User Interface Design of a Smartphone Application for Early Detection and Reduction of Risk Factors for Dementia as Part of an EU Study

From 27 March - 03 April

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Lisa Fresser / Tina Schart Master Thesis

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Declaration on oath

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I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

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Graz, June 07, 2022

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Graz, June 07, 2022

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1 Introduction

In the following chapter, general characteristics of the work are defined. The question, how the topic of the work came to be, is clarified and the process is is defined.

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Abstract

People are getting older and older. This means that the number of people suffering from some form of dementia is also increasing. For the longest time, dementia was considered neither treatable nor preventable. Today, it is known that the disease cannot be cured, but that the course of the disease can be changed by preventive measures.

The LETHE project is developing a digital intervention for an EU-wide study that will be used for personal screening, prevention and monitoring. For this purpose, an app will be developed that provides important data to medical professionals and researchers as well as helping the study participants to lead an active and healthier lifestyle.

Within the scope of this master thesis, a concept as well as a design for an app will be created. The result is an overall concept of an interactive prototype, which serves as a basis for the further development and programming of the LETHE app.

This is done using design thinking methods to work as user-centered as possible. This work includes all stages of a design thinking model – from the research phase on dementia or digital product design in a medical context, the creation of personas and initial concepts to the interactive prototype, which was tested and further developed with the help of user testing.

In order to make a digital application user-friendly for an advanced age group, special emphasis is also placed on aspects such as color usage, font size and complexity as well as the simple and intuitive use of the application and described in this master thesis.

Kurzfassung

Menschen werden immer älter. Damit steigt auch die Zeil der Personen, die an einer Form von Demenz erkranken. Demenz galt lange Zeit als weder behandelbar noch vermeidbar. Heutzutage ist bekannt, dass die Krankheit nicht heilbar ist, jedoch der Krankheitsverlauf durch präventive Maßnahmen verändert werden kann.

Im Rahmen des Projekts LETHE wird eine digitale Intervention für eine EU-weite Studie entwickelt, die zur persönlichen Früherkennung, Vorbeugung und Überwachung genutzt wird. Hierfür soll eine App entwickelt werden, die sowohl Medizinern und Forschern wichtige Daten liefert als auch den Studienteilnehmer zu einem aktiven und gesünderen Lebensstil verhilft.

Im Rahmen dieser Masterarbeit wird ein Konzept sowie eine Gestaltung für eine App erstellt. Ergebnis ist ein Gesamtkonzept eines interaktiven Prototypen, der als Basis für die Weiterentwicklung und Programmierung der LETHE App dient.

Dies geschieht unter der Anwendung von Design Thinking Methoden um möglichst nutzerzentriert zu arbeiten. Diese Arbeit umfasst alle Stufen eines Design Thinking Modells – von der Recherche Phase über Demenz oder zur digitalen Produktgestaltung im medizinischen Kontext, der Erstellung von Personas und ersten Konzepten bis hin zum interaktiven Prototyp, der mithilfe von User Testings geprüft und weiterentwickelt wurde.

Um eine digitale Anwendung für eine fortgeschrittene Altersgruppe benutzerfreundlich zu machen, wird besonders auch auf Aspekte wie Farbnutzung, Schriftgröße und Komplexität sowie die einfache und intuitive Nutzung der Applikation wertgelegt und in dieser Masterarbeit beschrieben • 9/134

Motivation and Goal Setting

Worldwide more than 55 million people live with dementia (WHO 2021). According to the WHO there are almost 10 million new cases every year. The FINGER research project in Finland showed that it is possible to decrease the risk of becoming dementia by a lifestyle change.

To show how it is possbile to motivate people to change their lifestyle the EU study "LETHE" was introduced. The main part of the study is, to collect data and see if there is a way to help people changing their lifestyle in the right direction.

The basis of this intervention, an app should be offered to study participant which they should use daily to gather further information about nutrition, sports and habits but also track their lifestyle to get data which can be analyzed by medical professionals.

Our part was to design the interactive prototype for this app. The app will be used by every study participant on a daily basis to collect data and also give information and motivation to change their lifestyle for a lower risk of becoming dementia.

As this work is just one part of the LETHE study, it should be a clear and detailed prototype which can be handed over to the developers who are programming the app using Flutter to have it working on Android phones. This leads to the following central question:

How should a smartphone application be designed to help study participnts to develop a healthier lifestyle?

Our task as UX designer is to make sure our app is usable and intuitive for all study participants so that they are willing to use it every day for the two years of study duration. The app should be usable for the age group of study participants and cover all required parts.

As we are both interested into the medical field of user experience, we are very happy and grateful for having the possibility of being part of such a big project •

(1) LETHE App Mockup mockupsforfree.com n.d.

Author

Self-care

Get personalized feedback on your health and fitness lifestyle.

G Continue with Google

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Process

In order to proceed in a structured and meaningful way, we have oriented ourselves on the design thinking process. This helped us to work in a creative and user-centered way of working. Depending on various constraints and preliminary work, the process was adapted accordingly. A large part of the knowledge, which is following pages, as well as some methods used in this work were acquired during my internship semester in the UX-department of Bosch.

Design Thinking

Design Thinking is not just a process. Behind this creative method is a mindset, which a design thinker must have in order to be successful. Team members need the ability to think crazy and enter a different world. They need to be able to let go and think unconstrained. Also, they should be able to think free of criticism and be willing to fail. Early failure is one of the basic building blocks of Design Thinking. In general, design thinking is divided into six phases according to IDEO's definition, which, however, do not have to be worked through strictly one after the other, but are iterative. This means that jumps are made between the phases and phases are repeated as needed (Plattner 2009). In addition, the premises and the team composition play a major role. Thus, it is important that the design thinking space is bright and well lit, offers plenty of space for creative ideas and is variable. This means that tables and chairs should be easy to move and that there should be enough white boards for post-its and drawings.

In order to cover as many ways of thinking and user groups, an intercultural team is essential. Ideally, there is at least one future user on the team. In addition, the project owner, developers, designers and other groups, form the ideal image of a team. The more different the better, because this way all points of view can be considered from the beginning. This results in a product that is well-thought-out as a whole and is ideally adapted to the needs of all project participants.

For this master thesis, we worked in a partly intercultural team. It existed of the designers, developers, project manager and the project owner. What was missing for having the perfect design thinking team was the future user and also the stakeholder group of doctors who are responsible for the content.

Also we jumpet multiple times between the phases. This is why this written thesis is not in proper chronological order.



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First of all we started with the discovering part. This included a lot of research about dementia but also about UX in the field of medicine.

There were already some information and targets of the project which needed to be worked through as well as understanding the wishes and needs of people living with

In our case, the definition phase happened parallel to the Discover phase, since we as designers were introduced to the project when the developer already started to work on the backend. Within a few weeks the target group was defined with the help of multiple methods and also our part in the project with restrictions and open points got defined.

Idea generation took place third in our process. Various methods helped to give free rein to creativity and generate numerous ideas. As the first step, without any criticism. In addition, our Ideate phase contained research on various dependencies to be taken into account later in this phase, such as the accessibility.

After that, the creation of an interactive prototype started. With influence of colors, shapes and styles, a concept was created which was then developed with wireframes into a fully designed functional prototype. It has been experimented, different versions were developed and tried out.

After the successful creation of the prototype, testing started as soon as possible. For this purpose, a typical use case was created. This use case was then tested with several potential users who saw the prototype for the first time. Feelings, ideas, problems and wishes are recorded, in order to improve them on the prototype and then test them

(2) Design Thinking Process Own representation, 2021

2 Discover

The first step is to research relevant topics in order to get an overview of the subject we are dealing with. In this chapter, topics such as user experience in the medical field, dementia and relevant standards are explored.

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Healthcare User Experience

Statista published figures from a long-term study on how many people use smartphones worldwide as well as a forecast of how much this number will increase. In 2022, there are approximately 6.57 billion smartphone users worldwide. That's the equivalent of about 84%. This figure is estimated to rise to 7.7 billion smartphone users in 2027 (O'Dea 2022). In the United States, an additional study published in 2021 indicated that 61% of Americans aged 65 and older owned a smartphone (Paw Research Center 2021).

Right: (3) Smartphone Users Worldwide in percent Own illustration based on Statista 2022

Devices other than smartphones have also taken on an important role in many people's lives over time. Wearable devices are also playing an increasingly important role. In healthcare in particular, these devices are already being used to monitor certain activities of users. Examples include smart watches that check heart rate, sleep, weight or activity and display the data to the user (Adarsha et al. 2019, 267). Estimations say that around 1 billion wearable devices are worn in 2022 (Laricchia 2022).

