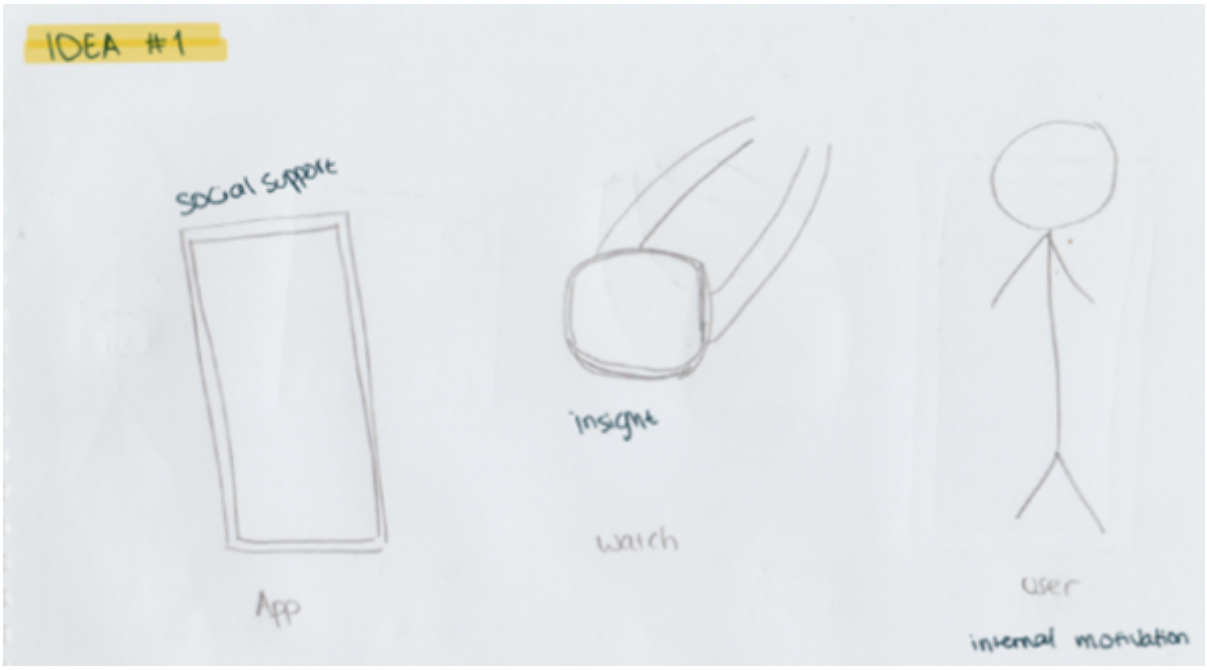


Figure 17: Idea #1: user's smartwatch connects to a platform that provides users to connect to each other

of use of the system. Moreover, the user is neither rewarded nor helped with creation of new habits, and they do not communicate with healthcare professionals this way.

4.6.2 Idea #2: Create smart-belt

The second idea, see Figure 18 explores the idea of creating a whole new wearable. The co-design session shows that smart-belts are favourable. The belt has all technologies to measure waist circumference as well as movement and activity. It could connect to an app and/or an existing app, such as the Fitbit app. When the user reaches a certain goal (i.e. one hole less), the belt can vibrate. This idea, however, is very complex in implementation. Instead, the idea of combining insight and social support should be built upon existing technologies. This way, focus can be given to ensuring the user experience, rather than the technical workings of the system.

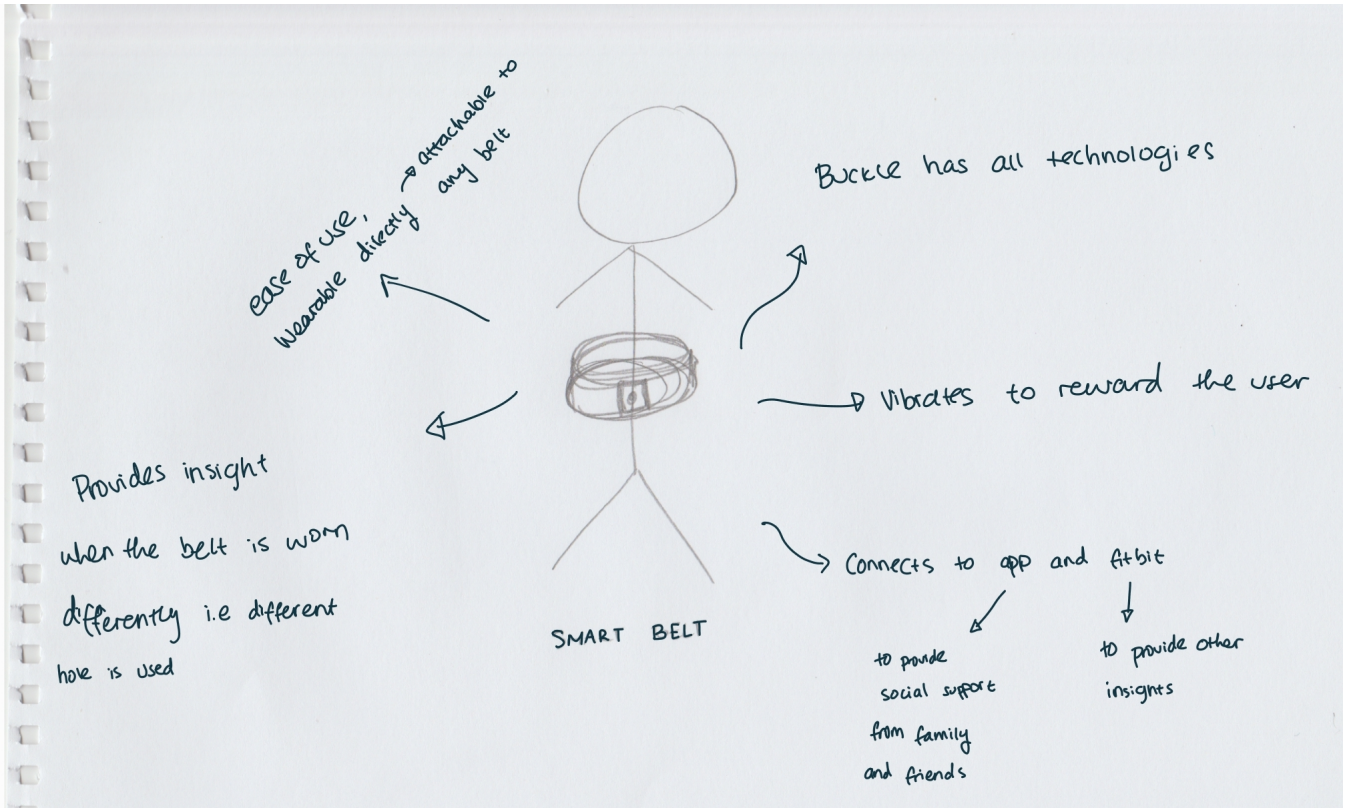


Figure 18: Idea #2: Creating a smart-belt

4.6.3 Idea #3: Combine all devices

The third idea, see Figure 19 explores the notion of combining an app to the user's devices: smartwatch, scale and an additional belt. All these devices could provide insight and the app could, similar to idea #1, be a platform for social support. The belt has a function that allows for wait-circumference tracking, the watch measures dynamic values like heart rate, movement, and sleep patterns. The smart scale could measure body fat percentage, weight etc. However, this idea seems to be too complex to implement. Since it requires a belt to be made as well. This belt will need sensory tracking, it will need to be programmed to understand waist-circumference, able to withstand wear-and-tear of daily use. Not all users will be comfortable wearing a belt, some do and some do not. It begs the question: *should* users be mandated to have some sort of wearable in order to access social support? Idea # 3 answers this question.

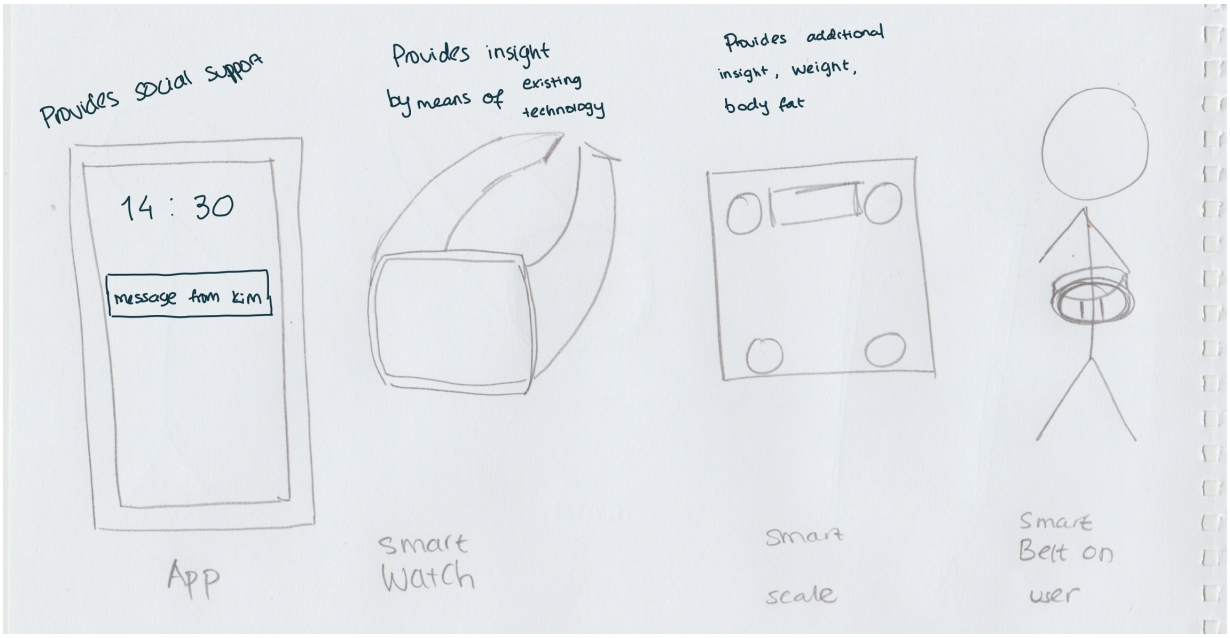


Figure 19: Idea #3: User's watch, scale, and belt connects to a platform that provides users to connect to each other

4.6.4 Idea #4: Create Hub App

The fourth idea, see Figure 20 explores the question: "Should users be mandated to have some sort of wearable in order to access social support?". It is previously established from the co-design session that users either prefer to use some type of wearable and/or an app. The application environment on their smart-phones have become almost intuitive to navigate. Furthermore, some users might have the opportunity to own wearables, while some deem their smartphone to be sufficient. Some users have a variety of smart devices (scale, watch, smart stationary bike etc) and others don't. Most of these devices have a stand-alone app. This could also be connected to one-hub app, allowing users to have only one app to manage their lifestyle-related devices.

A hub could be used to connect all these devices. The hub could be used to connect users to each other. As well as to connect healthcare professionals to their patients and their active data. The app would have to be fully automated and work on the background to promote ease of use for the user. Not all users are the same, so the app should allow for personalisation. This idea allows all types of users and their surrounding to be connected. All to help the user themselves.

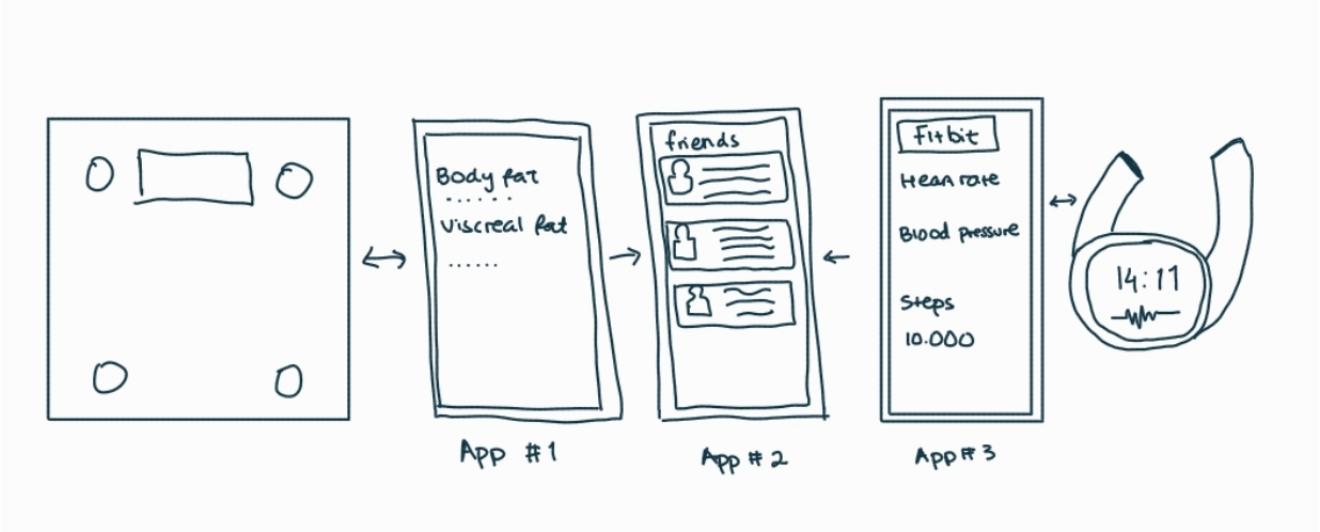


Figure 20: Idea #4: A hub app that connects all devices' apps into one app and allows for social digital connection

4.7 Preliminary Conclusion: Final Idea

The final idea, in short, is: a hub-app that connects all the user's devices to show insight and allows for receiving and transmitting audible messages to show social support.

Figure 21: Storyboard: Using the app at home and gym

After considering all of the above ideas, a final idea can be proposed. The final idea is a combination of an app and existing, but not limited to, wearables. These wearables are already possessed by the user. The app will act as a hub (similar to idea # 4) that will connect all the devices and provide an all-in-one insight to the user. This data can then be shared to the user's healthcare team. This can in turn provide functional support [8], because the app will allow the team to contact the user to provide them with rewards and compliments if they succeed in their goals. They could also provide feedback and tips to the user, if they deem fit.

The core of the final idea lies in: social support. Messages from the user's support system i.e. family, friends, other participants from the lifestyle intervention program, and other users could be used as a way to show support towards the user. These messages will only be released if the wearables (watch or scale) detects active movement or milestones achieved. These messages, however, are audio based. This is because hearing encouragements are deemed to be more impactful than reading them. The app will have different interfaces. One interface for the target user to track their movements and activity as well as to receive support, one interface for the user's support system to send messages, one interface for the user's healthcare team.

Users who are in a similar situation can encourage each other. This allows for external accountability towards other users. The app also allows users to have multiple devices without having a cluttered phone environment. Furthermore, the app will allow for personalisation, visualisation, planning, and creating new habits. These were the previously mentioned functions.

This idea is feasible given the smaller scale in comparison to creating a whole new wearable. It is more complex than idea #1, which is connecting a watch to an external app. Moreover, it builds on existing technologies. This allows users to not have to acquire new devices or equipment. The goal of the app is then to have a pleasant user experience where users have an increased feeling of social support from their environment. This will perhaps motivate them to adhere to their lifestyle intervention program longer, and in then end, live a healthier lifestyle.

Figure 21 shows a storyboard where the app could be used and presented. The user is at home and is unmotivated to go to the gym. Exercising throughout the week is part of his lifestyle intervention program. He sees that he also needs to lose weight before his next dietitian appointment, to lessen the feeling of shame. The app senses that his location is at home and not the gym. The app knows that he is supposed to be at the gym at this moment. The app considers this moment as a low-point in motivation. It sends out a pre-recorded message. The message is played on the watch as a notification, but could also be played on the phone. The encouraging message is from another user who is also in the lifestyle intervention program. The user hears their voice and feels better. He heads to the gym.

The app sees that the user is now at the gym. The watch tracks the user's activity. The user successfully completed his goal for today: going to the gym. This triggers a new message from the user's family. It contains an encouraging, rewarding message. The user hears this and is satisfied with his action for today.

Chapter 5: Specification

The specification phase is where ideas from ideation are developed. The answers that were found in ideation are made tangible through making smaller and fast-to-make prototypes. Every prototype has a short evaluation and can either be discarded or improved or altered upon. Early prototypes can be tested by users and/or/with the designer which could lead to further changes. These prototypes are created in a way that it only tests one or two functions of a whole system, rather than the entirety. It also displays a start to the look and feel of the device. [56]

This chapter starts by recalling the final idea from the Ideation chapter. It then proceeds to decompose the final idea into tangible requirements, both non-functional and functional. These non-functional requirements are made using the MoSCOw method [58]. This is followed by diagrams establishing the functional requirements. Both requirements are then translated to a Lo-Fi prototype. These requirements are brought to the next phase of realising the prototype.

5.1 Base Idea

The specification phase in this thesis will start by recalling the final idea from the ideation phase. The idea, in short, is: a hub-app that connects all the user's devices to show insight and allows for receiving and transmitting audible messages to show social support.

5.2 Non-Functional Requirements:MoSCOw

A list of requirements can be made based on the idea. These requirements can be considered as non-functional requirements. These are requirements that concern the qualitative nature of the system. It defines how a system should behave, rather than what it is supposed to do [66]. This list is made using the MoSCOw method. The MoSCOw method is a prioritization technique. This technique allows components within a list to be categorised based on must-have, should-have, could-have, and won't-have, or will not have right now [58]. These decisions are based on literature and the co-design session. Every section will divide the values and functions that were resulted from the co-design.

5.2.1 Must-Have

Values

- Positive Self-Image
- Motivation
- Health
- Humour

Functions

- Show health insight
- Promote motivation
- Provide feedback
- Support from other users
- Support from healthcare professionals
- Provide planning

Values, except for self-management, are all included in must-have. This is because the participants deemed these to be important and included them in their top three. Functions that are included are crucial for the workings of the idea. It touches insight and social support. It provides "Planning", a function that was included in all three participants. It provides support from healthcare professionals, an effective addition within social support, according to Verheijden, et al. [8].

5.2.2 Should-Have

Values

- Self-Management

Functions

- Provide visualizations
- Ability to be personalized

Self-management only occurred once in the rank of values. It is then a should-have. Functions that are secondary are visualizations and the ability to be personalized. By providing visualizations, viewers can look at their progress in an intuitive way, rather than viewing numbers. Graphs and plots can be made to show the user's development. Furthermore, the expert interview in Chapter 2.2 show that tailoring and personalisation is important, since every participant in the program is different. The app should then also be catered towards them. This means that certain functions can be enabled/disabled. For example, user 1 likes the idea of gamification with other users. Badges and points are earned when they accomplish their pre-determined goals. User 2 dislikes this and rather use the app for its audible messages function. These functions should come as secondary, since they do not directly affect the user's motivation and social support.

5.2.3 Could-Have

Functions

- Create and practice new habits
- Provide knowledge (other than insight)

All values have been divided. This leaves with the remaining functions. Creating and practising new habits can be a great addition to the app, but it is not the focus as for now. The same applies to providing knowledge. Insight was deemed a must-have. This type of knowledge encapsulates tips and miscellaneous knowledge that can be shared by the healthcare team. Both can be considered as a will-not-have right now.

5.2.4 Will Not Have

The system will not:

- have a complex interface
- provide negative messaging

The ease of use is a priority for the system in order to create a pleasant user experience. Designing a complex interface should be prevented. The user should only either be encouraged by their surrounding or receive constructive criticism from their healthcare team. The app will not have a function that could allow for cyber-bullying or for negative messaging.

5.3 Functional Requirements

This section will show the functional requirements needed to create the front-end of the system. First, the hierarchy of the screens will be established, also known as a sitemap, see Figure 22. Second, presets of every component will be presented, see Figure 23. Third, a mock-up wireframe will be presented that shows the general layout of most pages, see Figure 24. Fourth, a simplified system architecture will be presented showing the future of how the back-end might be implemented, see Figure 25.

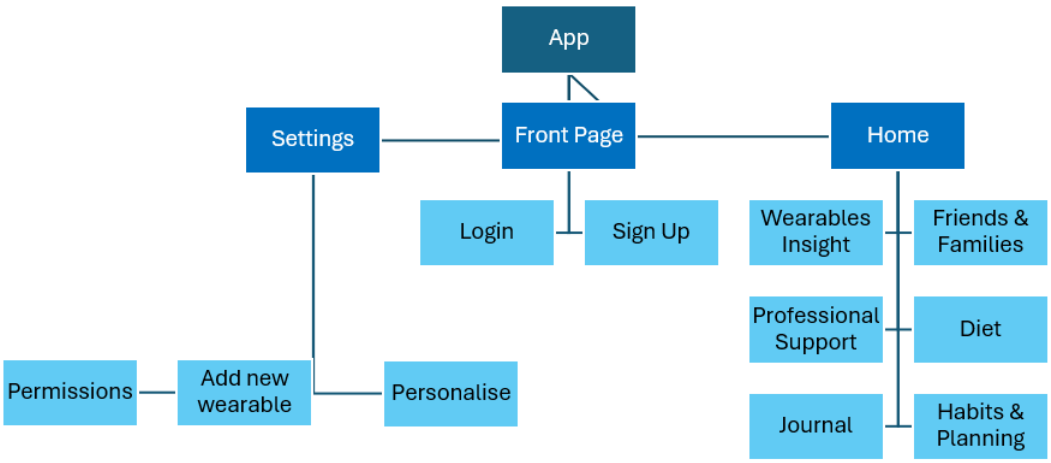


Figure 22: Hierarchy (sitemap) of different screens that will be present in the wireframe

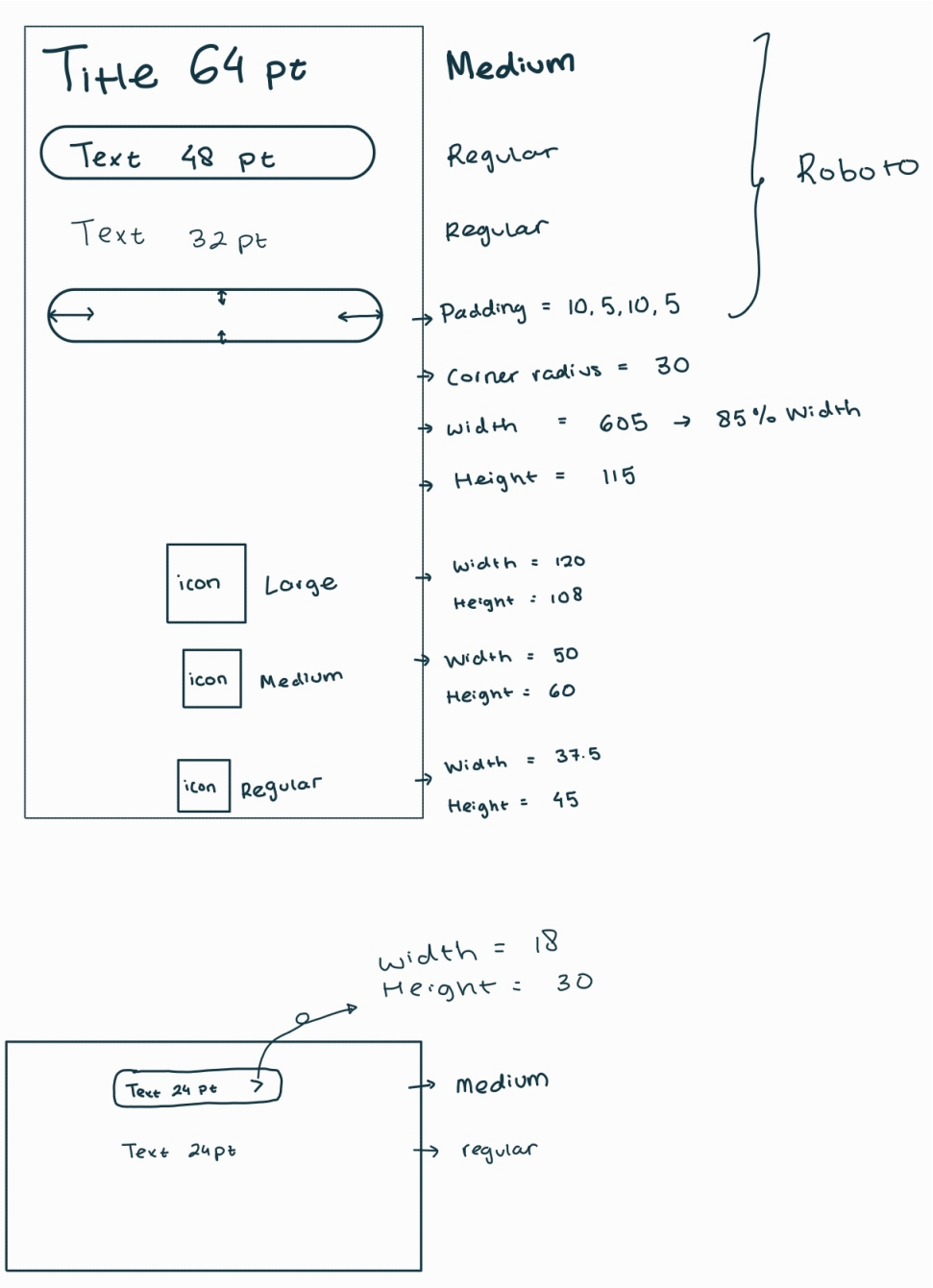


Figure 23: Presets for Wireframe, including width & height of all components. Combined with font sizes, weight and type. Buttons are split into two types: main buttons are large, sub-buttons are small

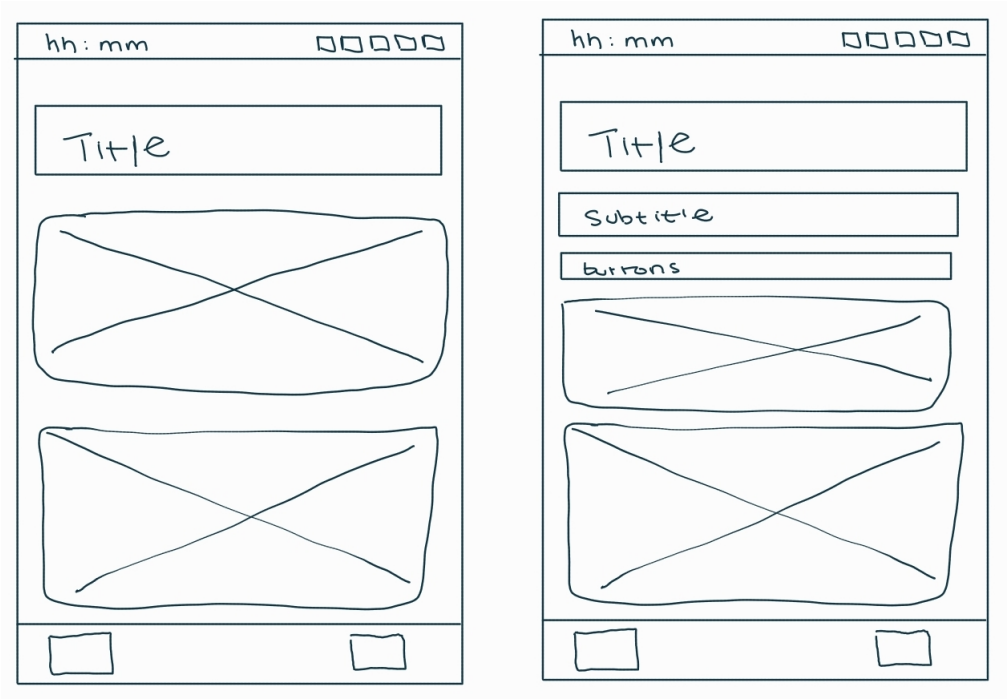


Figure 24: Mockup wireframe for all general pages, i.e pages with no special function (i.e. Home and Settings . Every wireframe has a title, subtitle, sub-buttons and content.

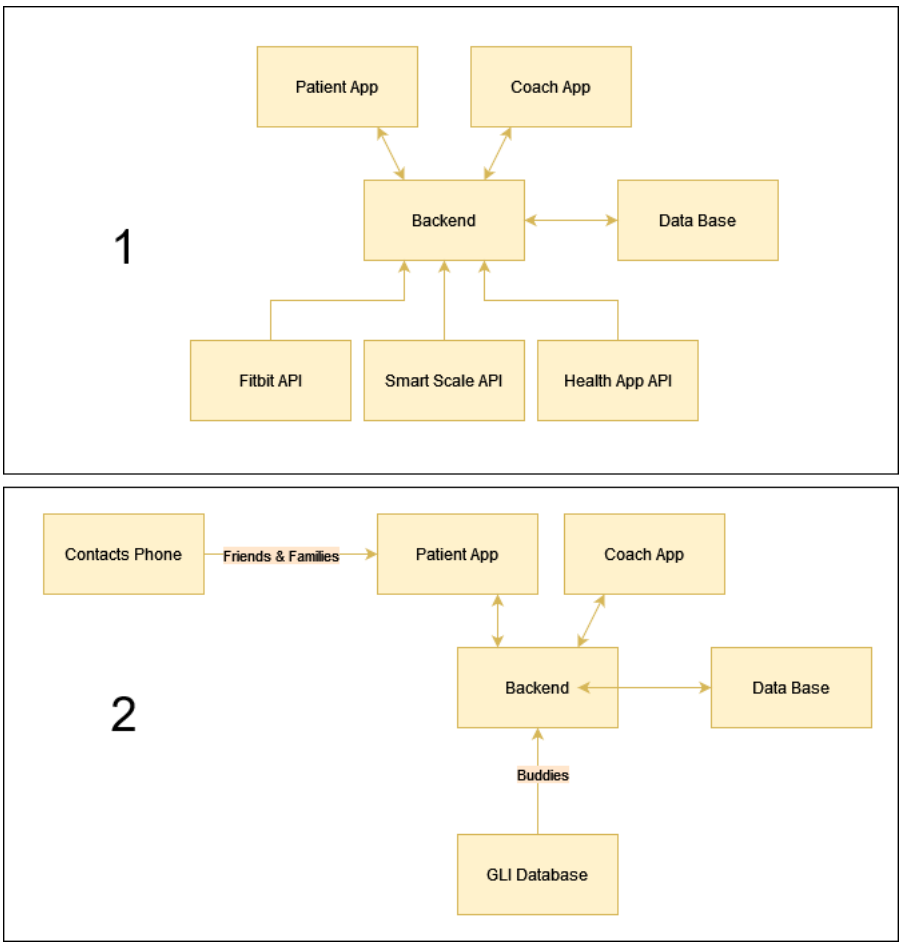


Figure 25: Future implementation of back-end API and contacts integration

In future work, the app will have two versions: Patient and Coach. The current version of the Hi-Fi will represent the patient version.

Figure 25 shows two diagrams, 1 and 2. These diagrams provide an overview of how the backend might be implemented during app implementation.

1 shows the different API's that the system needs to call towards. These are mainly API's that connect to wearables, devices, and apps that the user has added in the "Add new wearables" page. The database will store all information retrieved from the API and provide information to the backend.

2 shows how the backend uses people contacts to fill in the Friends & Family page as well as the buddies page. *Friends & Family* is retrieved from Contacts Phone. *Buddies* is retrieved from the GLI Database. The app's database will keep track and provide information of the different contacts.

The coach version allows lifestyle coaches to:

- Submit pre-determined goals
- View wearables insight from the user
- Encourage users through voice messages

This could all be implemented in future work.

Chapter 6: Realisation

The next step in the Creative Technology design process is realisation. In this chapter, the specification is decomposed into actual components. These components are the building blocks for the idea. The idea is then built. Here is where the integration of previous components are done. This is done by building Lo-Fi and Hi-Fi prototypes. A Hi-Fi prototype shows a polished simulation of the final system [67].
First, the realisation of the Lo-Fi prototype is done. This is based on the specification. Second, the prototype is evaluated. Third, this evaluation leads to different iterations as to how the Hi-Fi could be built. Fourth, a preliminary conclusion is made. Finally, two Hi-Fi prototypes are realised: one before the user evaluation and one after. The latter acts as the final prototype.

6.1 Specification Lo-Fi

The MoSCOw and PACA analysis has provided requirements. These requirements can be included in a Lo-Fi prototype. A Lo-Fi prototype is a fast-to-make prototype. It goes through a short evaluation and can either be discarded or improved or altered upon. Early prototypes can be tested by users and/or/with the designer, which could lead to further changes. These prototypes are created in a way that it only tests one or two functions of a whole system, rather than the entirety. This way, evaluation can be faster and easier. The prototypes often show some dynamic behaviour [56]. It also displays a start to the look and feel of the idea.

The lo-fi prototype will be made in Figma. Figma is a website that allows people to create and test designs for websites and mobile apps [68]. This way, a fast prototype can be made that is solely focused on creating the look and feel of the components. The components chosen are based on the provided requirements. By only creating the front-end of the application, faster iterations can be created. These iterations are presented in a wireframe. A wireframe is a basic blueprint that help designers align on requirements. It can also be used in user evaluations. Wireframes can be digitally made or on paper. Figma allows for digital wireframes. The goal of this lo-fi is to give an appropriate look and feel towards the user. See Figure 26 and Figure 27 for the wireframe of the system.