As the studies already predict, the numbers will only continue to rise in the coming years. The healthcare sector has already recognized this growth and is growing steadily as a result. These networked devices make it easier and more convenient to provide healthcare services, connecting patients, family members and medical staff to better monitor and care for patients. This dependency and interconnectedness make good user experience, safety and accessibility for patients the duty of designers. A poor user experience can impact the quality of patient care.

User Experience (UX) Requirements

",User experience' encompasses all aspects of the end-user's interaction with the company, its services, and its products." (Don Norman and Jakob Nielsen n.d.)

As mentioned in the previous chapter, the population is getting older. Along with an increasingly older population, there are more people who have developed visual or hearing impairments or cognitive disabilities. Therefore they are less able to use the digital technology than the world's younger generations. To enable this target group the access to healthcare technology, there are prerequisites that can help. These include higher color contrasts, options to adjust text size, text-to-speech, easy navigation and simple language in addition to figurative language. The goal should be to build the product or service in such a way that it is

Smartphone Users



Worldwide | State 2022

Born before 1957 (65+) that own a smartphone



U.S. citizens | State 2021

Users of wearable devices



Worldwide | State 2022

accessible, adaptable, clear and understandable also for the elderly (Rue n.d.).

Communication

Effective and intuitive communication of information can make the experience with a medical product like an app easier. Not only is easy navigation necessary here, but also the choice of words. Colloquial terms are preferable to medical jargon. Medical jargon can cause the patient to become stressed, as medical terms often make it seem like the condition is worse than it is. Visual elements such as pictures or icons can also convey easier communication, as they make it easier to remember certain terms for example (MindSea Team n.d.).

Examples of technical terms vs. colloquial language in terms of dementia (case 2019):



Personalized application

A personalized application also helps to improve the user's experience with the product or service. Self-diagnosis can be searched for quickly in today's world due to connectivity through the internet. Personalized healthcare apps ensure that users can be helped safer and more effectively (Mind-Sea Team n.d.).

Data protection

Another important issue is data protection. In healthcare, sensitive data is at stake. This sensitive data can become an issue when apps need to communicate with patients or if data has to be shared. This is where all the guidelines need to be included in the design process to avoid privacy breaches and still make the user experience as pleasant as possible (MindSea Team n.d.).

Current UX trends in digital healthcare

With the global pandemic, the digital health sector has evolved greatly, developing new user-centric tools that make it easier to contact patients or bring users personal data about their health status:

Right: (4) Born before 1957 that own a smartphone Own illustration based on Paw Research Center 2021

> **Right: (5) Users of** wearable devices Own illustration based on Laricchia 2021

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(6) Woman with Smartphone SHVETS production 2021

Telemedicine gained popularity primarily due to the CO-VID-19 pandemic, allowing people to contact their treating physician from a remote location. This rapidly increased type of treatment now requires new approaches to a user interface. Such as instructions or a clear user interface of an application, to make the process as simple and effective as possible (Győrffy and Fejes 2021).

Medical wearables, such as smartwatches, smart bracelets or fitness monitor apps, allow users to monitor their own medical data of all kinds to understand and change bad habits. This data can be more easily collected over a longer period of time and discussed with the treating physician. Here it is necessary to address the issue of data privacy in particular, and to show the user what data is collected and what it is used for (Rue n.d.).

Chatbots and artificial intelligence are also becoming more common in healthcare support systems. Chatbots in particular can help relieve the burden on the healthcare system, but this only works if the usability is intuitive and answers can be delivered quickly and thoroughly. Artificial intelligence is also used to help patients book appointments or remind them to take medication for example. This can make treatment more personalized and efficient. For physicians, the use of AI provides additional support for example for generating reports, treatment recommendations, diagnosis support or even for the conversion from analog to digital (Győrffy and Fejes 2021).

Mental health is also playing an increasingly important role in user experience healthcare. Social media and the ever-increasing dependence towards the internet and digital technology poses dangers. Depression or anxiety is on the rise. For this reason, apps that specialize in mindfulness and are designed to slow down motions are increasing as well (Győrffy and Fejes 2021). One well-known meditation app is the mobile app Headspace.

Such trends will continue to grow and greatly change and expand the scope of the healthcare industry. Along with this, user experience designers have a great responsibility to provide users with safer, more effective and accessible products and services •







(7) Headspace Korpai 2019

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(8) Senior in remote conversation with doctor Miroshnichenko 2021

(9) Smartwatch Grabowska 2020

App Design in the Field of Medicine

While health apps are widespread for private usage for many years already, they become increasingly more in medical areas too. A few years ago, in 2019, the legislature has enacted the Digital Healthcare Act (DVG) in Germany which enables doctors and psychotherapists to prescribe tested health apps at the expense of the statutory health insurance (Gesetz für eine bessere Versorgung durch Digitalisierung und Innovation, 2019).

Today medical apps are especially used for therapeutic interventions, therapy support, diagonstic and aftercare. The German Consumer Center devices this kind of apps into three categories:

1. Lifestyle Apps

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Fitness trackers, nutrition and exercise apps are the most common types in this category. The main purpose of them is to support the user to live in a more health-conscious manner.

2. Service-oriented apps

Taking medicine regularly at the same time can be hard. This is why there are reminder apps on the market, no matter if they remind about taking medicine or making an appointment for early detection examinations. Service-oriented apps can also give the opportunity to keep diary of symptoms or progress monitoring of a disease. Also, many health insurances offer an app nowadays to communicate with their clients, uploading prescriptions or searching for doctors.

3. Medical apps

Talking about health apps in general, most people would probably think of apps which diagnose or therapy a disease. Those apps are part of the third category, the medical apps. There is one main point which defines if an app belongs in this category: Medical apps must be approved as medical product and identified with the CE mark. However, this mark does not say anything about the health benefits. Due to legal regulations, more apps are now considered as medical products and must then also meet the higher requirements.

As good as some of those apps on the market are, it is certain that all of them are for support only and do not replace the medical diagnosis or treatment.

Regarding the question of how doctors evaluate existing apps to find out if they are trustworthy and reliable according to the AEZQ handout for physicians "Gesundheits-Apps im klinischen Alltag" one point mentioned is the ease of use.

Ease of use

User friendliness is maybe more important than anywhere else in the field of medicine. No other user group is as diverse as in this spectrum. Especially older people are more likely to feel lost with this modern technologies and even if they are familiar with using smartphones they are often struggling with learning new patterns and understanding new processes (Giffey, 2020).

This means, the user interface must be as fault tolerant as possible so that the older target group is not frustrated by the first usage. Also, using common and etapled patterns and interactions is a simple and good way for an app with such a widespread target group.

A big help is multiple well planned and detailed tested with the critical user group to detect missunderstandings or difficult parts in an early state before developing and improving this to a better before even frustrating the user.

As already mentioned it is a challenge to design apps for a older age group, but we are not in a time anymore where smartphones are only used by young people. Shown in figure (10) more than 40% of over 70-year-olds and 73% of 60-69 year olds are using smartphones. It is very likely that this number has increased during Covid-19 pandemic. Many older people were hit by social isolation during lockdowns. The easiest and quickest opportunity to stay in contact with relatives were messengers, video chats and social media. Accordingly, it is obvious that a smartphone or tablet helped through this special time.

Also during our user testing we observed the effect that for older people it maybe is harder to learn new things and find their way through the app but still they are willing and motivated to do so. Giving them more time and also providing sometimes food for thoughts will solve many problems and will give sens of achievement. In general, it can be said that older people encounter the same usability hurdles as younger people - with the difference that older people fail at these more often (mobisenioraat, 2015).

One problem that must be considered when dealing with seniors are the additional limitations that old age brings with it. These are, for example, visual and hearing impairments, coarser fine motor skills and cognitive difficulties (slowed absorption of information, memory loss and similar) (Seifert, Schelling, 2016).



However, seniors are quite creative in using their smartphones. For example, in the mobi.senior. A project by Dorothea Erhart and others, test person were observed to take photos of a small text and then zoom in the photo they had taken to read the text. The study also found out that 48% of all surveyed seniors describe themselves as eager to experiment with smartphones and tablets, which was confirmed by Thinking Aloud tests.

Another important part which needs to be considered is data management. First thing what will come up in mind is maybe data security, which of course is very significant. But regarding the design, data is also an essential part. Displaying the right data at the correct place in the perfect amount is a challenge for designers.