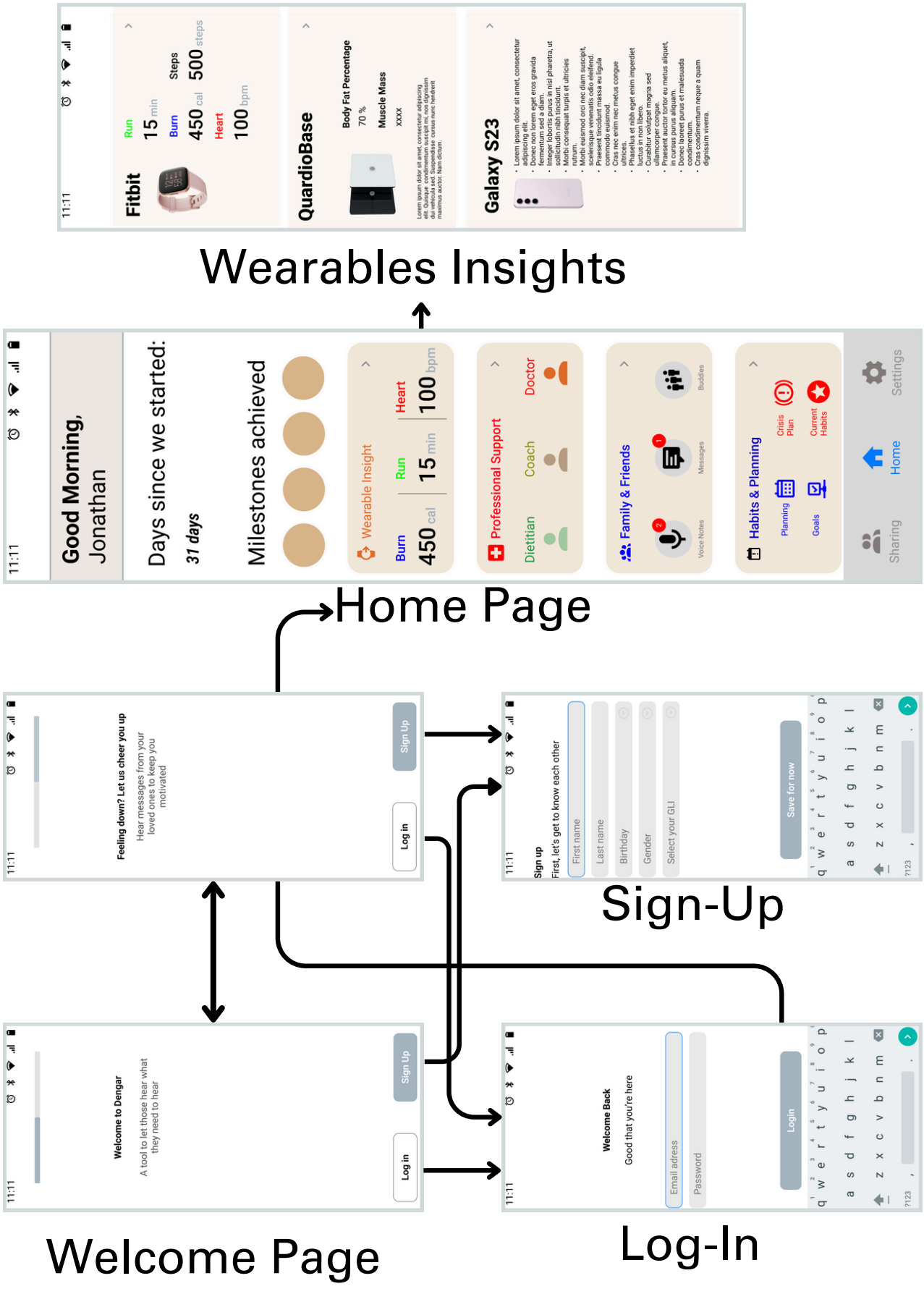


Figure 26: Welcome Page, Sign-Up, Home Page and Wearables Insight

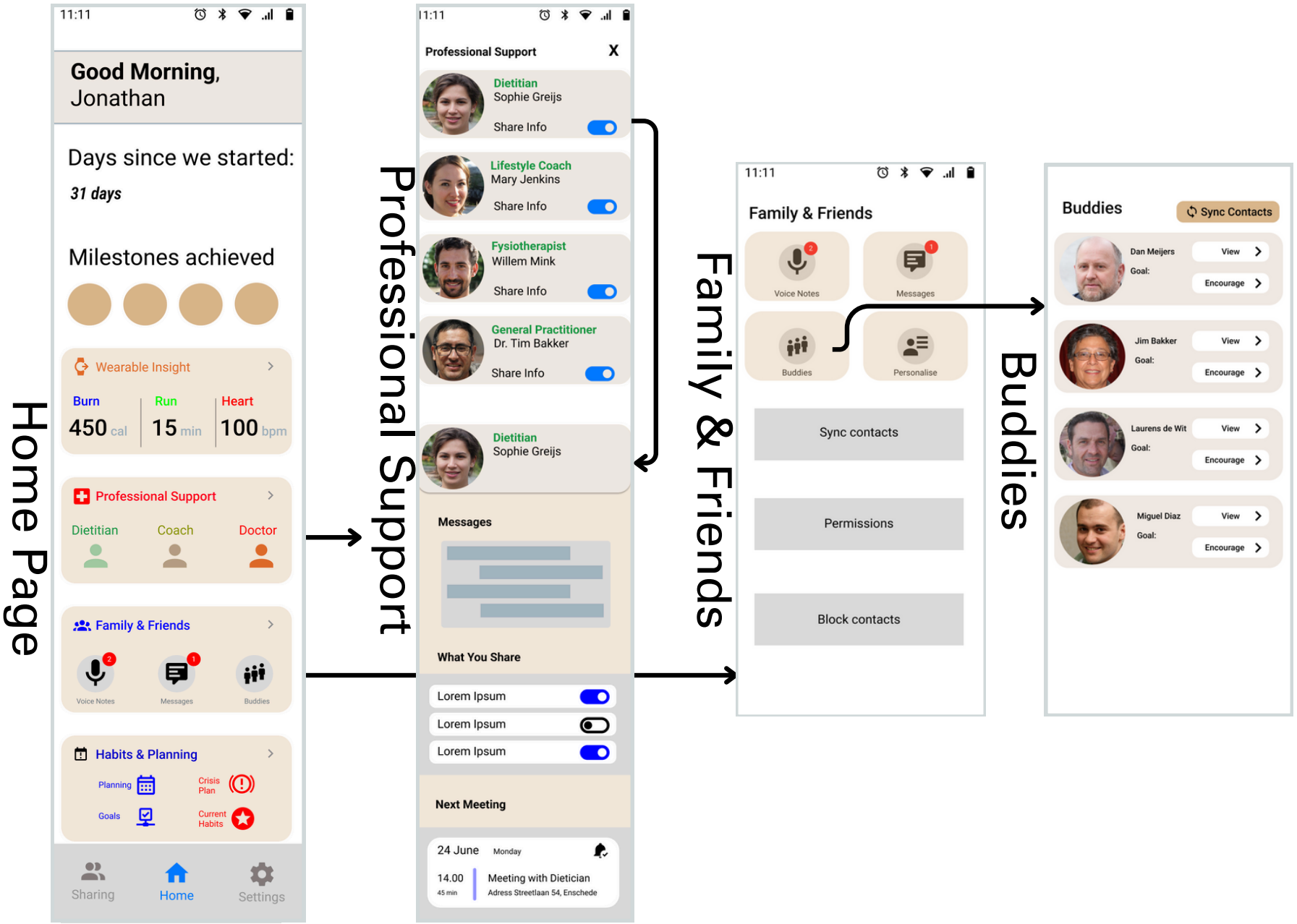


Figure 27: Home Page, Professional Support, Family & Friends and Buddies

The app is called Dengar. An Indonesian word which means to listen. Figure 28 shows the start screen. This is where new users will be welcomed into the app. When they first sign up, they can stop whenever and the app will assure that their details will be saved for later. This makes it less frustrating for users who do not have the time to go through all the steps to sign up at once. Within the sign-up page, the user will be asked to select a GLI. This allows the user to be connected to other users in the same GLI.

6.1.1 Start and Home Page

Once the sign-up is complete, the user can log in with their email and password, see Figure 28. The user will then be directed to their homepage. The wireframe uses the user persona as its logged user. In the home page, the user can view the days since they have started their LIP. They can see their achieved milestones. Insights from different wearables are displayed. A card that presents their healthcare team. This way, the team can communicate with the user and vice versa. The team can also provide encouragements, this is also displayed in the card.

Status of family & friends are displayed. This contains unheard voice messages, and unread messages by their support system. Buddies is the page where the user can connect with other users or those in the same LIP. The homepage continues with a Diet card, where the healthcare team can provide tips and recipes. Followed by a Journal Entry card, where users can reflect on their previous accomplishment and write small letters to themselves as a form of self-encouragement.

Lastly, Habits and Planning are also added. Users and their lifestyle coach can update their goals and plans dynamically. Current habits can be made and tracked. Crisis plans, which are harder days or parties or less-motivational days, can be made together with a coach, or individually. These plans will be used if the app sees that a pre-defined crisis is happening. This pre-defined crisis can be made in the app.

Every page will have a bottom bar for navigation. This is currently made to navigate between the Home page, the Settings page, and a Sharing page. The Settings page and Sharing page have not been developed for this wireframe.

6.1.2 Wearable Insight Page

This page will show all the connected devices and their synced up data, see Figure 30. The user can select which data they would like to see from a wearable, and which of these data can be shared with their healthcare team. This allows for the element: insight. In this page, although not shown in the wireframe, a visualization is presented. This could be a graph or a plot that shows the user's activity and development using the wearable's data.

6.1.3 Professional Support Page

This page will show all contact persons of the healthcare team. The user can select who to share their data with. When a person is clicked on, a card will appear, see Figure 32. This card contains details of the person, recent messages which could be practical (i.e. user is 10 minutes late to a session) or it can be encouraging audio messages that will be played once the user has achieved something. The user then can specify what to share with the person. Lastly, the app is also synced with the user's calendar to alert the user of any upcoming sessions. This could also be used as reminders and encouragement if the user knows that they have a session soon.

6.1.4 Family & Friends

This page is the most important page to focus on. This encapsulates the social support element of the system. Here users will have access to their audible messages, have contact with other users, either in or outside their LIP, see Figure 31. Voice notes will be available once the user has achieved their pre-determined goals. The user can filter through the notes based on who it is from and when. This is to ensure that they can always find back a voice note.

Buddies is the page where the user can connect with other users or those in the same LIP, see Figure 31. Every person here has a and a goal that they can share with their contacts. Users can view more of their profile and send encouragements to each other. People can be added to their phone contacts. If they also have a Dengar account, it will be synced here.

6.2 Lo-Fi evaluation results

Once the Lo-Fi was created in Figma, an evaluation took place. For more on how the evaluation took place, refer to Chapter 7: Evaluation. The Lo-Fi has been tested with one target user and one ex-lifestyle coach. He provides the following pro's and con's:

Pro

- App is automatic
- App combines all devices
- App acts as a hub
- Audible messages are helpful and unique
- Milestones are a nice function

Con

- Seems cluttered
- "Look into the future" seems to be excessive, some adults prefer to have a more serious app. An avatar could ruin that experience.
- Personalisation in colours should be implemented.

The ex-lifestyle coach provides the comments:

- The app could also have a journal/diary function where users could give themselves encouraging messages. These messages could be "Hi future self, you have done so well! Treat yourself to a cup of coffee with your sister." The journal should act as a way to reflect and celebrate the achievements.
- The app could have the option to have gamification. Users can go on competitions with other users. Or be in teams, where group achievement can be accomplished.
- The app, in the future, could have the option to be synced with gym memberships. Often gyms, will have a code or a key where users can enter the gym. This could be used as an alternative to "check-in" on the user instead of using their phone location.

These pro's and con's can be taken into consideration to specify to Hi-Fi prototype.

6.3 Specification Hi-Fi

A Hi-Fi prototype tests a certain crucial concept within the system. This Hi-Fi will test the effect of social support on the user. By using social support, the user may be able to maintain motivation to adhere to their lifestyle intervention program. The program has smaller goals. The user knows that support will come, but can only trigger that when they achieve their pre-determined goal. This concept will be tested. If the test succeeds, this means that they this system is the answer to the main research question. There are many ways to create and test it. The following sections will discuss how to build the prototype and if this is feasible to be tested.

6.3.1 Hi-Fi Iteration #1

This iteration involves using an existing wearable device such as a Fitbit, see Chapter 2.2 for more on the Fitbit. The idea is to have the watch connect to the app. When an activity is detected, it sends data to the app. This releases a pre-recorded encouraging voice message. However, access to the Fitbit's data can only be accessed by the official Fitbit API. This only allows access to official developers. Furthermore, the complexity of accessing the data is beyond the scope of designing a system. Designing and developing the system is regarded to be two different paths. Designing implies the front-end user experience, and developing implies the smooth and efficient workings of the app along with its other connected devices. Another approach must then be taken.

6.3.2 Hi-Fi Iteration #2

This iteration involves only proving a concept. The concept is: a voice message is triggered when the user achieves a pre-defined goal. For this proof of concept, the goal can be pre-defined as going to the gym. The voice message does not have to come from the app, to prove the concept. Instead, a wizard-of-oz method can be applied here. Wizard-of-oz is a method where the back-end workings of a device are "faked", in order to prove the abstract concept of the system.

The proof of concept will be as follows: a test user will provide a smart-phone. There, a new contact person will be made. This contact person will represent their contact person in the Family & Friends circle within the app. The evaluator will insert a phone number that is unique to this new contact person. The user's smartphone location will be tracked by the evaluator. The user will go through their week, preferably having to complete one of their pre-determined goals i.e. going to the gym. The user does not tell the evaluator what their activities are for the week, instead the evaluator will track the user's location. If the user is seen at home, and not the gym, the evaluator will call the user and play a pre-recorded encouraging message. Similar to the storyboard in Chapter 4: Ideation, see Figure 21. Then, once the user has been at the gym for a few moments, the evaluator will call once more with a different pre-recorded encouraging message. This is then followed by an evaluation

6.4 Preliminary Conclusion

Hi-Fi iteration #2 seems to be the most practical and manageable to do. While the proof of concept takes place, the wireframe will be expanded. It will be expanded to have a more uncluttered outlook and iterate base on the cons of the Lo-Fi evaluation. Of course, the Creative Technology Design Process, is an iterative one. This means that the wireframes will keep on changing based on the smaller evaluations. The Hi-Fi will be further developed into a working and pleasant front-end that will display all the required elements. This is combined with a back-end that only supports the social support function. Other functions are, although deemed must-haves in the requirements, outside the scope and time-frame of this thesis.

6.5 Specification Hi-Fi

The following section will present the Hi-Fi wireframes that will be presented to test during the final Hi-Fi evaluation. To recap: these were the steps that will lead to the final version of the Hi-Fi prototype.

1. Ideation
2. Lo-Fi creation
3. Lo-Fi evaluation
4. Hi-Fi creation
5. Hi-Fi evaluation
6. Final Hi-Fi creation

This section will discuss step 4. Step 5 will be further discussed in Chapter 7: User Evaluation. Step 6 will be presented further in this chapter.
Based on the feedback during the Lo-Fi evaluation, the following wireframes are adapted: 1)Addition of Journal 2) Addition of Diet 3) Removal of "Look into the future" 4) Addition of Personalisation. Furthermore, the wireframe was expanded based on the previously established requirements. The following section shows the wireframe for this Hi-Fi Prototype.