Data handling

The future competence "data literacy" requires learning digital skills like critical, planned and context-specific handling of data. Not only evaluating data, but also serving as an ethically and legally secure basis for decision-making and operation. A critical approach thus also means knowing the limits of the meaningfulness of data-based decisions (aerzteblatt.de, n.d.).

This effect was also noticeable at our user test when people interpreted numbers wrong and basically started to panic, believing they have a high risk of becoming dementia just because of a single number.

So talking about data the expectation management needs to be considered in a save and unequivocal way •

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out how serious and useful a health app is, g questions should be ask yourself:

- is the purpose of the app?
- elong to the target group for which the app ended?
- exactly can it support me which problem it solve?
- eally need it? Does it solve a problem? content up-to-date and reliable?
- user experience intuitive and simple? now enough about apps to be able to use ? Is there someone who can support me? aware of the fact that the app may only wo
- f I use it regularly?
- villing to provide personal information if it essary for the function of the app?
- e readings seem plausible? If you have ts, ask your doctor.
- s the provider? How does he earn his
- y? (for example, with the evaluation or sale data)
- ne app already been rated by other users? re any information about this app, for ple from self-help groups?
- the app cost anything? Is the amount nable?
- ave to take out a subscription?
- app recommended by a health insurance pany?

Left: (10) Proportion of smartphone use in Germany by age group in 2019 Own illustration based on Statista, 2020

Right: (11) Checklist usage of healtapps AEZQ, 2020

Dementia

cognitive abilities = how we aquire and process information

Typical symptoms of aging include slowed thought processes, decreased ability or duration to concentrate as well as misplacing everyday objects (NIH NIA 2020). However, there are diseases that can emerge as we grow older. Dementia refers to a syndrome – usually chronic or progressive – that impairs cognitive abilities and goes beyond what would be expected from the usual symptoms and consequences of biological aging. The term dementia combines several clinical pictures with comparable or overlapping symptoms that bring about cognitive decline. Dementia is therefore an umbrella term (WHO 2021a). To name one very well known form of dementia: Alzheimer's disease.

And although age is the strongest known risk factor, this does not mean that dementia is a normal part or an inevitable consequence of aging. This disease can also affect much younger people in a few cases (WHO 2021a).

Dementia develops over time. This is due to injuries to brain cells. When brain cells get damaged, they affect the communication between each other and this leads to consequences such as impaired thinking, changes in social behavior or in the emotional control over oneself. Damage to brain cells can occur due to, for example, Alzheimer's disease, whose cause is still not known (Alzheimer's Association n.d.), strokes, infections, increased alcohol consumption or even malnutrition (WHO 2021a).



(12) Stove

"Dementia robs millions of people of their memories, independence and dignity, but it also robs the rest of us of the people we know and love." Dr. Tedros Adhanom Ghebreyesus, Director-General of the World Health Organization (2021b)

Short trip into history

The term dementia is derived from the Latin word demens and translates as being "out of one's mind" (Bogousslavsky et al. 2019, 118).

Cognitive decline with increasing age was already known to the Egyptians around 2000 BC. At that time, people with cognitive decline were marked as stupid. In the Middle Ages, people with symptoms or people with depression were marked as insane, which was interpreted as a kind of punishment from God and demonic possession. This assumption was led to by the fact that these conditions could not be explained. In the 14th and 15th centuries, demented people were often victims of witch burnings (Yang 2016). After this time, people with symptoms have often been placed in mental hospitals and asylums. People with this cognitive impairment were labeled as insane and had to be hidden and secluded from society. They were often severely mistreated, for example by electric shocks, ice baths, straitjackets or humiliation (Munson 2020).

As medicine made great strides in the late 1800s, making it possible to view the biological tissue of the brain through microscopic anatomy, scientists and physicians became aware that this degradation could possibly be caused by a disease. Alois Alzheimer, a German psychatrist, published in 1906 the first case of a woman with symptoms as a result of this medical discovery. At that time, however, this discovery was not considered a breakthrough, as it did not seem to make sense to call a condition closely associated with aging a disease. At the same time, more and more people in the United States were being diagnosed with dementia and admitted to state mental hospitals. What became noticeable after a while, however, was that local welfare authorities took the incentive to portray old people who could no longer live independently in a community as insane, in order to house them at the expense of the state. Elderly with dementia became one of the most important groups in the patient population. As a result, the topic was brought further into the public eye and attempts were made to find ways to deal with this disease. It was known that medical therapy could not provide a cure. Thus, it

became known in the 1950 that measures and programs would have to be developed to engage the growing number of aging people and keep them active so that their mental abilities could be maintained longer. Due to the progress of science and research, instead of mental hospitals, rather care and nursing homes were established to take care of people with this disease and the staff was specially trained (Ballenger 2017, 714).

Around 1970, Alzheimer's was recognized as the most common type of dementia. It was also recognized that in few cases the symptoms behaved differently from the natural cognitive decline of aging (Munson 2020).

In the years that followed, scientists realized that dementia does not necessarily go hand in hand with old age, but is a severe cognitive disorder. Since that time and until today, scientists have been researching for a better understanding of dementia and for ways and means to cure this disease or to change its course (Bogousslavsky et al. 2019, 118).

Types of dementia

The following four types of dementia are the main forms of this disease.

Alzheimer's disease is the most widespread form of dementia. Due to the dying of nerve cells, people become more forgetful, more confused and their personality or behavior changes. This form can be inherited. Exact causes for the development of the disease are not known (Alzheimer's Society 2020).

Vascular dementia is the second most common type. Thinking disorders, speech difficulties or memory loss are typical symptoms. The cause is a circulatory disorder of the brain, which can be a consequence of several strokes (Alzheimer's Society 2020).

Dementia with Lewy bodies is another form of dementia. Protein clumps develop in the brain cells. Hallucinations are a typical symptom here. The reason for the development is not known (Alzheimer's Society 2020).

Frontotemporal dementia is less common. Symptoms include drastic change in personality and behavior as well as difficulty with speech. Risk factors are not known. However, this form of dementia may be inheritable (Alzheimer's Society 2020).



Stages

After the symptoms persist for more than 6 months, it is decided which grade prevails. Here, a distinction is made as to which of the three stages the diagnosed patient is in:

Early stage, in which symptoms are often overlooked due to the gradual development (WHO 2021a) Memory loss

(WHO 2021a)

- Time and place are no longer known
- Personal hygiene only with assistance
- Walking problems

Development

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Diagnosis Today

There is no definite way in which the diagnosis can be made. The type of dementia is diagnosed individually and depending on the underlying causes (WHO 2021a). The WHO has formulated binding regulations for doctors as a guideline. Therefore, a diagnosis may only be given if the symptoms have persisted for at least 6 months. Symptoms include (Fröhlich 2012):

Impairment of actions relevant to everyday life

- Consciousness is not impaired
- Disturbance of social behavior
- Brain dysfunction

- Losing track of time
- Getting lost

Middle stage, where the indications become more obvious

- Forgetfulness regarding recent events
- Confusion at home
- Difficulties in communication
- In need of assistance with personal hygiene
- · Change in behavior

Late stage, characterized by physical signs and changes in character (WHO 2021a)

- Difficulty recognizing relatives and friends
- Behavioral changes that lead to aggression
- People are getting progressively older. As a result, the
- number of people suffering from dementia is also rising. It
- is estimated that 55 million people over the age of 65 are
- currently living with this syndrome. By 2050, this number is



(13) Estimated growth of people with dementia **Own illustration** based on WHO 2021b

(14) Forecast

of total estimated

annual worldwide

costs of dementia

on WHO 2021b

Own illustration based





(WHO 2021b)

estimated to rise to 139 million people. Especially people with low or medium incomes are affected (WHO 2021b). According to Statistics from the WHO, dementia is also "currently the seventh leading cause of death among all diseases and one of the major causes of disability and dependency among older people worldwide" (2021a). These facts and figures are closely aligned with the global costs associated with the disease. Estimates put global costs at \$1.3 trillion in 2019, and the figure is expected to rise significantly by 2030. If rising healthcare costs are included, associated costs would be \$2.8 trillion globally by 2030. This affects not only health insurers but also private individuals who have to travel to their loved ones and cover all payments (WHO 2021b).

Treatment

Dementia is not curable at this point in time. Therapeutic approaches and medications have been developed over the years, but their effectiveness is limited. Some can stabilize certain symptoms but stopping or halting them is not possible. Many of the methods developed are also only approved for the best-known form of dementia - Alzheimer's disease (NIH NIA 2020).

The FINGER Study

As the world's population continues to grow older and thus the number of people who will develop dementia will increase, several researchers and scientists have set themselves the task of finding methods or preventive measures that can slow the disease or alter its course. Risk reduction and preventive measures are currently the most important aspects to reduce the global progression of dementia. Based on this approach, FINGERS - Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability was founded (WW-FINGERS n.d.). The purpose of this study is to support dementia prevention studies, share data and experiences, and determine the extent to which preventive measures, therapeutic approaches, or medications can prevent or lessen cognitive impairment (Kivipelto et al. 2013, 659).

Prevention

Once the disease-induced degradation of brain cells begins, there are no successful therapeutic approaches (Kivipelto et al. 2013, 658).

In 2017, the American Heart Association issued recommendations that positively impact brain health. These are (Ronald et al. 2021, e298-e300):



Tina Schart

Healthy Diets with

by Depression •

(15) Recommendations that positively impact brain health Own illustration, 2022

About the LETHE Project

FINGER = Finish intervention study to prevent conitive decline and disability More information at wwfingers.com

The FINGER Study

prevention measures.

The research project started in 2009 when several lifestyle parts like nutrition, exercise, cognitive training and social activity were monitored of 1 260 Finish at-risk elderly participants with the age of 60-77 years.

Since the age of the world's population is rising, the

number of people living with dementia is also growing.

This illness was considered as unavoidable and untreated

for a long time. But at the latest after the publication of the

results of the FINGER study, it is known that the disease

progression is modifiable in an early state with the right

After two years, the outcome was that the intervention group improved the cognitive performance in all studied domains. A general increment of 25% overall cognition as well as a decrement of other chronic diseases by 60% was logged after two years (Finger, 2011).

It proved that declining the risk for cognitive deterioration is possible with a lifestyle changes, especially in older ages. Based on this result, the Finish Institute for Health and Welfare (THL) published a model for identification of high risk patients as well as supporting healthy aging depending on a healthy lifestyle.

Right: (16) LETHE Logo lethe-proejct.eu n.d.



Left: (17) The finger trial own illustration based on ww-Fingers n.d.

The LETHE Project

The LETHE project is a "feasibility study" based on the "FINGER" research project. Feasibility study means that it will help to assess how participants experience the use of technology and investigate how well they follow the intervention program and different activities. The study focuses on forms of dementia that have not developed as a result of sudden accidents or strokes but on forms such as Alzheimer's disease which means forms of dementia that can develop over the years.

The goal is to develop an individual intervention and prediction model for decreasing risk factors which are causing dementia. For this, an artificial intelligence with machine learning is used. Those two technologies are collecting and evaluating medical and digital data to project personalized risk factors.

A successful LETHE project could improve the lifestyle of people regarding the health factor by providing a better customized risk factor prevention for patients who cognitive decline started. This could be a huge benefit for the whole society.

LETHE will help to understand how some parts of the FINGER intervention might be implemented or measured. Following technologies should help:

1. Existing technologies

Already existing wearables like the FitBit smartwatch and smart glasses as well as apps which are already on the market like an online cognitive training program.

2. The Lethe smartphone app

This app will be specifically developed for the LETHE project. It integrates all intervention-related content like surveys, messages and data input.

This master thesis wll deal with the user interface of this LETHE smartphone app.

Facts about the study

The Lethe study will last for four years. 160 study participants between 60 and 77 years old are acquired from four countries: Austria, Italy, Sweden and Finland. The cognitive condition of the participants should be considered as normal according to the individual age, so until they start the study, they do not have dementia but have an increased risk of cognitive decline according to a dementia risk score which is calculated by age, sex, education, blood pressure, body mass index, cholesterol and physical activity. Each participant will be part of the study for 18 months and must

be willing to use a smartphone application on an Android phone on a daily basis. The smartphone and a Fitbit smartwatch will be provided to everybody.

In each country, half of the participants will be assigned to the structured intervention and the remaining 20 participants will be in the self-guided intervention. The selection of who will be in which group happens randomly. The features of the LETHE app will vary depending on which group the user is assigned to. During the study period, all participants will be invited to three study visits at the study center for multiple measurements and assessments. Additionally they need to fill in three questionnaires provided in the app.

As seen in Figure (17) there are five main subject areas which will be tracked: nutrition, physical exercise, cognition, social activity and vascular and metabolic monitoring.

The FH Joanneum is responsible for two big parts of the LETHE project: the Project Management and quality assurance Overview as well as the AI-based personalized risk prediction which includes the smartphone app •







_isa Fresser

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HE-Project has d funding from the an Union's Horizon search and ion programme trant agreement po

https://ec.europa.eu/digitalsingle-

s/ehealth



icht ity





26

FH JOANNEUM

FORTH



Finnish institute fo health and welfare



Combinostics

theLisboncouncil

(18) Consortium LETHE lethe-project.eu n.d.

Norms and Standards

The healthcare sector will continue to change strongly in the direction of digitalization. Along with this, there are more and more users who are less well trained and have difficulties with increasingly complicated medical devices. For this reason, standards have been defined to reduce hazards and risks for users. Since the LETHE project is a medical app, it is appropriate to follow standards here as well. In the following, chosen points of different standards are mentioned and described, which have importance for the project LETHE and for the designers. The intention of following the standards in this work is to help the designers avoid any use errors.

IEC 62366: Application of usability engineering to medical devices

The "IEC 62366-1 Medical devices - Part 1: Application of usability engineering to medical devices" (ISO/TC 2015, 1) is a European usability standard regulated by CENELEC (Ibid, 3). The aim of this standard is to identify use errors and to reduce and minimize all risks before, during or after use. For this purpose, a usability engineering process has been developed to help analyze, specify, evaluate and optimize these issues (Ibid, 7).

This standard has among others the following content:

Use specification

The goal is to define who intended user groups are, what differences these user groups have in their abilities, what the intended use is, where the product will be used and whether training needs to be provided for users (Ibid, 17).

Applied to the LETHE project

Identify features of the user interface in terms of security and potential use errors

For this purpose, a risk analysis should be performed, for example, through a task analysis, where use errors related to the user interface can be identified (ISO/TC 2015, 17-18).

Applied to the LETHE project

User interface of the device

It should be specified which technical features the device must provide to the user in order to minimize all risks. This includes requirements for the graphical user interface such as colors, fonts and character size, or placement of controls. It is also important to document whether instructions for use or specific training for users or personnel is required (ISO/TC 2015, 19). If training is necessary, a verbal description of the device's user interface should be available and the necessary training materials should be provided (Ibid, 22).

Applied to the LETHE project

User Testing

Prior to testing, it is important to justify why the test environment was chosen and what type of test was selected, such as a simulated application or a clinical evaluation. The number and type of test participants should also be justified, as they should represent the intended user groups. In addition, the objective of the test should be defined, what critical tasks and scenarios under investigation are to be tested, and what and how much technology will be used to capture test results or application errors. Before the test, the standard recommends establishing a definition that describes exactly when a performance error is an error (ISO/ TC 2015, 21). After the test, a description and analysis must be made of all task failures to effectively minimize all risks. These causes should include subjective comments from the user as well as observations of the user's behavior during the test (Ibid, 22).

ISO 9241-161

Applied to the LETHE project

ISO 9241

ISO 9241 is a collection of several standards regulated by the International Organization for Standardization (ISO). It defines important aspects for the ergonomics of human-computer interactions. For the LETHE project and the app, two standards in particular were considered:

ISO 9241-125

"ISO 9241-125:2017: Ergonomics of human-system interaction - Part 125: Guidance on visual presentation of information" is a guide and assistance for the design of visual, digital presentations of information and takes human perception or memory into account (ISO/TC 2017, 8).

Applied to the LETHE project

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"ISO 9241-161:2016 Ergonomics of human-system interaction - Part 161: Guidance on visual user-interface elements" covers software components that make human-system interaction usable. It includes a list of design-related visual user-interface elements, such as input methods or labels (ISO/TC 2016, 12).

Applied to the LETHE project

of the design tools used •

3 Define

This chapter describes and analyzes the current situation. It contains all information and framework conditions about the LETHE project and defines the target group of the app. This chapter is the basic building block of the thesis.

3.1 Deceptive Design	32
3.2 Ethics of Design	
3.3 Persona	
3.4 User Journey	42

Deceptive Design

This chapter will go into some detail about deceptive design or dark patterns as well as showing examples. Deceptive design or dark patterns are deliberate User Interface / User Experience decisions that try to get users to do things they don't want to do. The psychology of people is deliberately exploited here as well as the fact that visitors often only skim over things. Multiple dark patterns are also often combined (Brignull n.d. a).