6.5.1 Hi-Fi before evaluation

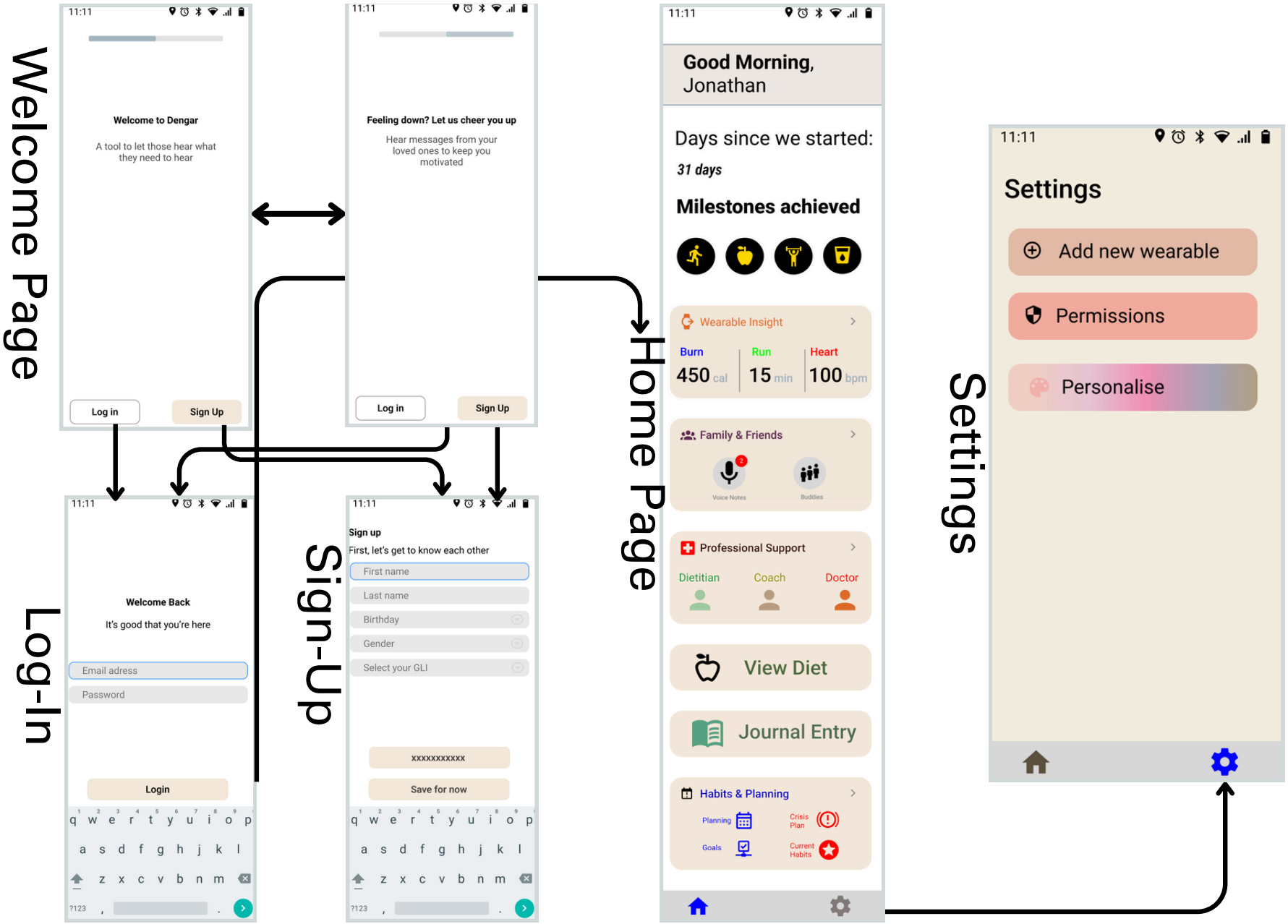


Figure 28: Welcome Page, Sign-Up, Home Page and Main Settings Page

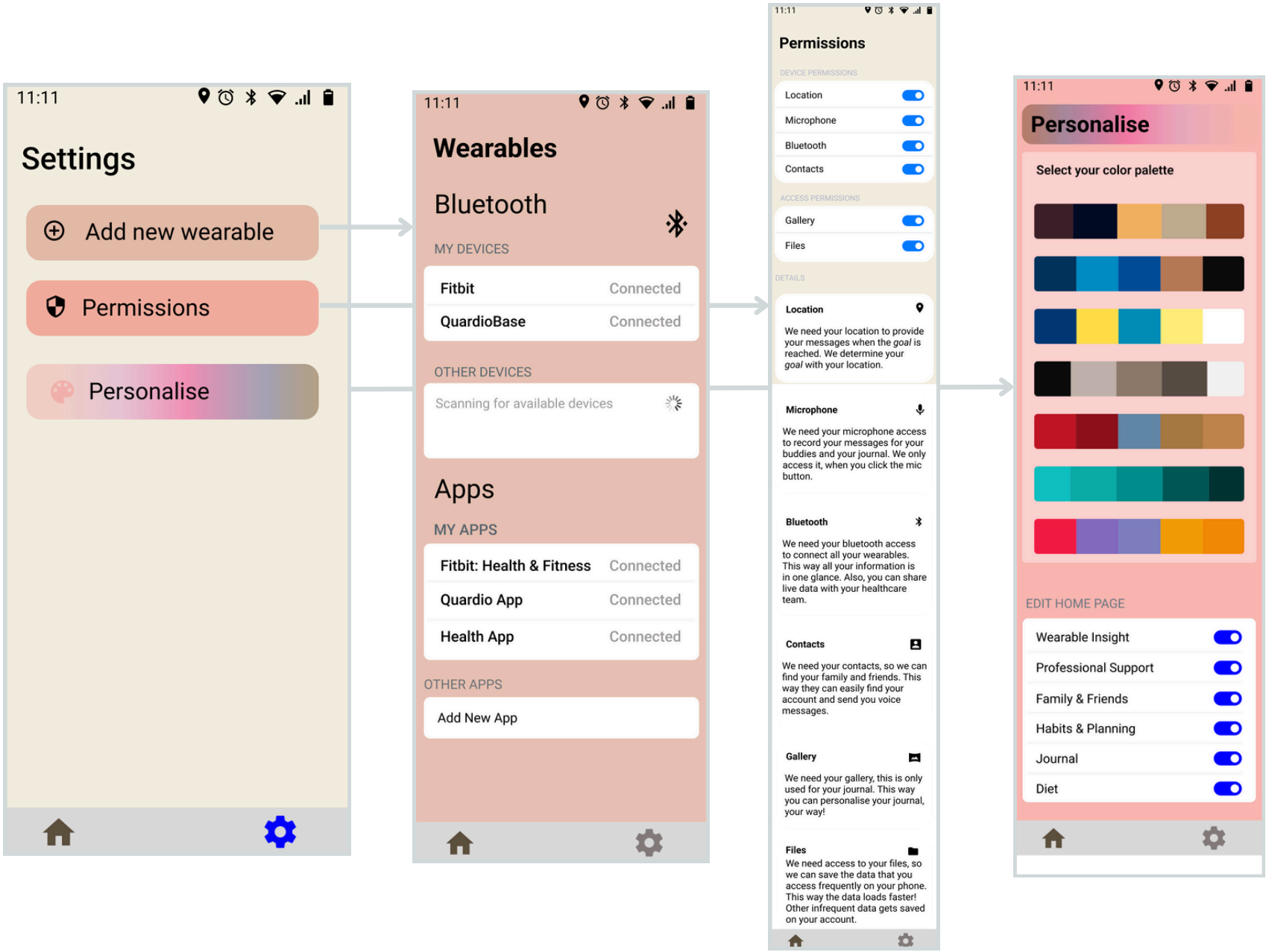


Figure 29: Settings Page, Add New Wearables, Permissions, Personalise

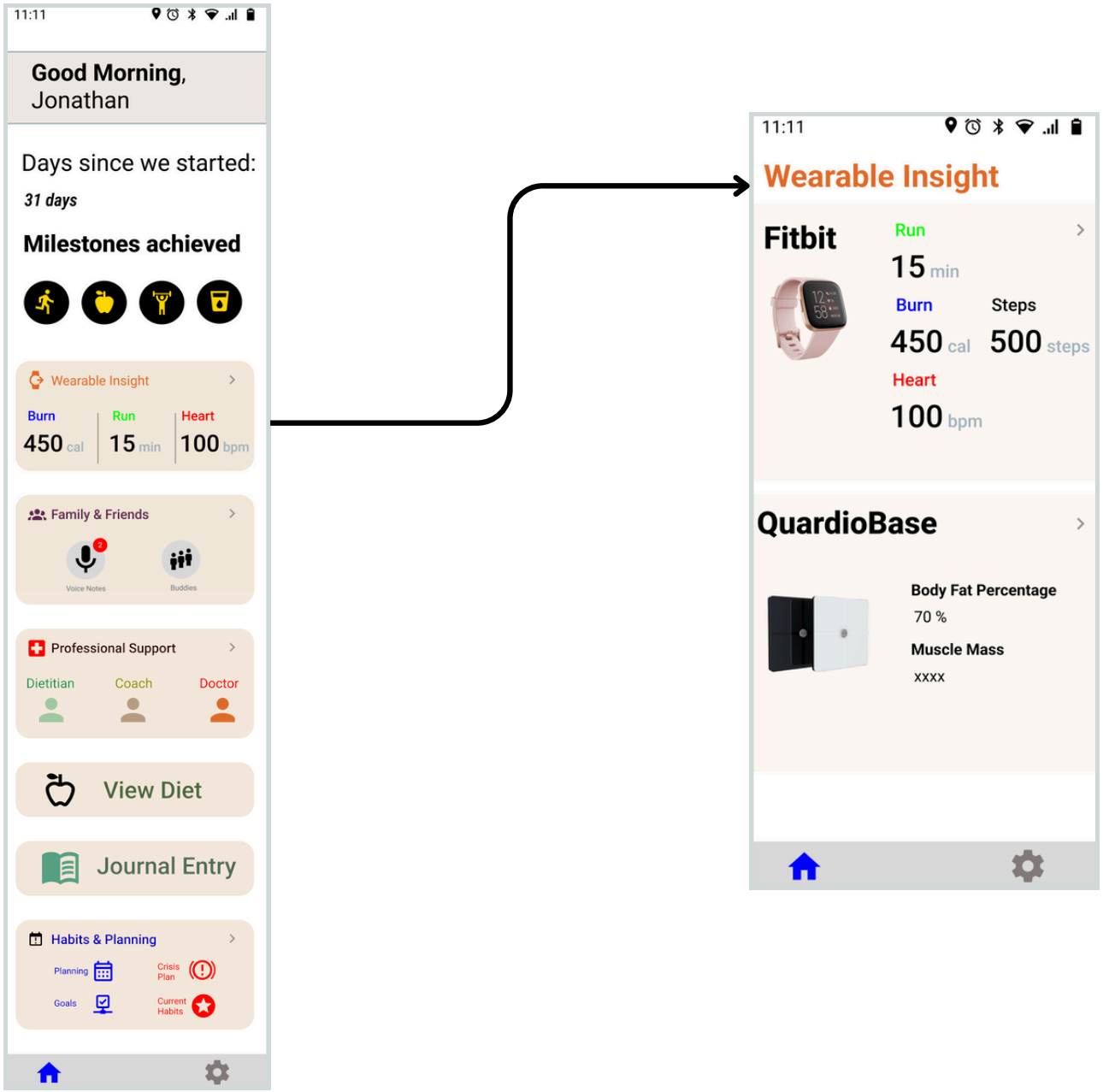


Figure 30: Wearable Insight

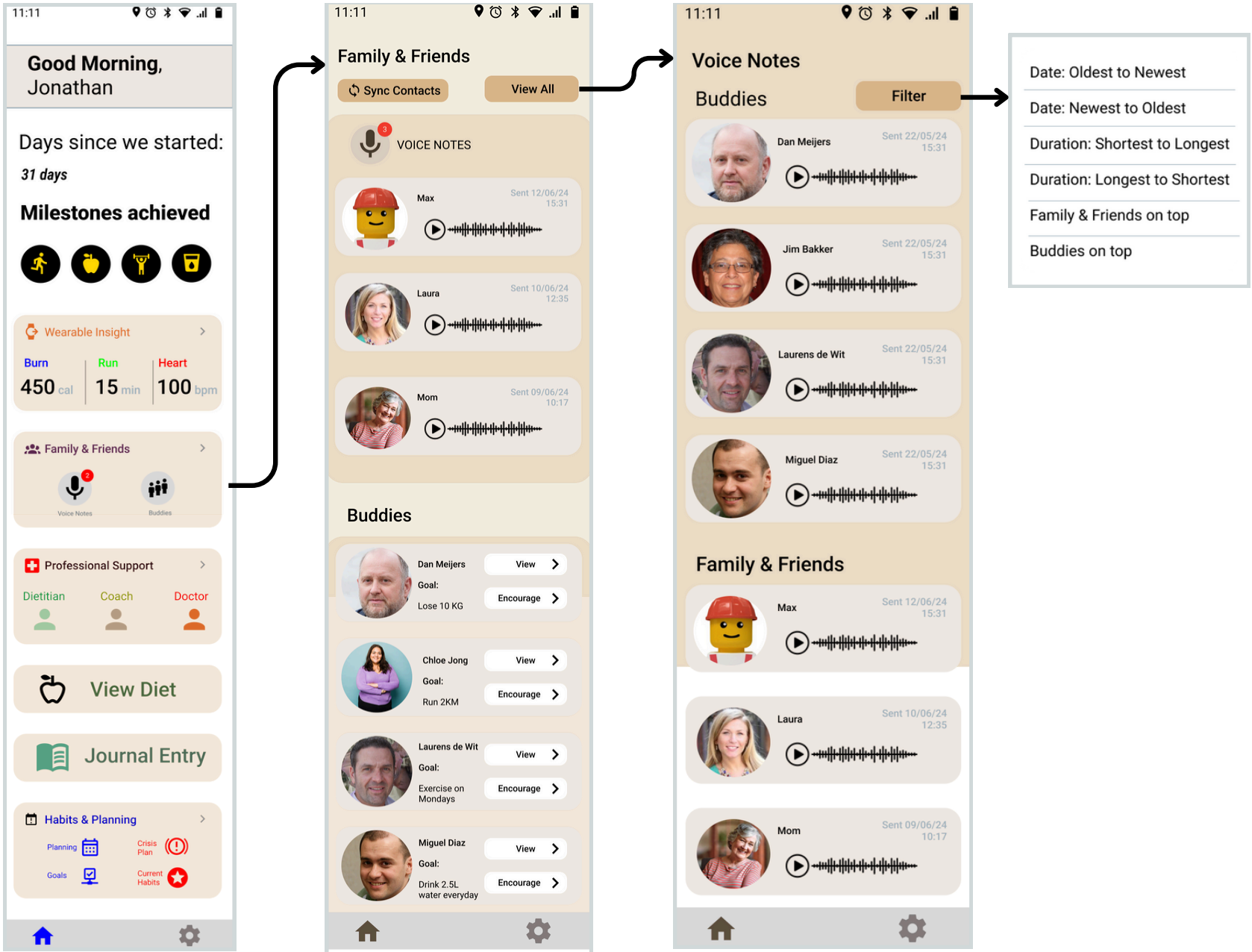


Figure 31: Voice messages within Friends, Families and Buddies

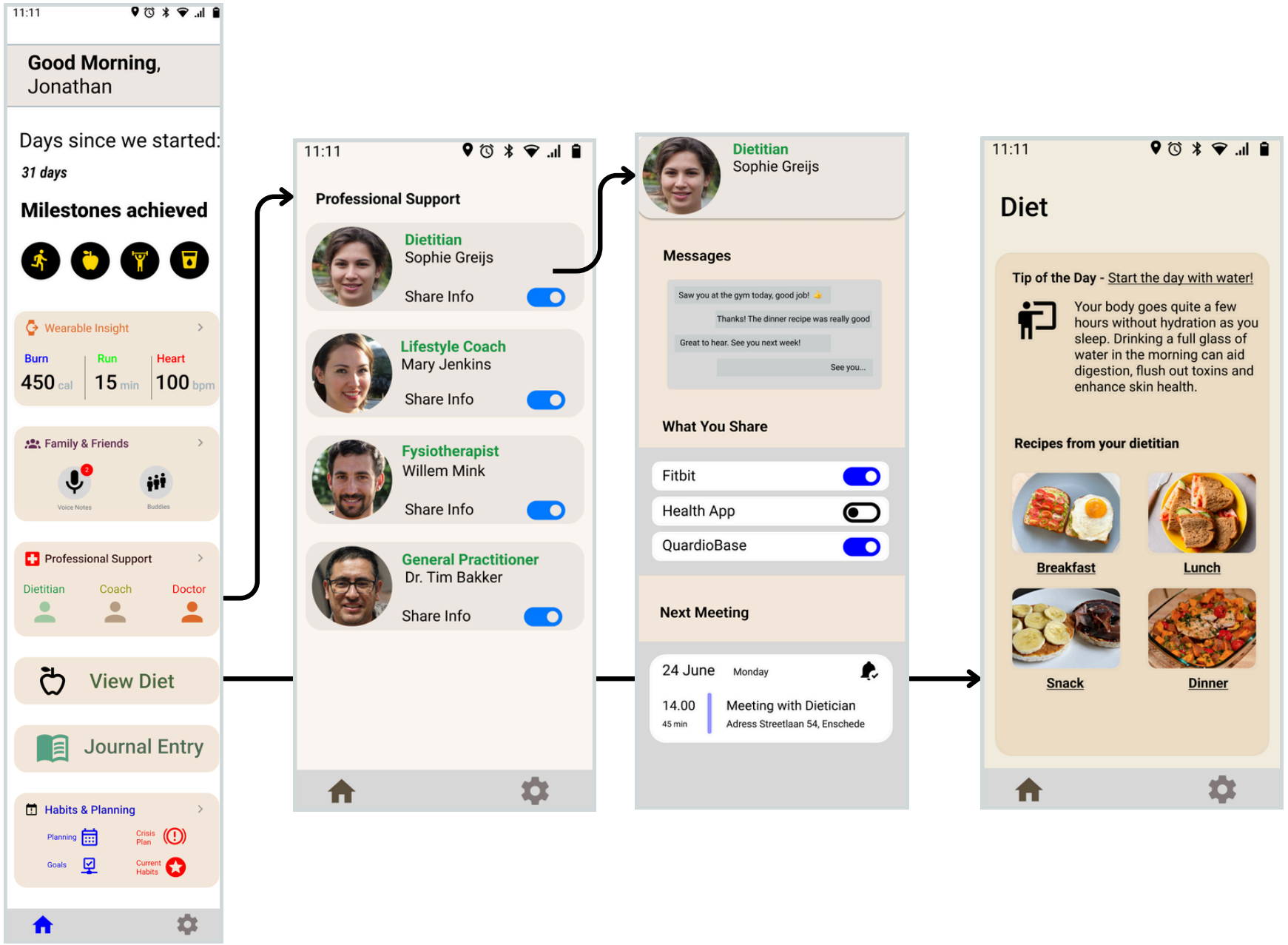


Figure 32: Professional Support and Diet

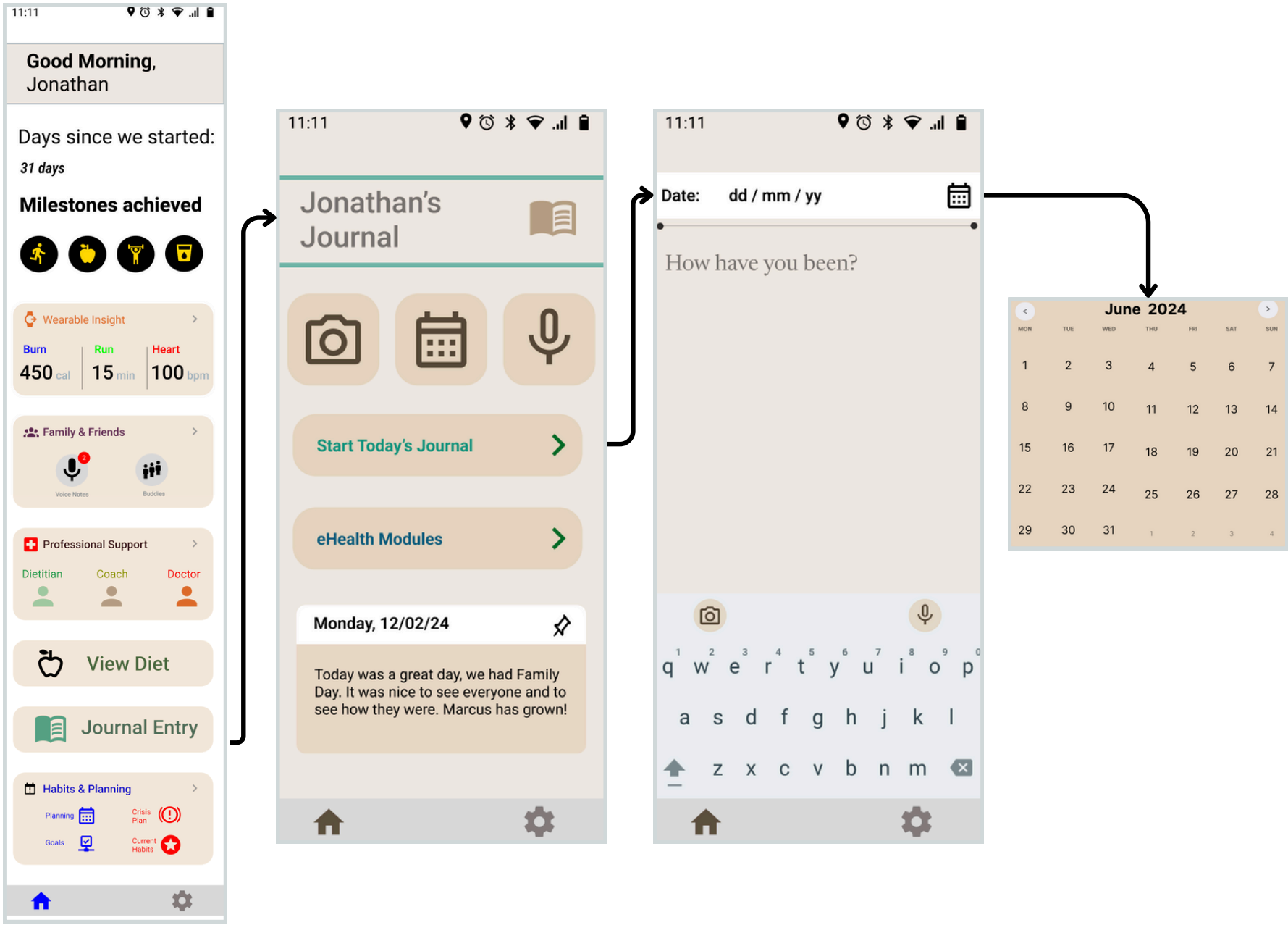


Figure 33: Journal, Add New Journal Entry

6.5.2 Hi-Fi Final

After evaluating this Hi-Fi prototype, many smaller changes have been made to ensure a smoother navigation and less cluttered experience. The evaluation is further discussed in Chapter 7: User Evaluation. The following shows the final prototype. The QR code leads to an online testable version of the prototype, see Figure 34. Figure 35 shows the final flow of the Hi-Fi prototype.

It must be noted that the app works without the user directly opening the app. The app is simply a means to allow users to reach their notifications of unlocking new voice messages. If the user wants to do so, they can open the app to gain deeper insight into their devices, contact other participants of the GLI and communicate with their healthcare team, among other things. The main thing of the app is to unlock social support by means of the audible messages.

Figure 34: QR Code to Prototype [69]