The term dark patterns emerged in 2010 after e-commerce became much bigger. Designers and business people started to design interfaces that manipulate the user to increase sales or gain more subscribers (Jaiswal 2018).

Windows 10 is a Recommended Update for this PC

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Preisgekrönte Filme, TV-Shows und UEFA Champions League mit Prime Video

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✓ It's the most secure Windows ever to help protect you

✓ Your PC is ready for Windows 10 – see compatibility r

Vorteile

ung bestätigen Sie, dass Sie die Teiln

✓ Over 300 million

ROOM

ings, this PC is scheduled to upgrade on

List of dark patterns

Harry Brignull defined a list of 11 typical dark patterns (Brignull n.d. b):

Bait and Switch

Here, the user wants to do something and has an expectation of what should happen. However, something unexpected happens.

The most famous Bait and Switch pattern is the update to Windows 10. This popup window was displayed. However, the x is not the sign to close the window but to start the upgrade on the computer (Brignull n.d. b).

(19) Bait and Switch Own picture 2022

Confirmshaming

The user can re language was ilty and is pushed Amazon uses this pattern for example. Here, for example, faster and free delivery. The refusal option or the wording is formulated in such a way that it makes the user feel guilty and thus makes him give in (Brignull n.d. b).

(20) Confirmshaming Own picture 2022

(21) Disguised Ads

Own picture 2022

eject something relatively easily, but the
chosen in such a way that the user feels guil
to not reject after all.

the following wording is chosen: No thanks, I do not want

D:		I - X	A .I
11150	FILICA	en /	2ns
			1

Here, advertising is so cleverly hidden that it appears as if it were part of the website or part of the navigation, which leads to it being clicked or tapped on more often by mistake.

In this example, the actual download button is at the top left with the wording: download now. It can happen very easily here that the user clicks on the ad because there is also a download button in a similar color shade (Brignull n.d. b).



Forced Continuity

This pattern can often be found on websites that offer free trails. Here, the user must enter credit card details despite the free trail. After expiration, the user is automatically billed, without a reminder and usually under difficult cancellation conditions.

This example wants the user to test the service for free for 30 days. After these 30 days, the price is debited without sending the user a reminder message (Brignull n.d. b).

audible

Friend Spam

In this dark pattern, the product asks for the user's mail or certain permissions and then spams all contacts with a message that looks like it is from the user himself. The company LinkedIn had to pay \$13 million in fines due to using this pattern. Through clever wording, users were tricked into importing their address book. Clever wording was also used on buttons to friend supposed LinkedIn members. In reality, spam emails were sent (Brignull n.d. b).



Here the user is led to the last page in the ordering process, only to discover hidden costs such as taxes or shipping costs.

The endprice is supposedly displayed in the shopping cart. After the user goes through all the steps to enter their name, adress, credit card details, they are suddenly also charged with additional costs. When the hidden costs are discovered, a lot of time has already been invested (Brignull n.d. b).

Misdirection

The user is deliberately distracted in order not to notice certain other things going on alongside.

This airline adds - without asking beforehand - pre-selected seats to the shopping cart. This will cost him \$9 more. So the user has no chance to choose this option himself, it is automatically added to the shopping cart. Here the user must read very carefully so that he does not bear additional costs (Brignull n.d. b).





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(22) Forced Continuity Own picture 2022

	earch for people, job	bs, companies, and more	۹				9
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(23) LinkedIn **Dark Patterns** Schlosser 2015



(24) Hidden Costs Brignull n.d.





(25) Misdirection Brignull n.d.

Price Comparison Prevention

The user cannot make an informed decision about a purchase because he or she cannot compare products with each other. Or can do so only with difficulty because prices are not displayed on one page at a time.

LinkedIn makes it difficult to compare prices and offers for example. To get an overview of the prices and the offer, the user must click on each page and remember the prices (Brignull n.d. b).

(20) FIICE	
omparison Prevention	
Own picture 2022	

(27) Dark Patterns design:

3 Privacy Zuckering

Gonzalez 2020

(28) Roach Motel

Own picture 2022

(29) Trick questions

Brignull n.d.

(26) Drico

Privacy Zuckering

Here, the user is tricked into revealing more information about himself than he actually wanted. The name of this pattern comes from Mark Zuckerberg, as this pattern was discovered at Facebook first.

The Facebook Messanger app uses this pattern. Here, the user is asked if they could have access to all contacts. The reason given is that it allows users to network with all their contacts. With this tactic, Facebook can now send perfectly tailored ads to not only the user but also all of the users contacts as well (Brignull n.d. b).

Roach Motel

It is difficult to get out of the situation again, although it was easy to get into it. A well-known example for this dark pattern are subscriptions.

Here a well-known example from Amazon. Only with tutorials or additional help will the user find the option to permanently delete their account. The user needs 7 clicks to find this option (Brignull n.d. b).

Trick auestions

In this dark pattern, the user is tricked into giving answers when filling out a form that was not intended to give. This is done, for example, by choosing a confusing language or by alternating between option and mandatory fields. In this example, the text choice for the two lower checkboxes is intentionally chosen so that one box means opt in and the other opt out. The user must carefully read everything here to understand the meaning of the question (Brignull n.d. b) •

Messenger will continuously upload your contacts to connect you with friends.	
Learn More	OK
	\land

it und Datenschutz
a lina anerialiskan lafaran tinara afarat
n Ihre persönlichen Informationen verwendet
n Ihre persönliche Informationen schützt
zeinstellungen für digitale Inhalte und Endgeräte
Informationen verwalten
Ihre persönlichen Informationen an
chere Identifizierung von Amazon E-Mails, Anrufen oder
ichten
iSung und Datenlöschung anfordern
rt, wenn ich mein Konto schließe?

First name * :	First name
Lost some * -	
Last name - :	Last name
Email * :	Email
Phone number * :	Phone number

"Your job is to make it EASY for people to do WHAT THEY WANT. Dark patterns are designed to do just the **OPPOSITE**."

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Monteiro 2019

Ethics of Design

Before doctors, journalists or lawyers begin their work, they usually agree to a code of ethics that they promise to follow. These codes state, among other things, that their work should be performed with compassion and respect for human dignity (Riddick 2003, 9). Unlike in these professions, official codes of ethics in design are not defined. Since designers can have an impact on humanity through their work, a code of ethics or an ethical framework could help designers to decide how to behave in certain situations. In order to develop projects that help humanity and support the end user instead of harming him or her (encyclopedia. com n.d.). This code could be a tool for decision-making to examine motives and outline important facts and implications (Bowers n.d.).

Design ethics

Aral Balkan and Laura Kalbag took Maslow's pyramid of needs and translated it into a pyramid for design ethics. The lowest level starts with human rights. It is important not to exclude any communities or to design projects

only for certain groups of people (Ind.ie n.d.). This can be achieved by having as many different viewpoints from as many different cultures with as much experience as possible working together. This way, no designer has to study other groups of people, but the project, product or service is designed by the employees' own experiences (Monteiro 2019,83).

The middle level of the pyramid describes that products should be modest or effortless to use. Products should respect how human nature works. For example, the design can take into account that people have only a short attention span (Ind.ie n.d.).

The top of the pyramid is built upon the lower two levels. Everything people do is experiencing things in their lives, both with objects and other people. These experiences must be respected. That means that products or services must be intuitive, bring joy, get things done, or make life easier (Monteiro 2019, 17).





"While it is certainly impossible to predict how any of your work may be used, it shouldn't be a surprise when work that is meant to hurt someone fulfills its mission." (Monteiro 2019, 17).

Basic Design principles

The following is a selection of important basic principles to achieve these ethical goals when designing a product or service.

Usability

Jakob Nielsen of the Nielsen Norman Group defined 5 components of usability (Nielsen 2012):

- · Learnability: How easy it is to finish a task for the first time
- Efficiency: How quickly can a task be finished
- · Memorability: How memorable is the usages after returning
- · Errors: How many errors do users make and how serious are they
- Satisfaction: How enjoyable is the product

Accessibility

Products are usually designed for the target customer. Here it can happen that other users are excluded, usually people with disabilities or people of advanced age. To give an example, websites or apps should always be designed so that older people can also use these digital applications. This includes a larger font size, larger images, higher contrasts, not only colors as information providers or giving additional instructions (Stanley 2018).