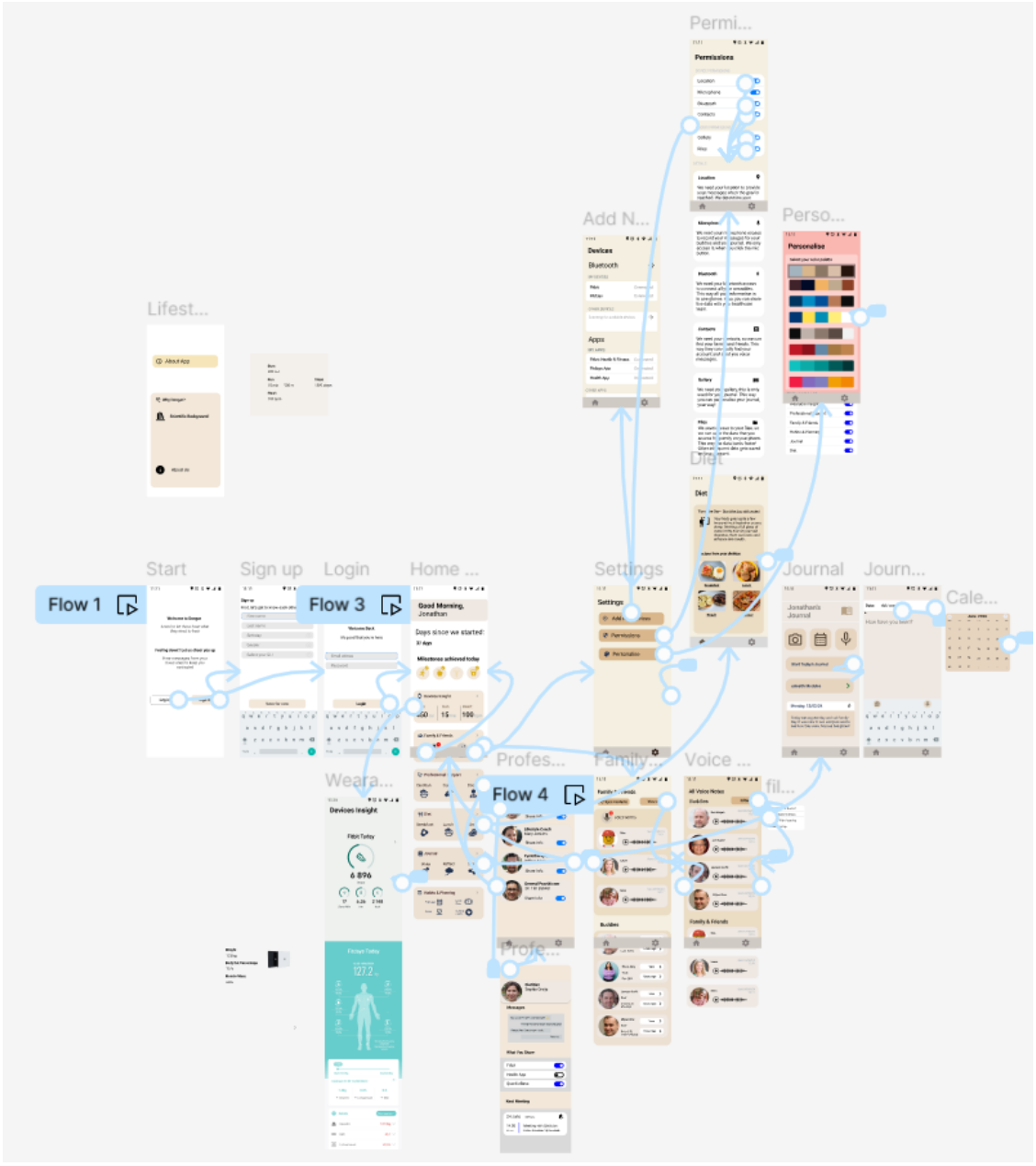


Figure 35: User Flow in Hi-Fi wireframe

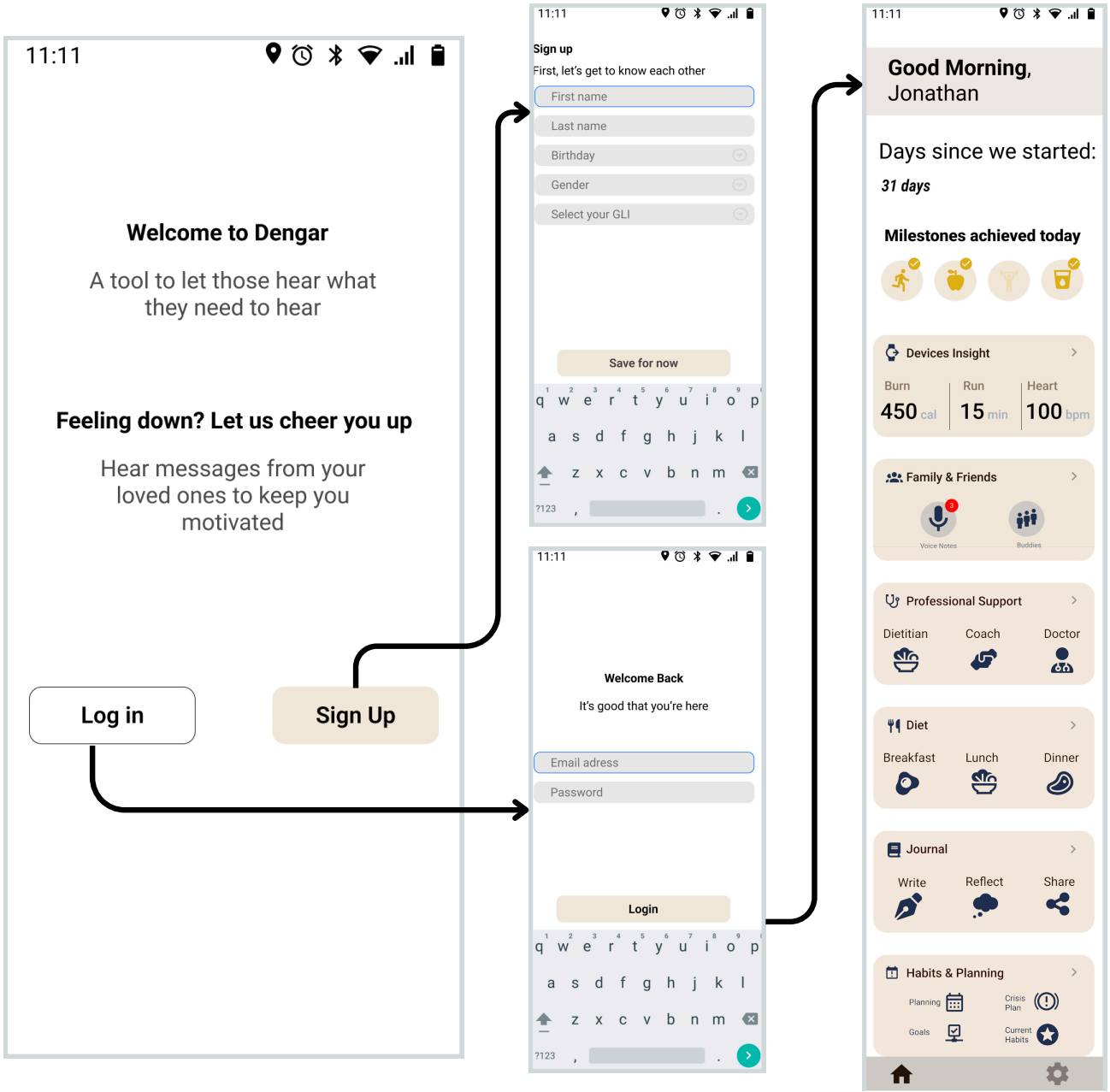


Figure 36: Welcome Page, Sign-Up, Log-in, Home Page

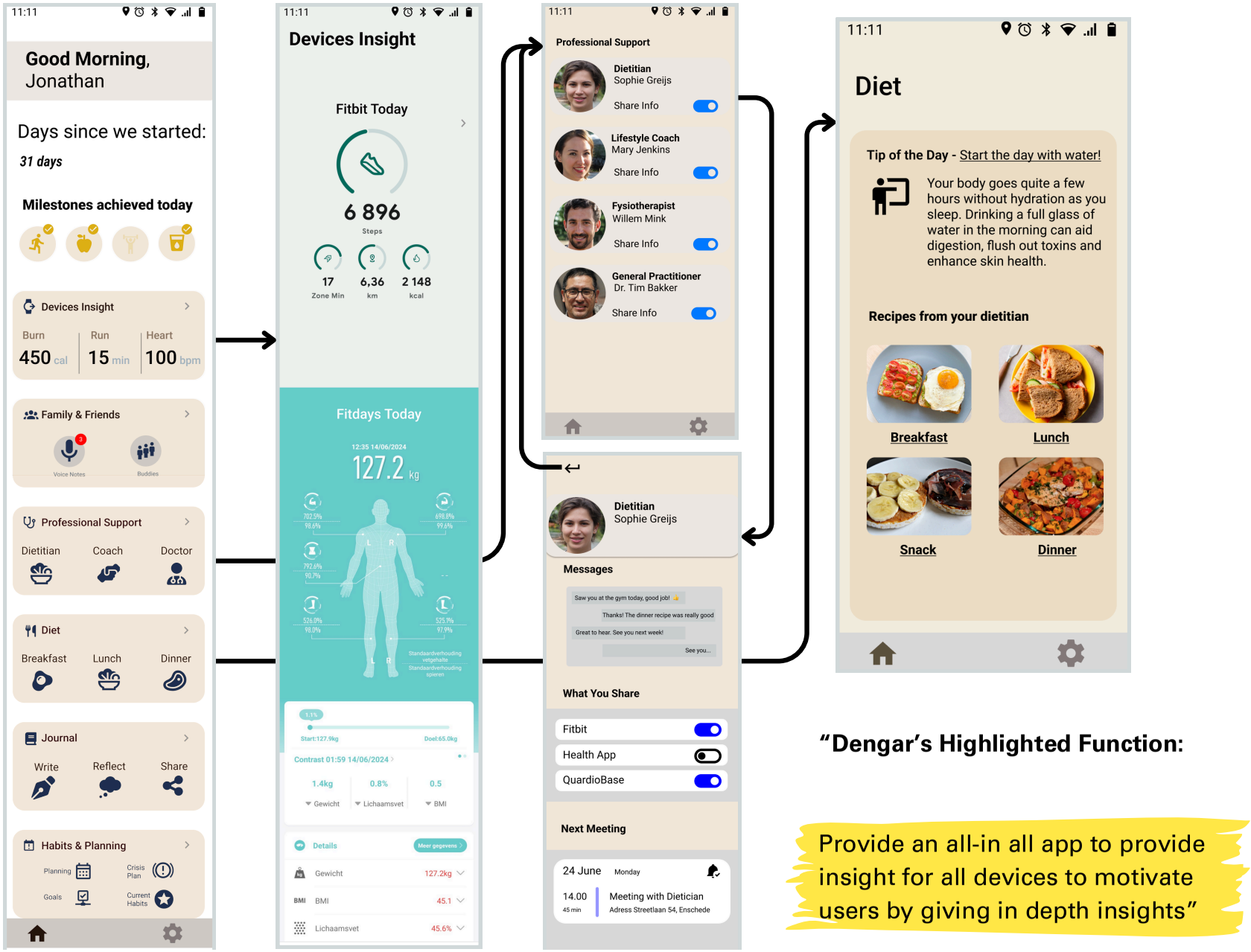


Figure 37: Home Page, Devices Insight, Professional Support, and Diet

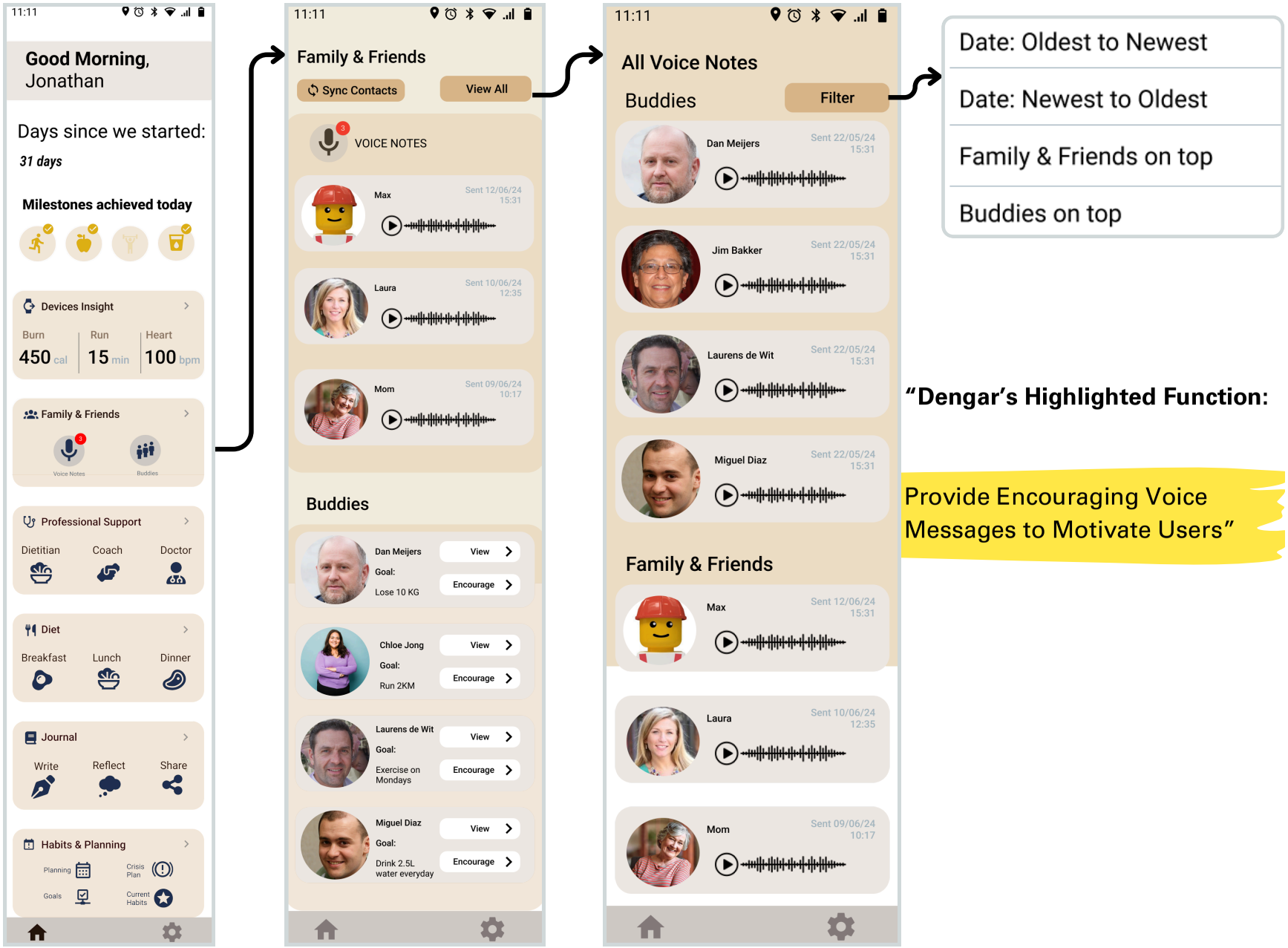


Figure 38: Voice messages within Friends, Families and Buddies

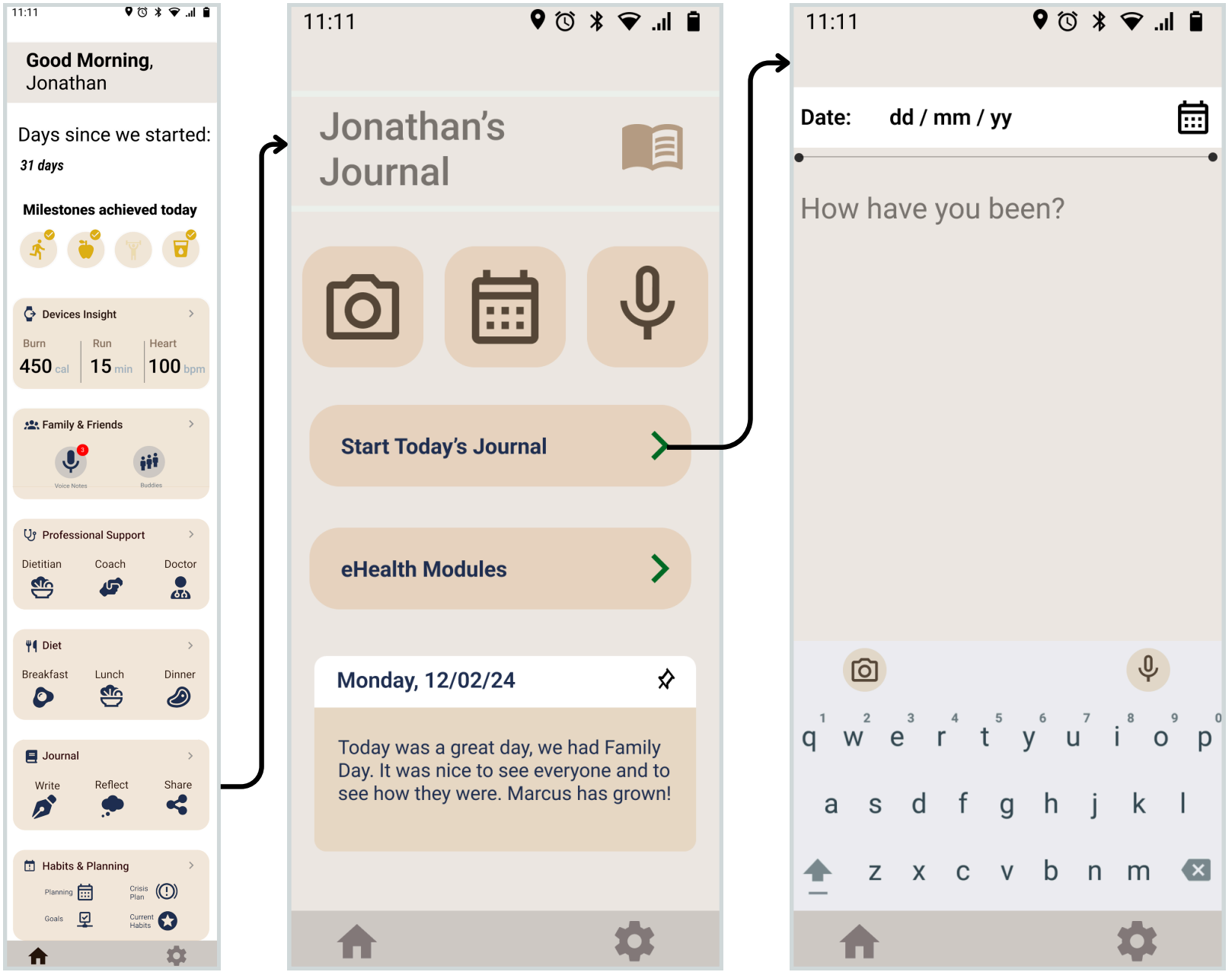


Figure 39: Journal, Add New Journal Entry

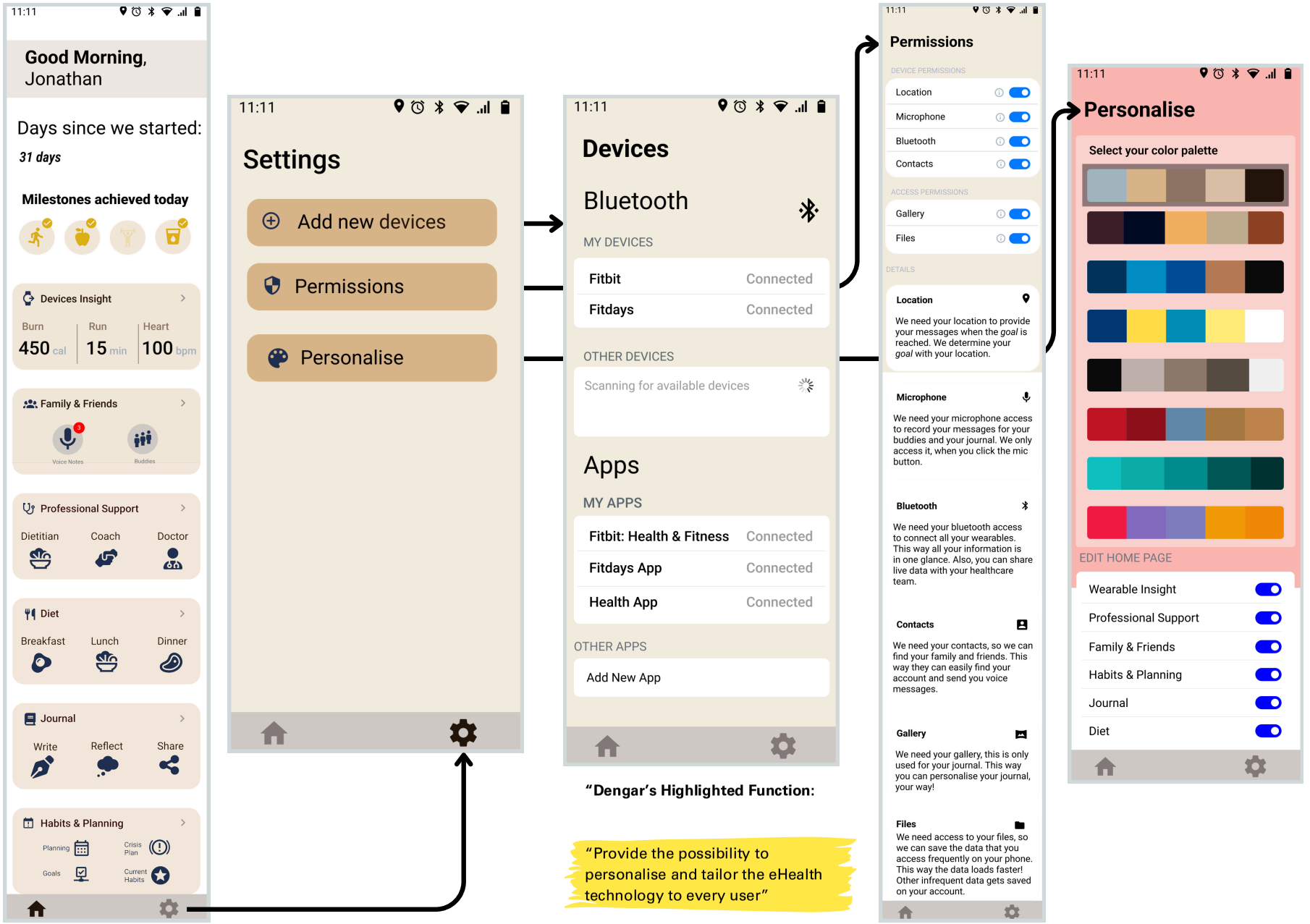


Figure 40: Home Page, Settings, Add New Devices, Permissions, Personalise

Chapter 7: Evaluation

This chapter will cover the evaluation phase. This phase is also the last in the Creative Technology design process. Here, usability of the Hi-Fi prototype will be evaluated. First, recruitment for the evaluation is described. Second, the experimental design and protocol is presented. Third, measures which are used in the evaluation are also described. Finally, a data analysis of the results from the evaluation are presented.

The focus of this evaluation is on usability. Usability testing is used to improve the quality of an interface by finding interface-flaws. Interface-flaws are components within an interface that is confusing, misleading, or generally suboptimal.

7.1 Recruitment

Past participants from the co-design session and Lo-fi evaluation are approached. One web-designer was also approached, he was not a target user. However, he did have knowledge on user interfaces and improving an application's usability. Furthermore, students from Creative Technology were also physically approached. Demographics can be seen in Table 8.

Participants	**Age**	**Gender**	**Status**	**Method of Recruitment**
Participant #1	55	Male	Target User	Acquaintance
Participant #2	29	Male	Target User	Acquaintance
Participant #3	52	Male	Web Designer	Acquaintance
Participant #4	21	Female	Creative Technology Student	Physical Approach
Participant #5	20	Female	Creative Technology Student	Physical Approach
Participant #6	23	Male	Creative Technology Student	Physical Approach
Participant #7	23	Female	Creative Technology Student	Physical Approach

Table 8: Participants in Hi-Fi Evaluation

Lazar, et al. [70, p. 275], states five participants is sufficient to find 80% of usability problems in an interface. Seven participants are thus deemed sufficient.

7.2 Experiment Design & Procedure

Procedure
The experiment design used in this evaluation is usability testing. Usability is assessed through the level of intuition provided by the prototype in terms of navigation, easy-to-use, and content. Here, interface flaws can be found.

Procedure
The evaluation took place in different locations. The location is online for participants who are not physically in the region. Students are physically approached on the university campus. Table 9 shows locations for each participant.

Participants	**Location**
Participant #1	Online
Participant #2	User's Home
Participant #3	Online
Participant #4	University Campus
Participant #5	University Campus
Participant #6	University Campus
Participant #7	University Campus

Table 9: Location of Evaluations

Before the evaluation, the participants were approached in their respective locations, see Table 9. The participants were each provided with an informed consent form. This was discussed and signed. The form can be found in Appendix E.