Privacy

The best ethical design practice is to create designs that are in the best interest of users and only collect personal data that is necessary to collect (Sownie 2021). Data collection should therefore be limited to the absolute minimum. If more data is needed than can be used, this fact must be communicated to the user. The reason for extra data collection is often a kind of safeguard for the companies. Should something go wrong, this data can be turned into money afterwards (Monteiro 2019, 94).

Avoiding deceptive design or persuasion through transparency

The user can only make an informed decision if there is transparency. The task of a designer is to make it easy for (Sowni 2021) •

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the user to decide what he wants to do. Dark patterns usually intentionally - have the opposite effect (Monteiro 2019, 91). There is also the question of the extent to which designers can influence the thoughts, feelings or behavior of users. Fonts or colors can also have an influence on users

Test yourself - what would you decide?

Persona

To make our app as user-centered as possible, we need personas. Personas are fictitious representatives of the target group. They have personalized characteristics, wishes, goals or experiences. These personas are used to put ourselves better in the shoes of future users and to see things from a different perspective. They also enable more effective communication among each other and help prioritize important requirements and evaluate the need for certain functions (Spies 2015, 79).

The primary target group of the application is - as previously specified – study participants between 60 and 77 years of age. Therefore, three personas are formed that correspond

to this target group. For each persona, life circumstances and personality aspects are defined. Adapted to the goal of the project and the application or the study, technical competence, mental state or areas such as smoker, diet or fitness are also specified. These special and personal characteristics, needs or feelings help us to create interactive products or services that are really relevant for the users.

In the first weeks of the project, a workshop was held to create personas, among other things. These personas were revised during the course of the project, since, for example, the age of the target group changed significantly and the requirements for the app therefore changed •



High

Motivation

Aktiv

Social

Extrovert

Mental State

Good

"I am a rather quiet person, enjoy my life and like to walk my dog. I know that my lifestyle is still not very healthy. This topic often leads to arguments with my wife. She thinks I really need to change something."

62 Age Work Bus driver Graz, Austria Location Wife and dog Family Archetype

Smoker

ш

The Everyman

Hobbies

- Watching Soccer
- Dog training
- Alcohol

Occasional smoker



After-work beer

(31) Workshop Own picture 2021



Tina Schart

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• Exercise through daily walks with his dog do him good • He travels a lot and is often stressed

Wants and Needs

• Would like to have personal information about his state of health, but does not know from where and how • Would like to pursue his work and retire soon to spend more time with his family

• Gardening club

Diet

Meat

Fitness

in R

Walking

(33) Persona 2

Patel 2019



Astrid Lundberg

"My health is what matters most to me. I therefore have a lot of activities that keep me fit. After all, I witnessed my mother suffering from Alzheimer's disease. It wasn't just her who suffered but also me."

Age	69	
Work	Retired architect	
Location	Stockholm, Sweden	
Family	Husband and three kids	
Archetype	The Explorer	



Technical competence



Mental State



• Lots of yoga and self-respect leads to a generally healthy lifestyle and a good mental state

Wants and Needs

- · Wants to lead a healthy lifestyle for herself
- · Actively seeks information about her health
- Well-being comes first
- Would like to use her smartphone more

Hobbies

- Yoga
- Cooking
- Meeting with her friends





Riccardo Giovanni

"After the rather sudden death of my wife two years ago, I try to make the best of it. Even though it is often very difficult for me. I also miss my children a lot sometimes but I manage."

Age	74
Work	Retired Gelataio
Location	Perugia, Italy
Family	Widower and two kids (Abroad)
Archetype	The Magician



Smoker Alcohol P ш Daily smoker



Occasional drinker

High

Motivation

Aktiv

Social

Extrovert

Mental State

Good

• Often feels lonely because he misses his wife and two children, who live abroad and do not visit him often

Wants and Needs

- friendships

Hobbies

- Discover Cafes

Tina Schart

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• Wants to get out of his daily routine and feel better again • Wants to make more contact with others or intensify

• Is sometimes reliant on support from his community

• Reading the newspaper

Diet

Meat

Fitness



No fitness

User Journey

After we get to know our target group, how our app is roughly structured and which paths the user will take through the app, the next step is to use another user-centric approach: the user journey.

It shows what feelings, thoughts, needs and motivation the user might have. This information can help discover and eliminate negative aspects (Babich 2019). Usually, user journeys are created with the information from surveys or interviews of future users, and this basis forms the individual steps within the map. Since the study participants have not yet been determined, this map is created on the basis of assumptions and describes a possible everyday life of a study participant, with the aspects that were unclear to us or where we thought a different perspective would be useful.

We asked ourselves the following questions:

- What influences the user?
- What difficulties can the user encounter?
- What can be improved?
- How complicated is it to find specific components? •



(35) User journey Own illustration 2022 **43** / 134

4 Ideate

The following chapter deals with the creative ideation of the app. The applications of various creative methods are described. Here, all constraints are ignored and the focus is only on idea generation. At the end of the chapter, technical feasibility and accessibility are discussed.

4.1 User Flow	46
4.2 How Might We	54
4.3 Idea Collection	56
4.4 Sitemap	58
4.5 Final Requirements and Obstacles	62

1 2 3 4.1 5 6 7 8

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User Flow

A user flow visualizes how a user might move through the product and shows the physical journey through the app. This tool helps to evaluate which steps a user needs to be able to do to finish a task quickly, effectively and without frustration. User flows are therefore useful for creating intuitive interfaces, evaluating and assessing existing interfaces, or presenting the product to other stakeholders involved to get everyone on the same page (Design+Code n.d.).

This tool is based on a predefined persona, with a task and a scenario. Accordingly, each user flow should contain a different persona, motivation, intent, action, and also a different solution.

In our case, user flows are formed based on three personas – Niklas, Astrid and Riccardo. Each persona has a different goal that is previously defined in more detail in an objective. This objective is formulated in a sentence in everyday language and usually begins with "As a...", and contains the persona's wish and ends with the goal that should be achieved.

These user flows show the structure of the app. Because many areas of the app were not yet known or clearly defined when the designers joined, the following user flows evolved over the course of the project. For this reason, the authors decided to put this part of the work in the ideate chapter of the thesis.



(37) User Flow

Own picture 2022

(36) Agenda User Flow Own picture 2022



high / Low

0 SUCCESS Takes care of health report > enough data doctor monitoring Sign in with Google Roose accant Pernissions Dashboard Enter Email Receive Mail E 0 Success Check blood values sees impraement

(38) Persona 1 Akyurt 2020



Niklas Baumgartner

Age	62
Work Bus driver	
Location	Graz, Austria
Family Wife and dog	
Archetype	The Everyman

User Story

As a Bus driver, I want to keep track of my overall health, so that I can be healthier in a more sustained way and enjoy time with my family as I age.



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(39) User Flow Persona 1 Own illustration 2021

1 2 3 4.1 5 6 7 8 Author

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(40) Persona 2 Patel 2019

Astrid Lundberg

Age	69	
Work	Retired architect Stock-	
Location	holm, Sweden	
Family	Husband and three kids	
Archetype	The Explorer	

User Story

As a person who puts their health first and according to my doctor should have my heart checked regularly, I want to have something where I can enter the data to have an overview over my blood pressure so that I can see my own results and show them to my doctor if neccessary.

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(41) User Flow Persona 2 Own illustration 2021

(42) Persona 3 Santana 2019

Riccardo Giovanni

Age	74
Work	Retired Gelataio
Location	Perugia, Italy
Family	Widower and two kids (Abroad
Archetype	The Magician

User Story

As a senior, I want to help medicine find out how dementia can be prevented and at the same time get tips on my own health so that I can still have a sense of purpose in life and also live healthier.

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(43) User Flow Persona 3 Own illustration 2021

1 2 3 **4.2** 5 6 7 8

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How Might We

The "How Might We" method helps the team focus on the right problems and generate creative ideas to solve the problems. This method helps to generate a lot of ideas and in the end the best and most important versions are selected (Rosala 2021).

In order to filter out the most important goals, the following questions can be asked:

- Does the problem really exist?
- Can an idea achieve a positive result here?

We first started writing down questions and problems on post-its. In the next step, we thought of ideas on how to tackle the problem.

For us the most important questions were:

How might we...

Right: (44) How Might We Own picture 2021 ... include older people/ not technology affine people?

affer a simple .. not overload navigation 4 the screen Leeping if 1 11213 Botton / clear, simple Header most important = Less important Bar 1213 NOT 11 colar red gree TOO WALLY 2 Coded blue INTERACTION/ yella CHOICES Main screen 000 Subscreens integrate and design a clear nark external calendar in which. applications 2 personal as well as doctor appointments are shown L R color ICON coded USAGE O GLEER COLOR CODE and design input fields decide on the to make it interesting notivational questions to use (content + time) (specific time) in the Sliders -0this? Morning buttons 85 after waking elc 4 GNE WREN FEEDBACK GEED GUAL FOR RIGHT REACHED INPUT

Idea Collection

In order to generate as many ideas as possible very freely, various creative methods were applied. Here, it is important that nothing is criticized, but to think without restrictions and as unhindered as possible.

The results of the previous phase form the basis of the generation of ideas. Problems have been defined that need to be solved: An interface design of a smartphone application which can be used by all study participants. Also, the app should be designed for a daily usage encouraging and motivating to change the lived lifestyle. Generally, to create an ideal user experience during the participation of the study regarding the smartphone application.

As shown in figure 44, innovative ideas are generated when many crazy ideas have been created. To do so, you need to thing "out of the box", i.e., thoughts that at first seem absurd. In this phase, failure is not only allowed but even desired, because the design thinker sees failure as an opportunity (Rassek 2016).

"FAIL faster. Succeed SOONER. "

David Kelley, IDEO

Crazy Eight

A popular creativity method is the Crazy eight method. All that is needed is a DIN A4 sheet of paper. The sheet is folded in half four times and unfolded again to create eight rectangles of equal size. These rectangles can be used very well as a smartphone screen.

Now a timer is set to 8 minutes. After the How-Might-We questions have been read through again, a solution is scribbled into each rectangle. So every rectangle has a time limit of only one minute.

The drawings are about different concepts that are created under time pressure and put on the sheet paper. For this

project, this method was used to scribble interfaces for the individual functions of the app. This generated a preliminary stage of the first wireframes. For each screen, different variants and variations were drawn.

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(45) Emergence of innovative ideas Own representation based on Dark Horse Innovation 2021

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An advantage of this method is to not focus on details but more about the general. Also doing this in groups is better since a typical restriction is to think straight and forget that there are other options also. So if multiple people are doing it at the same time without knowing what the others are drawing, new versions are created of which others would not have thought.

(46) Crazy 8 scribbles Own illustration 2021

Sitemap

(47) Sitemap Own illustration 2022 Tina Schart

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Home/ Dashboard

(47) Sitemap Own illustration 2022 **61** / 134

Final Requirements

Before starting the design, the final requirements are defined. These include the planned functions as well as the content and design goals. This requirements developed during the time. Especially after the user testing new requirements were added. This is a summery of all requirements during the project.

General

When designing a digital product, there is a tendency to include too many features. Because of the physical freedom and limitless possibilities, this is a mistake often made by digital designers and connectionists.

The end product is then mostly too confusing and complicated to use. Especially for the target group of this project, it is very important to guarantee a simple and easy handling.

Therefore, the application was limited to the following functions:

Tasks

This is where the opportunity of adding personal and also selecting predefined tasks out of a list should be possible. These tasks should be able to be defined both together with the physician and alone.

Calendar

A simple read only calendar where appointments from the native calendar are displayed. While the function of adding appointments to this calendar within the app was first planned, we decided that this function is not really necessary as it is not the main part of the app.

Score

The score should also be a read only screen where study participants can get an overview of their progress on interacting with the app, fitness or their mental health.

Activities & Lifestyle

A combination of information storage and data input is planned for this screen. The first section is about getting information about different parts of the influences on dementia risk. Also, this is the place where the transition to external apps like the CTrain or meditaton app should happen. As second part, the user should be able to save important data like blood pressure or how many cigarettes he or she smoked today.

Ouestionnaires

In yet undefined intervals the questionnaires should appear and the user should be made attentive to fill out the auestions.

Concept

The application is to be designed as simple and straightforward as possible, so that as many user groups as possible are picked up. For this purpose, it should be possible to use the application infrequently and briefly, without complicated familiarization with the application. It must lead the user intuitively and quickly to the goal, and in doing so, respond as good as possible to individual restrictions.

Design

One in ten Germans cannot distinguish between red and green (Ippen 2016). Therefore, while the colors used should support unrestricted users and simplify use, the application must also function without colors.

Icon usage plays a major role in picking up users with reading difficulties and giving them an alternative to words through visual language.

Large buttons, appropriate font sizes and high contrast are essential to enable easy operation, especially for older users.

Likewise, error acceptance must be as high as possible to avoid user abandonment due to lack of understanding.

Style guide

A main style guide was already existing when the designers startet their work. The fonts and colors were defined in this style guide, nevertheless the colors were slightly changed to increase the contrast which makes it easier to differ between the blue shades. With the exception of this, the style guide was followed.

Obstacles

During our journey we passed many obstacles, some smaller some bigger ones. Probably the main issue was the communication. The first months we just worked with the smaller team like the developer and the project owner together. Not until february we met the medical part of the team and this was when the biggest problems appeared. We now found out that the age of our target group is much older than we were told.

In the beginning we were told to not pay too much attention to disabilities of old people since the user group is not really old. But at the testing we were told something else, so we needed to adapt the accesibility parts.

One issue to include when dealing with seniors is the additional limitations that comes with age. These include, for example, visual and hearing impairments, coarser fine motor skills, and cognitive difficulties (slower absorption of information, memory loss, and the like) (Seifert and Schelling 2016).

In our case, especially the contrast and the font size were a problem. So we slightly changed the colors to make the difference clearer on the screens. Also, we increased the font size.

Until february it was not clear, which device the pariticpants will get. We decided for a screen size at the beginning and after five months of work we found out that the screen size of the decided device will be different. So we needed to adapt every single screen on the new size. This came witha lot of work that could have been better used.

In addition, many parts were rarly defined contentwise which is why we put much effort into the conceptional part. Out of this a second research question developed with time:

How can a designer help to build up a concept and define the needs of the client?

With our design drafts the whole application topic started to get much clearer for the team. This was well recognizable during the process. At our meetings, many open topics were only defined then.

Also a meeting after the testing with the whole team was

very clarifying since the developers were on a different state of knowledge than the medical team. As an example, during our April meeting, we heard for the first time about users having to enter or personalize certain things themselves. This of course made a big difference for our design so we changed the screen another time after already adopting it with the results of the user testing.

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To summerize, the communication could have been much better by having more meetings with the whole team and by giving more value to the design ●

5 Prototype

The prototype chapter documents the development of the prototype from the first scribbles, through wireframes to the final click dummy. Among other things, this chapter provides insights into the elaboration of the overall concept and the use of various design elements.

5.1 Paper Prototype	66
5.2 Low Fidelity Wireframes	68
5.3 Low Fidelity Wireframes	72
5.4 Loading Animation	90
5.5 Clickdummy	92

1 2 3 4 5.1 7 6 8

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Paper Prototype

Paper prototypes are a tool to quickly try out design possibilities in a team and see if the drawn idea is the right approach (Mifsud n.d.).

This paper prototype was created at the beginning of the project and shows already outdated screens. Since we had limited information and little content already defined, this prototype helped us mostly in keeping track of when which

steps are taken and which screens and top categories are connected. Many of these paper forms do not yet have content or content we provisionally invented so that a foundation could be formed to talk to developers and team members.

Through this tool, the naviagtion emerged, which was mostly adopted until the current prototype ●

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Right: (49) Paper Prototype Overview Own picture 2021

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Low Fidelity Wireframes

Wireframes represent the basic framework of an application. They serve as a visual representation of the concept and focus on functionality. The design is not considered when creating the wireframes, wireframes are therefore colorless in various neutral shades of gray. The overall concept, as well as the positioning and size of various elements can thus be tested (Nguyen 2019).

For the LETHE app, it was from the beginning clear, that only Android smartphones will be used. The study participants will be provided with a smartphone, so responsiveness does not need to be considered.

Also four main parts of the app were defined already: there should be a dashboard, a calendar, a kind of to-do list which was called tiny habits and an overview for reflection on how good the interaction with the app and the tasks that have been completed, called "Score". As an additional part, the user will be asked to fill in questionnaires within the app in an unknown interval.

Based on our crazy eight we started with wireframing which was a challenge as there was nearly nothing defined yet. We

had only the named four main parts, the information that there will be a fixed screen size (we did not know what size it is going to be) nor what the content of those parts will be. So maybe the biggest task for us designer was not to design an intuitive user interface but to help the client to get the needs in a visual dimension. So the conceptional design was at the beginning and maybe through the whole process a big task and maybe the biggest challenge of our project.