In all three locations, the same procedure was followed. The flowchart is provided in Figure 41. First, a Figma prototype link was sent to the participant. This link contained the Hi-Fi prototype. The link can also be found in Figure 34. Second, the participant was asked to open the link on their phones. This is to ensure that they evaluate the prototype in a familiar digital environment. Then, the participant is asked to go through the app. The participant is not provided with an explanation on what the app does. This is to test whether the content

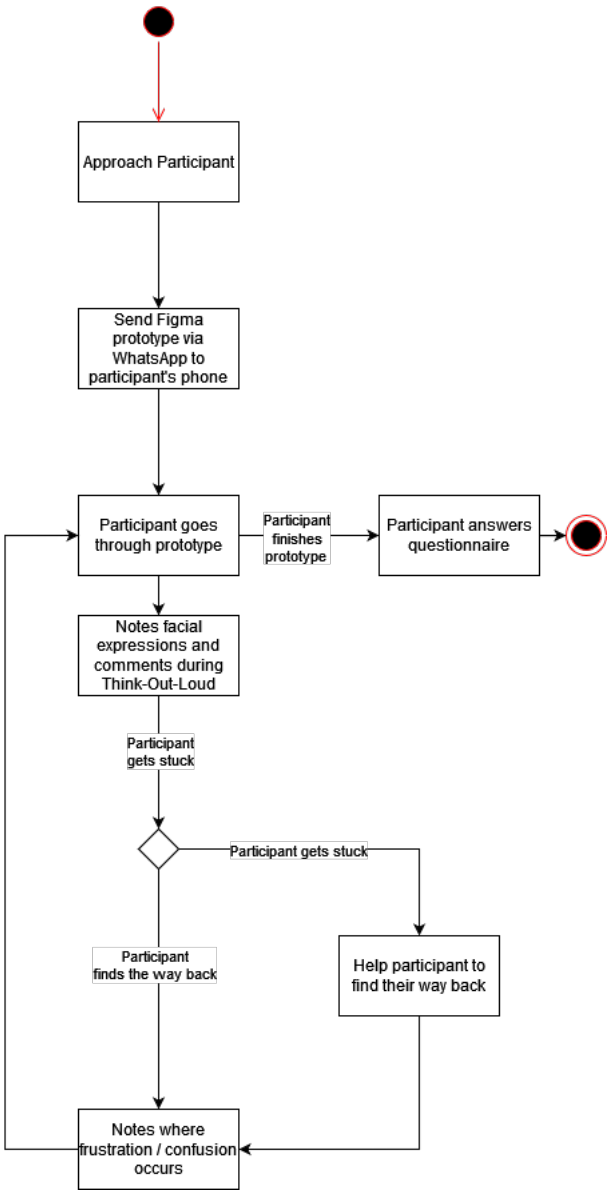


Figure 41: Flowchart for Evaluation Procedure

presented could provide sufficient intuitive information. This is followed with the Think-Out-Loud method. Here, the participant explains their selections and impressions during their journey through the app, out loud to the researcher. The researcher takes notes on their facial expressions and their comments. If the participant is stuck or cannot continue within the app, the researcher will guide the participant back to the home page. The researcher will take note of where this occurs. The prototype evaluation is near complete once the participant has opened all components within the prototype. The evaluation ends with a small verbal questionnaire, see Table 10. Answers to this questionnaire are noted as well.

Questionnaire
"After going through the app, what do you think it does?"
"If the app was completely implemented, would you use this app yourself?"

Table 10: Questionnaire used at the end of evaluation

After the first question, the actual premise of the app is explained to the participant. When the participant answers the final question, the evaluation is complete.

7.2.1 Ethics

Since this evaluation works with human participants, an ethical review was submitted and approved by the Ethics Committee of Computer and Information Science. This ethical review included a request to perform the expert interview, Lo-Fi evaluation and Hi-Fi evaluation. All participants receive a written information brochure and signed an informed consent form before participation, see Appendix E.

7.3 Measures

The Thinking-Out-Loud method, observation and a questionnaire is used to measure usability. The Thinking-Out-Loud and observation is used to assess navigation and easy-to-use within the prototype. The questionnaire is used to measure the content's perceptive level of intuition. The following are elements to look out during the observation :

- Order of navigation i.e. which buttons do they click
- Facial expressions
- Where they are in the app when they are confused/frustrated
- All their comments
- Their final feedback

7.4 Data Analysis

The evaluation resulted in a collection of observations, comments from participants and answers to the questionnaire. These results are first summarised, then analysed by categorising them based on its relation to either navigation, easy-to-use and content. This is presented in Table 11 and Table 12. Table 12 shows results relating to the content of a page. Not all pages are noted, these pages are highlighted because more than one participant had a comment about it. The pre-analysis notes can be found in Appendix D.

Navigation
They found the navigation to be confusing. Their native phone uses swipes to navigate, but the swipe-to-navigate was not working in the prototype. They mentioned that the app should take into account on the different ways that people navigate, i.e. either swiping or clicking a back button.
Easy-To-Use
The app was considered to be very clean and clear. It was easy to use, information was easy to find, and the app gave a calming feeling.
They like the option of messaging their healthcare team and that everything they need is in one app.
They had a clear understanding of where to find information. They found it to be very nice looking. They liked the calm colours and found the app to be calming.

Table 11: Results of Data Analysis: Categorised based on Navigation and Easy-To-Use.

Page	Content
Sign-up /Log-in	They found the sign-up / login page to be confusing, it was not clear whether they had to sign up or log-in. They thought that the app would allow for typing.
Home	On the Home Page, they clicked on all milestones. There is currently no page for milestones. They suggest a milestone page be created.
Home	They mentioned that "check" icons should show whether a milestone had been achieved or not.
Home / Wearables Insight	"Add new wearables" should change to "add new devices", because they use their smart-scale more than their watch. They do not consider their smart-scale as a wearable, therefore they found it misleading.
Wearables Insight	The layout of wearables insight should be the same for all types of wearables.
Diet	They found the Diet page to be really nice. They also suggested that the pictures be clickable.
Personalise	The Personalise button should not have a gradient background, it should be a solid colour, like the rest.
Personalise	In the colour palette component, an active palette should be shown.
Permissions	In the Permissions page, they suggested to not scroll to find the information, rather to click on item and have a pop-up.
Journal	They found the calendar in the Journal page unnecessary, the date of today should already be filled in.

Table 12: Results Analysis of Content-based Comments and Observations

During the question of "If the app was completely implemented, would you use this app yourself?", both target users have stated that they would like the app to be implemented. They add that if it was implemented, they would definitely use it.

Results from Proof of Feasibility
Then, there was the proof of feasibility mentioned in Chapter 6.3.2. One of the target users from the co-design session was willing to participate. To recap, this was the task the participant had to do: to share when he would be at the gym that week and to share his phone number and location with the researcher. The researcher asked the participant's family member if they could provide a voice audio, either encouraging him to go to the gym or celebrating that he is at the gym.

The participant found the surprise to be encouraging. He really liked hearing the voice of a real person instead of an artificial voice. He did not expect much of it at first, but realised that hearing it did help him with motivation to stay longer at the gym. He felt the extraneous accountability from his family member. In the end, he was proud that he went to the gym and exercised.

Chapter 8: Discussion and Conclusion

This last chapter starts by recalling the aim of this thesis and problem it tries to tackle. This is followed by answering the main research question and sub-questions. Thereafter, limitations of this thesis and the mitigation thereof are presented. This is continued by a collection of strengths within this thesis. Finally, future implementation is described and a future direction is expressed.

8.1 Conclusion

To reflect on the goal of this project: This research aims to ultimately design a technological system to help male obese adults adhere to their lifestyle intervention program by means of social support.

The problem that is addressed in this thesis is about male obese adults that, due to lack of motivation, do not complete their lifestyle intervention program. This allows them to be prone to obesity's severe effects and to continue living an unhealthy lifestyle.

Males are often overlooked in research surrounding the topic of obesity and eHealth devices. Therefore, this thesis fills that gap by focusing on obese male adults.

The technological system is implemented by means of co-design and the Creative Technology design process. This system highlights insight and social support to help its users with motivation. It does so by allowing people around the user to encourage them using voice messages and by providing a hub-all-in-one app layout to gain maximum insight. Although, the implementation might be limited, the current prototype shows well-received evaluations.

The main research question can be recalled as:

> How to co-design a technological system that motivates obese adults to adhere to their lifestyle intervention?

and the sub-questions, together with their answers:

1. Which components make health technologies effective for weight loss in obese adults, according to literature?

   According to literature, two components are responsible for making health technologies effective for weight loss in obese adults : *social support and insight*. A health technology is not effective for weight loss in obese adults when 1) the health device is used as a standalone device (i.e. no other support is provided). 2) Patients (obese adults) with a low socio-economic background do not receive guidance from healthcare professionals when using the device. 3) When physical and psychological barriers of these obese adults are not held in consideration within the design of the health technology.

2. What other co-design sessions have been done with obese adults?

   There are currently not many sessions done with obese adults found in literature. Although, the study done by Asbjørnsen, et al. [37] has presented a comprehensive co-design session with obese adults on creating an eHealth device to help with weight loss. This results from this study were used as a base for this project's co-design session.

3. What are the state-of-the-art technologies which help obese adults lose weight?

   Currently, there are many apps, wearables and devices that help obese adults lose weight. Examples are Smart-scales with its corresponding app, the Oura ring with its corresponding app, the Fitbit with its corresponding app, the Health app and the Ommetje app. It appears that *social support* is currently not equally broadly implemented in consumer technologies as *insight*.

4. What are barriers and facilitators for obese adults to start with and adhere to a lifestyle program, according to patients and lifestyle intervention coaches?

   According to patients, lack of motivation that could occur throughout the program can be a barrier to them adhering to the lifestyle intervention program. Social support is mentioned to be a facilitator in increasing their well-being and motivation, thus facilitating them to adhere to their lifestyle intervention program.

   According to the ex-lifestyle intervention coach, patients who have strong intrinsic motivation and a supportive environment will most likely adhere to their lifestyle intervention program. So, lack of intrinsic motivation and a supportive environment could pose as a barrier, while possessing intrinsic motivation and a supportive environment could pose as a facilitator to adhering to their lifestyle intervention program.

All in all, the summative answer to the research question could be formed as follows:

> A system can be co-designed in the shape of an all encompassing app that provides insight and social support through means of audible messages. This concept shows the future possibility of increased motivation, which could help obese male adults adhere to their lifestyle intervention in the future.

8.2 Implications

These results build on existing work from different fields. First, it was built upon previous co-design research with obese adults within eHealth, namely Asbjørnsen, et al.'s [71] research. Their paper provided the base for this thesis' co-design session. Asbjørnsen, et al.'s follow-up paper on creating the eCHANGE app [72] is parallel to Dengar. However, Dengar's novelty is that it was made in the context of it being used next to a lifestyle intervention program.

Second, it continued Griffin, et al. [73] and Cavallo, et al. [74]'s research on enhancing social support by means of text-messaging and social-media, respectively. It did so by incorporating voice-messages.

Third, it was built upon Batsis, et al. [75] work on health insight to further motivate obese adults into losing weight and lifestyle changes. Which inspired the function "Devices Insight" within Dengar.

Fourth, Vuorinen, et al.'s [76] work on showing how longitudinal health data can be shared with healthcare professionals and its positive effects towards patient's motivation is also an inspiration for and integrated within the function "Professional Support". A combination of the healthcare team's presence and encouragement with "Devices Insight".

Fourth, all-in-all the development of the app could bridge the gap in research focusing on men within the obesity-eHealth context, as pointed out by Robertson, et al. [12]. They suggest that it is important to understand men's view on weight-loss, among other things, how it relates to motivation. This research built on that suggestion by only including men in the co-design session.

Finally, this whole system's place of context is built on top of Oosterhoff et al. [77]'s yearly report for the Dutch National Institute for Public Health and Environment. Here, they report on the current GLI status and, among other things, how to make their participants adhere to the program. They state the problem of participants yielding the program due to lack of motivation. Which Cifuentes, et al. [7] also state that patients who had a non-tailored lifestyle intervention resulted in feeling that the program did not suit them, which results in lack of motivation to complete the program. A problem that through the design of a system could possibly contribute a solution towards.

As a total picture, the design of the system contributes to the narrow selection of eHealth-intervention related research with obese adults based on a co-design setting within a lifestyle improvement context.

8.3 Ideation Limitations

A point of limitation within the co-design session is the structure itself. The co-design already had a structure where participants were given options to choose from. Most co-designs are freely structured, where participants are free to invent something themselves. However, this assumes that the participant has the creative capacity to do so. It also could allow for some impractical ideas to show, although impracticalities are also a part of ideation. It was more feasible to provide pre-determined options, that way the direction of the system was already shaped. This way the divergence phase does not go too far, that convergence is too difficult to implement.

The way to mitigate this structure limitation, is by introducing a short discussion during the session. Here, the participants are free to comment or add any thoughts that they have on the system. These comments are noted and taken into account.
Moreover, as for the amount of participants, it is a limitation that there were only three participants. One of them is currently obese and two were formerly obese. An improved co-design could have more participants who are currently obese and currently following a lifestyle intervention program. An attempt to mitigate this was

done by handing out flyers. Unfortunately, there were no participants who were interested.

During ideation, participants were asked to rank their values and building blocks that they found important. Not all of their input and feedback were incorporated. Rather, only elements that were provided by all three participants were implemented. In future work, the app should be able to incorporate all the values a user has.

8.4 Specification & Realisation Limitations

During the specification and realisation phase, it could be considered a limitation that the back-end of the app was never implemented. This was mainly because of the large extent of the implementation. This required deep knowledge on API workings, access to the Fitbit API and watch itself, access to a smart-scale and its API. It also required a good skill set in programming swiftly and effectively given the time constraint. The back-end would also need a database and a server to be able to store and fetch data. It is a project on itself to implement the back-end.

It was sufficient for usability testing to have a front-end Hi-Fi prototype within the Figma environment. This showed to be efficient during designing. Furthermore, it is also a limitation that the very core of Dengar, the audio messages itself, was never implemented in the wireframe. This is because Figma has not allowed for audio uploads and usage within its "Free" subscription. To mitigate this limitation, a proof of feasibility using a phone call was done.

On another note, there was a comment given by a participant during the evaluation. It was about the permissibility of the app that allows users to stop sharing their Wearable data with their healthcare team. It was a discussion on whether the user should have autonomy on their data but at the same time there is a possibility that the user, who already has difficulties with motivation, will block all healthcare team help by removing their Wearable data access. This means that by allowing the user to block/unblock data, the app does not serve its purpose as helping the user's motivation. This is certainly different for all users. However, further research must be done to define the difference from user autonomy versus "letting the system do its job".

8.5 Strengths

Up until the publication of this project, no eHealth app has been able or has existed to be an all-encompassing-hub app that integrates all possible different components within the context of helping obese male adult in adhering to their lifestyle intervention program. Components such as:

- Social support by means of unlocking encouraging voice messages from friends and family,
- Integrating all the user's wearables and devices,
- Using this integration to share data with healthcare professionals,
- Contacting and being encouraged by healthcare professionals,
- Be connected with and encourage other GLI participants
- Provide an all-in-one platform for healthcare professionals to share information to the users (Dieticians can post recipes, psychologists can post mental exercises)
- Allow for personalisation

This idea was welcomed by all participants of the different evaluations. This concept-app shows that this is one way to incorporate social support and insight to increase motivation.

Then, on strengths within the thesis itself. First, co-design was used as a tool within user-centred design. This allowed most design choices to be sourced directly from future target users. Allowing the design to be made for users, by users.

Second, the Creative Technology design process was used as a main method. This method is mainly targeted for designing existing technologies within a social context. This allows for an iteration process, one that is quite

common practice in the design domain.

Third, although it was a considerably small pool of users, they did provide sufficient insight as to how the system was to be designed. This led to the overall satisfaction of usability during the Hi-Fi testing. Target users even consider using the app once it has been fully implemented.

Fourth, the co-design session was based on peer-reviewed research by Asbjørnsen, et al. [37]. This allowed for a grounded base. The app could be considered to have a grounded starting point because it was based on the paper.

8.6 Future Implementation

In the future, once the app is fully implemented, it could act as a one-of-a-kind eHealth technology. With this app, users (male obese adults) are encouraged by their family, friends, GLI participants and their healthcare team to continue and adhere to their lifestyle intervention program until the end. The program will continue to help them curate a healthier lifestyle. They reduce their level of obesity and avoid being prone to obesity's side effects.

If the app is fully implemented, it must be free to use. In other words, there should be no obstacles for users who want to use the app. It should be a voluntary part of their lifestyle intervention program. The app should be either offered by the healthcare team, or the user could discover it themselves and include the healthcare team. The app should, in the end, be one of the many effective ways of motivating obese adults in their path to a healthier lifestyle.

Evaluations has shown this app was well received amongst its target users. Target users even continue to say that it is probable that they will use the app once it was implemented in the future. Although, this thesis only focused on the usability of the app and not the feasibility. Future work could continue this work by fully implementing the app through-and-through and evaluate its long-term feasibility. Results of this future work could possibly help users adhere to their lifestyle intervention program and, in the end, live a healthier lifestyle.

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Generative AI Directive: During the preparation of this work, I used no artificial intelligence tools.

Appendix A: Co-Design Guidelines

Guideline 1: Understanding Stakeholder Vulnerabilities and Diversity

1. Researchers who are not familiar with the context in which the eHealth system will be used should be acquainted with that first.
2. Encourage trust between the participants and the research team.
3. Researchers should be mindful and respectful of the health vulnerabilities of the participants.
4. Researchers should understand and contact the different stakeholders involved.
5. Researchers should understand the significance of evaluation and actual implementation of the device.

Guideline 2: Planning for and Assessing Health Behavior Change

1. Researchers should consult behaviour change literature and or involve experts in the field that are relevant to the problem context to identify the targeted change and help plan the type of activities that should be done in a co-design session. This should be done in the early stages of the co-design preparation.
2. The co-design session should be tailored to the individual circumstances and capabilities of the stakeholders, especially for the end user.

Guideline 3: Identifying and Involving Co-design Facilitators

1. Researchers should engage diverse stakeholders that have an authentic understanding of the problem context(i.e. app developers, health practitioners, and health insurance providers etc.)to partake in the co-design session as well.
2. Researchers should urge these stakeholders to empathize and respect the end users during the session.

Guideline 4: Immersion Into the mHealth Ecosystem

1. Researchers should be immersed in the context of the stakeholders.
2. Researchers should identify diverse stakeholders in the early stages of co-design to allow them to contribute and be involved in the design.

Guideline 5: Identifying and Involving Post-design Advocates

1. Stakeholders who are well-connected and respected in the application context should also be engaged in the co-design session. By actively involving them early in the co-design process, their contributions can already be considered in the pre-design and generative phases.
2. These well-connected stakeholders are critical to informing and supporting the implementation of the system in the real world and to continue to promote the system to other new patients.
3. Researchers need to recruit these stakeholders to, in the end, help with the post-design phase and to measure the impact of the system in the long run.
4. These stakeholders should be involved in every phase of the co-design, since they can help in implementing the system and provide feedback when the system is used in practice.

Guideline 6: Applying Health-Specific Evaluation Criteria

1. In the evaluation phase, researchers should ensure that the system undergoes a real-world feasibility test for potential (health) risks and ethical issues associated.

Guideline 7: Collecting and Analyzing Usage Data to Understand Impact

1. After the system's implementation, usage data should be collected to observe the system's impact to understand its effectiveness in the long-run.

Appendix B: Brainstorm

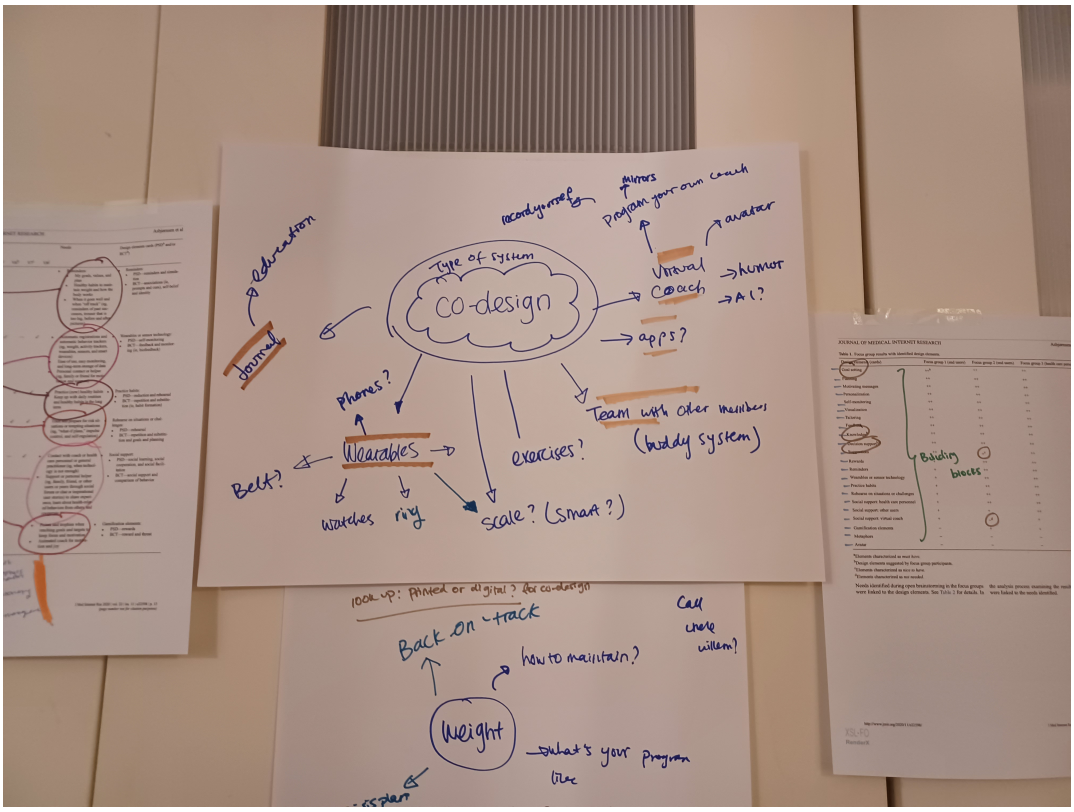

Figure 42: Brainstorm for co-design

Appendix C: Recruitment Flyer

Figure 43: Flyer used to recruit participants for co-design

Appendix D: Pre-Analysis Evaluation Results

Participant 1

- He mentioned that "check" icons should show whether a milestone had been achieved or not.
- He wants the option to block contacts or prevent contacts from seeing him using the app or allowed to send him messages.
- First, he scrolled through the home page all the way to inspect all the components.
- He wanted to change "add new wearables" to "add new devices", because he uses his smart-scale more than his watch. He does not consider his smart-scale as a wearable, therefore he found it misleading.
- He liked that he could personalise the app
- He had a lot of trouble navigating through the app, a back button would be helpful. The current prototype uses swiping left (back) and right (forward) to navigate. He does not like swiping.
- He wants the conversation in the professional profile to have different colour bubbles for each person.
- He says that his dietitian appointments are 15 minutes, stating 45 on the professional profile seemed too much.
- He liked the Diet component, he did not like having to click on the links, he rather has the recipes be directly loaded inside the app.
- The calendar in the journal is unnecessary, since the date of today should already be filled in.
- Lastly, the overall impression is that the app looks very nice and "If this were fully implemented, I would definitely use it"

Participant 2

- He started with the sign-up / log-in page in which he found confusing. He thought he needed to actually sign up for it. He was guided to the Home page.
- He liked the look of professional support and the contents.
- He especially liked the Diet component. He clicked through all the links to the recipes and looked happy looking through the recipes.
- During the evaluation, he had received a text from someone. He was slightly distracted, but could find his way back to the app. This means that the app has a low cognitive load and easy to find back to where one left it.
- On the Home Page, he started to click on all milestones. There is currently no page for milestones. He suggests a milestone page be created.
- He proceeds to the journal page. He starts clicking on the camera, microphone and calendar icons. He wanted to test if that worked, but that feature was not implemented.
- All in all, he found it creepy that the app had access to his location. He wondered if he could also opt to fill in the metrics such as food intake, water intake etc manually. He would want to have the option in the future.
- Lastly, he wanted the app to also be in Dutch, since the GLI program is also given in Dutch. His overall impression: "Looks good, I would totally use it in the future."

Participant 3

- He found the Top Bar confusing, this bar showed the times, and standard settings of the phone. He found it confusing because a phone naturally already shows the details, the wireframe should not show it.
- He wants the full app to have universal colours. Not too many different ones. He does not want the use of harsh colours. The scheme must be calming.
- He liked the Diet page, he wants the pictures to be clickable as well. He does not want to only be able to click on the link.

- He wants all fonts to be the same: bold for title, regular for normal text.
- He thinks that the navigation needs to be fixed using back arrows.
- Milestone should show incomplete milestones too, and a separate page for more information on each milestone.
- The Personalise button should not have a gradient background, it seemed childish.
- In the colour palette component, an active palette should be shown.
- The layout of wearables insight should be the same for all types of wearables.

Participant 4

- They liked the different categories in the Home page.
- They found the sign-up / login page to be confusing.
- On the Home Page, they started to click on all milestones. There is currently no page for milestones. They suggest a milestone page be created.
- To improve on clarity, it is suggested that the Fitbit in Wearable Insight should show what date the data is showing.
- They liked that the next meeting could be seen in Professional Profile.
- They suggest that the navigation needs to be fixed using back arrows.
- They found the Diet page to be really nice. They also suggested that the pictures be clickable.
- In the Permissions page, they suggested to not scroll to find the information, rather to click on item and receive information.
- All in all they found that it was very clear where everything was. They found it to be easy to understand and the layout is pretty.

Participant 5

- They found the sign-up / login page to be confusing.
- On the Home Page, they started to click on all milestones. There is currently no page for milestones. They suggest a milestone page be created.
- They really liked the permissions component on professional profile page. They thought it was nice that they had a sense of autonomy.
- They found the Diet page to be really nice. They also suggested that the pictures be clickable.
- They really liked the option to have the app be personalised.
- They had a clear understanding of where to find information. They found it to be very nice looking. They liked the calm colours and found the app to be calming.

Participant 6

- They found the sign-up / login page to be confusing.
- On the Home Page, they started to click on all milestones. There is currently no page for milestones. They suggest a milestone page be created.
- They found the navigation to be confusing. Their native phone uses swipes to navigate, but the swipe-to-navigate was not working. They mentioned that the app should take into account on the different ways that people navigate i.e. either swiping or clicking a back button
- They found the Diet page to be really nice. They also suggested that the pictures be clickable.
- They like the option of messaging their healthcare team and that it is in one app.
- They also suggested sharing milestones to social media as well.

Participant 7

- They found the sign-up / login page to be confusing.
- On the Home Page, they started to click on all milestones. There is currently no page for milestones. They suggest a milestone page be created.
- They like that they were able to share certain and not all data with their healthcare team.
- They liked that the next meeting could be seen in Professional Profile.
- They found the Diet page to be really nice. They also suggested that the pictures be clickable.
- The calendar in the journal is unnecessary, since the date of today should already be filled in.
- They like the Permissions page because it stated the different purposes for each permission.
- They really liked the Buddies page and found the encouraging component to be nice.
- They really liked the option to have the app be personalized.
- They want the option to change the order of the Home page.
- All in all, the app was considered to be very clean and clear. It was easy to use, information was easy to find, and the app gave a calming feeling.

Appendix E: Information Brochure and Informed Consent

Graduation Project || Information Brochure

You are asked to take part in research study that is conducted by Jacelynn Moesker and Dr. Femke Nijboer. This research is part of a Creative Technology bachelor graduation project. Our research pertains to how a system can be designed to help motivate obese adults adhere to their lifestyle intervention programs. One of the tools to design such a system is co-design. Co-design is a workshop where target users are involved in the design process. This workshop will be done in three sessions:

1) A brainstorm session
2) User evaluation part 1
3) User evaluation part 2

1) The brainstorm session will be held online. We will use a website that allows for discussion with visual materials (pictures, drawing etc). We would like to hear about your experiences on technologies that you may have used during your lifestyle intervention program.
2) After two weeks, we would like to hear your input on the device that we are developing. We will change the device based on your input.
3) Two weeks later, we would like to hear your input on the final version of the device. This will also be the last session.

Your participation is this research is voluntary and you are free to withdraw from participation at any time and without giving a reason. Please read this information brochure carefully in order to decide whether or not to participate. If you have any questions, do not hesitate to ask the researcher.

Purpose of the research:

There is an increasing number of obese adults in the Netherlands. A percentage of those are following a lifestyle intervention programme i.e. diets/exercises regimes/stress management etc. It is often hard for these adults to maintain and adhere to their program, even though they know about what they need to do, how to do it and when to do it. The purpose of this research is to design a system that can help those adults in adhering to their program, so they can achieve their end-goal, whether that is to lose weight or to live a healthier life.

During the session(s):

1) The concept of brainstorming will be shortly explained. Then, a brainstorm session about how to design such a system will be held. Participants will be asked to write down their thoughts or use visual tools provided by brainstorming website. A 5-minute tutorial on how the website works will be given. After 10 minutes, participants will shortly explain their thoughts and the discussion can start. After 20 minutes of discussion, the researcher will give a short summary of what has been discussed. The session will take approximately 35-50 minutes, excluding introductions of participants to each other.

2) The researcher will visit the participant and present them with the first prototype. The participants will be asked to use the prototype and give their input. Their input will be written down. This session will take approximately 20-30 minutes.

3) The researcher will visit the participant and present them with the second prototype. The participants will be asked to use the prototype and give their input. This session will take approximately 20-30 minutes.

Benefits and risks of participation

This research has been reviewed by the Ethics Committee Information and Computer Science. There are no risks in participation. There are no immediate personal benefits. Participation solely helps the researcher in their graduation project.

Procedures for withdrawal from the study

You have the right to withdraw from the study at any time without penalty. If you wish to withdraw, please inform the researcher. You do not have to provide a reason if you wish to withdraw.

Collection and Processing of Personal Information

During this study, we collect and process a minimal amount of personal information about you: birthday, gender, whether you are obese, whether you have visited a dietician in the past or present and your level of income i.e. whether you are from a low- or middle-class background. This information will be collected in accordance with GDPR. We will ensure that your personal information is kept confidential and secure, and that it is only used for the purposes of this study. Your personal information will be anonymized before it is used in any publications or presentations of the research study. You have the right to request access to and rectification or erasure of your personal data.

Data Usage, Dissemination, and Archiving

The data collected in this study will be used for research purposes only. We may use the data in publications or presentations, but your personal information will be anonymized before it is used. The data will be kept confidential and secure, and it will only be accessible to members of the research team. The physical notes made during the session will be destroyed six months after the co-design session date.

Contact Information

If you have any questions about the study, please contact the research team at j.g.m.moesker@student.utwente.nl. If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: ethicscommittee-CIS@utwente.nl

Graduation Project || Information Brochure

You are asked to take part in research study that is conducted by Jacelynn Moesker and Dr. Femke Nijboer. This research is part of a Creative Technology bachelor graduation project. Our research pertains to how a system can be designed to help motivate obese adults adhere to their lifestyle intervention programs. One of the ways to design such a system is to ask and interview experts directly on lifestyle intervention programs.

Your participation is this research is voluntary and you are free to withdraw from participation at any time and without giving a reason. Please read this information brochure carefully in order to decide whether or not to participate. If you have any questions, do not hesitate to ask the researcher.

Purpose of the research:
There is an increasing number of obese adults in the Netherlands. A percentage of those are following a lifestyle intervention programme i.e. diets/exercises regimes/stress management etc. It is often hard for these adults to maintain and adhere to their program, even though they know about what they need to do, how to do it and when to do it. The purpose of this research is to design a system that can help those adults in adhering to their program, so they can achieve their end-goal, whether that is to lose weight or to live a healthier life.

During the session:
The interview will be approximately 30 – 45 minutes long. We will be asking questions pertaining to the participant's experience with curating a lifestyle intervention program and the results as well as effectiveness that these programs have on their patients both short and long term.

Benefits and risks of participation
This research has been reviewed by the Ethics Committee Information and Computer Science. There are no risks in participation. There are no immediate personal benefits. Participation solely helps the researcher in their graduation project.

Procedures for withdrawal from the study
You have the right to withdraw from the study at any time without penalty. If you wish to withdraw, please inform the researcher. You do not have to provide a reason if you wish to withdraw.

Collection and Processing of Personal Information
During this study, we collect and process a minimal amount of personal information about you: your current profession.

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Afstudeer Project || Informatie Brief

Jij bent uitgenodigd om deel te nemen aan een onderzoek. Dit onderzoek wordt gedaan door Jacelynn Moesker en Dr. Femke Nijboer als begeleider. Dit onderzoek is deel van het afstudeerproject van Creative Technology. Dit onderzoek gaat over hoe een system kan worden ontworpen om volwassenen met obesitas te motiveren en ondersteunen bij het volgen van gecombineerde levensstijl interventies (GLI). Een van de methoden om een system te ontwerpen is “co-design”. Co-design is een workshop waarbij de doelgroep wordt betrokken bij het ontwerpproces. Deze workshop wordt gedaan in drie sessies:

1) Een brainstormsessie
2) Evaluatie met de doelgroep, deel 1
3) Evaluatie met de doelgroep, deel 2

1) De brainstormsessie wordt online gehouden. Wij zullen een website gebruiken die we je eerst zullen uitleggen. Het programma zorgt ervoor dat het makkelijker wordt om ideeën te visualiseren.
2) Na twee weken, zouden we graag jouw feedback willen over het systeem dat wij ontwerpen. We passen het systeem aan op basis van jouw feedback.
3) Vier weken na de brainstormsessie, doen wij opnieuw een feedback sessie. Dit is de laatste sessie.

Vrijwilligheid

Deelname aan dit onderzoek is geheel vrijwillig. Je kunt als deelnemer jouw medewerking aan het onderzoek te allen tijde stoppen, of weigeren dat jouw gegevens voor het onderzoek mogen worden gebruikt, zonder opgaaf van redenen. Het stopzetten van deelname heeft geen nadelige gevolgen.

Als je tijdens het onderzoek besluit om jouw medewerking te staken, zullen de gegevens die je reeds hebt verstrekt tot het moment van intrekking van de toestemming in het onderzoek gebruikt worden.

Wil je stoppen met het onderzoek, of heb je vragen en/of klachten? Neem dan contact op met de onderzoeker.

Doel van het onderzoek

Er is een toenemend aantal volwassenen met obesitas in Nederland. Een percentage daarvan volgt een leefstijlinterventieprogramma, d.w.z. diëten/oefenschema's/stressmanagement enz. Het is vaak moeilijk voor deze volwassenen om hun programma vol te houden, ook al weten ze wat ze moeten doen, hoe ze het moeten doen en wanneer ze het moeten doen. Het doel van dit onderzoek is om een systeem te ontwerpen dat deze volwassenen kan helpen om zich aan hun programma te houden, zodat ze hun einddoel kunnen bereiken, of dat nu afvallen is of gezonder leven.

Tijdens de sessie(s)

3) The researcher will visit the participant and present them with the second prototype. The participants will be asked to use the prototype and give their input. This session will take approximately 20-30 minutes.

Benefits and risks of participation

This research has been reviewed by the Ethics Committee Information and Computer Science. There are no risks in participation. There are no immediate personal benefits. Participation solely helps the researcher in their graduation project.

Procedures for withdrawal from the study

You have the right to withdraw from the study at any time without penalty. If you wish to withdraw, please inform the researcher. You do not have to provide a reason if you wish to withdraw.

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Graduation Project || Information Brochure

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During the session:
The interview will be approximately 30 – 45 minutes long. We will be asking questions pertaining to the participant's experience with curating a lifestyle intervention program and the results as well as effectiveness that these programs have on their patients both short and long term.

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Consent Form for Co-design Session

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [05/04/2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves: participating in a co-design session.	○	○
Use of the information in the study		
I understand that information I provide will be used for: a graduation project and a presentation presenting the graduation project.	○	○
I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.	○	○
I agree that my information can be quoted in research outputs	○	○
I give the researchers permission to keep my contact information and to contact me for future research projects.	○	○
Use of media If the researchers take pictures of the workshop, I agree to be on the photo. Your face will always be blurred so you cannot be recognized.	○	○

Signatures

_____	_____	_____
Name of participant	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name	Signature	Date

UNIVERSITY OF TWENTE.

Toestemmingsformulier voor Co-design Sessie

JE KRIJGT EEN KOPIE VAN DIT TOESTEMMINGSFORMULIER

Je kunt per onderdeel voor kiezen wel of geen toestemming te geven. Indien u voor alles toestemming wil geven, is dat mogelijk via de aanvinkbox naast de stellingen.	**JA**	**NEE**
Deelname aan onderzoek		
Ik heb de informatiebrief van [05/04/2024] gelezen en begrepen, of deze is mij voorgelezen. Ik heb vragen kunnen stellen over het onderzoek en mijn vragen zijn naar tevredenheid beantwoord.	○	○
Ik begrijp dat ik deel neem aan een co-designsessie.	○	○
Gebruik van gegevens tijdens het onderzoek		
Ik begrijp dat de informatie die ik geef zal worden gebruikt voor: een afstudeerproject en een presentatie waarin het afstudeerproject wordt gepresenteerd.	○	○
Ik begrijp dat over mij verzamelde persoonlijke informatie die mij kan identificeren, zoals [bijv. mijn naam of waar ik woon], niet buiten het onderzoeksteam zal worden gedeeld.	○	○
Ik ga ermee akkoord dat mijn informatie mag worden geciteerd in onderzoeksresultaten	○	○
Ik geef de onderzoekers toestemming om mijn contactgegevens te bewaren en contact met mij op te nemen voor toekomstige onderzoeksprojecten.	○	○
Gebruik van media		
Als de onderzoekers een foto maakt van de workshop, geef ik toestemming om op de foto te staan. Mijn gezicht wordt altijd onherkenbaar gemaakt.	○	○

Handtekening:

_____	_____	_____
Naam van deelnemer	Handtekening	Datum

Ik heb de informatiebrief nauwkeurig voor gelezen aan de potentiële deelnemer en er naar mijn beste vermogen voor gezorgd dat de deelnemer begrijpt waarmee hij of zij vrijwillig instemt.

_____	_____	_____
Naam van onderzoeker	Handtekening	Datum

Consent Form for Expert Interview

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated [04/04/2003], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	○	○
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	○	○
I understand that taking part in the study involves an audio-recorded interview which will be transcribed as text. In which both recording and transcription will be destroyed six months after the interview	○	○
Use of the information in the study		
I understand that information I provide will be used for: a graduation project and a presentation presenting the graduation project	○	○
I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.	○	○
I agree that my information can be quoted in research outputs	○	○
Consent to be Audio Recorded I agree to be audio recorded. Yes/no	○	○

Signatures

_____	_____	_____
Name of participant	Signature	Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Researcher name	Signature	Date

UNIVERSITY OF TWENTE.