An important thing which needed to be considered was, that the study participants should be motivated to use the app on a daily basis. The duration of usage is likely to be only for a few minutes, but could also be longer. This means that the user interface (UI) needs to be simple and fast targetable. For this purpose, the interaction options on all screens are limited as far as possible and reduced to the essentials. In order to reach the target group as good as possible, the use of text is kept as concise as possible. This is to support clarity, save time and avoid misunderstandings.

Following our first wireframes are displayed.

(50) Wireframe Dashboard Own picture 2021

Dashboard

The dashboard is always the starting screen and the central point of the app. To engage the user to identify with the product and underline the individual offer and data in the app, he or she is welcomed by a changing greeting based on the time of the day.

There are the four main parts of the app displayed as tiles which are working like a link. By clicking on them, one will be leaded to the respective screen.

Quick information like upcoming appointments or most recent notifications are displayed in a preview mode on the dashboard already so that the user does not need to get one level deeper every time.

On the upper right corner the list icon displays the questionnaire. Whenever a qustionnaire needs to be filled in, a little number will appear, to make clear there is something new which needs attention.

Notifications

on function.

Calendar O Lunch with Lilly O Take a walk

Calendar

ments.

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What later turned out to be one of the obstacles is the notification screen, which was also called "tiny habits". We tried to split up those tasks into the medical and the personal category. In our concept, this screen is used for upcoming events and appointments as well as reminder to do sports and fill out the questionnaires. Also, the user by himself should be able to set reminders using this notificati-

Each task is displayed on the list, can be ticked or expanded by clicking on the arrow down. Further information will be displayed like a description or, if existing, the due date.

> (51) Wireframe Notifications Own picture 2021

The first version of the calendar screen included three tiles. The first tile is a scrollable list view of today's appoint-

A monthly overview where an preview with a maximum of two appointments is shown underneath each day. The idea of the third tile was to display the notification part again, since they are likely to be connected with the calendar. If, for example, a questionnaire is due until a certain day, it will be displayed in exact this section.

> (52) Wireframe Calendar Own picture 2021

1 2 3 4 5.2 7 6 8

Dashboard

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Android - ... Centroard Good morning, Anna

(53) Wireframe **Activities & Lifestyle** Own picture 2021

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Activities & Lifestyle

In the beginning this screen was as well very undefined. The requirements were to have a screen where users can find more information about sports and nutrition or general news but also find external apps for cognitive training and mediation. Additionally this should be the section where the manual data input takes places. It was not clear what and how many input this will be, so we started designing this section to make it clearer for everybody. Each input category is shown on one card including an input field and a "Save" button. As soon as the input is saved, the card swipes to the left and the next card will be displayed. Of course this concept works only if there will be less than 10 input categories.

Score

Another unclear topic was the score screen. The idea was to have an indicator which shows how good one has done within a certain time. This should not just help to keep track but also motivate to do better next time. A visualization of the data with help of three colored circles like known from the Apple Watch should be the base of this screen. Underneath there are more information about how this score comes about.

The data is clustered into three categories which are displayed as expendables underneath each other. When expanding the categories, there will be shown many different numbers like how much sleep one had or how many cognitive training games one played •

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(54) Wireframe Score Own picture 2021

> (55) Overview Wireframes Own picture 2021

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Activities & Lifestyle

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High Fidelity Wireframes

On the following pages the latest state of our prototype is shown. Design Thinking is an iterative process which means that jumping between phases is important to have the best possible outcome. We jumped multiple times between the different phases and following is the final result . Some screens shown here are already adopted and revised after the user testing described in the next chapter.

Onboarding and Login

At the beginning of the study, the participants receive a short introduction to the topic of the study, the reason for the app and the individual and personal benefits of the

study and the app for the participants. We also decided to give a short introduction to inform the users about the features and benefits of the app and to welcome the users. This introduction is given on three screens, on the topics self-care, prediction and knowledge discovery. The waves in the background are variations of the LETHE logo and play a big role in the rest of the app's design.

Study participants are given an email address in advance with which they can log into the app. Here, the decision was made to register and link with Google in order to speed up the login process.

Dashboard

The dashboard was designed by applying Gestalt principles. In particular, two Gestalt principles were used to emphasize connections and help people perceive and process information efficiently. One is the law of proximity, where elements that are close to each other are perceived as belonging together (ISO/TC 2017, 18) and the other is the law of closure, where non-existent parts of a figure are

These two laws are found again and again within the app, but they are especially prominent on the dashboard.

perceived as complete forms (ISO/TC 2017, 19).

Dividing the dashboard into tiles

ISO 9241-125 recommends using no more than six colors (ISO/TC 2017, 41). We decided to use four colors from the style guide and add a darker color to achieve a higher contrast. Each color was assigned a category within the app and should help separate the categories better. The dashboard starts with a personal greeting. Below

tasks.

On the ,Health Report' tile, the user can see his or her personal score or health report for the last week at a glance. For a more detailed display of all information and the health report, the user has to tap on it.

screen in mind.

1 2 R S Good morning, Today's Tasks Today's Task 1/4 tasks done 1/4 tasks done > Calenda February, 2022 5 2 3 ctivities & Lifestyle Todav's Tasks No tasks added yet > > Report 3 Not enough data yet

lethe Left: (56) Onboarding Self-care Own picture 2022 Self-care Middle: (57) Onboarding Prediction

G Continue with Google

Own picture 2022 Right: (58) Onboarding

Knowledge discovery Own picture 2022

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that is the ,Today's Task' tile. This tile contains a personal display of the tasks to be completed by the user on that specific day. The number of to-dos is indicated by a visual display as well as a written description of the number of

The ,Calendar' tile shows the current calendar week, month and the current day.

The fourth and last tile of the dashboard is ,Activities & Lifestyle'. It covers several important areas of the app. It therefore takes up the space on the bottom right to make it easier to tap on by keeping the size of the smartphone

Questionnaire Icon

Study participants are asked to answer questionnaires at different time periods and on different topics to provide data for the medical professionals to evaluate. If there is no need or no current and new questionnaires to be completed, there will only be the four tiles on the dashboard 1 . If there are questionnaires, an icon appears in the upper right corner with a number for the amount of new questionnaires. This disappearance and appearance of the icon should make it visible that there is something new to do and thus draw attention to it 2 .

First use

Designers also have the task of thinking about screens that do not yet have content, or in other words, when the app is started for the first time. The dashboard specifically has two tiles that display personalized content. These tiles work like a preview. When the app is first opened, there is no personalized content yet, so the wording has changed to tell the user that these tiles will change as they use the арр 3.

Left: (59) Dashboard Own picture 2022

Right: (60) Dashboard Icon Own picture 2022

Right: (61) Dashboard First use Own picture 2022

1 2 3 4 5.3 7 6 8 Author

October 2021

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Pop-Up

Under Today's Tasks, study participants are asked to select goals and Tiny Habits from a list and set their own personal goals. To check if they finished those personal goals and at the same time remind users of the goals they have set, blue tiles appear throughout the day 4 . In example 4, the user is asked how his or her mood is today. After tapping the answer, the tile disappears again. Depending on the question type, a different tile appears with different question and answer options 5 . In addition to that, depending on the question type, there is the possibility to get more information about the question asked, to remember why the

goal was set and what the benefit is. This information can be accessed by tapping on the question mark in the upper right corner 6 . This message can be closed either by tapping on the x or by tapping on the information text. The placement of the question mark was intentionally chosen to prevent accidental answers.

In order to simultaneously provide feedback to the user that the response has been accepted by the system and leave a positive feeling of achievement, a positive message is displayed for 4 seconds after answering the question asked 7.

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Dashboard

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Health Report

Activities & Lifestyle

April 2022

January 2022

(63) Dashboard Overview Own picture 2022

Tina Schart

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Health Report

An important part for the personalized display of all the user's data is the Health Report. This report collects data, groups it and displays these individual values for each week.

Rings

The rings give an overview of the user's performance and have their own color code. It also shows how much the ring would have to fill up until the next or better level is reached 8.

Feedback

(64) Health

Report Overview Own picture 2022

The blue tile below the rings gives additional short and simple written feedback about the performance. If the user's performance has deteriorated from last week, this is indicated here 9.

More insights

Further down the user has the possibility to view more insights about the appearance of the rings. Each ring is assigned to its own category: App Interaction, Fitness and Brain Training. The categories have been arranged as an accordion. According to ISO 9241 161, an accordion is a group of elements separated by several reducible sections (18). It consists of a label, a means to reduce or expand, and the workspace that shows the content (ISO/TC 2016, 18). Within the categories, the user can view the data and also see through numbers or arrows whether their performance has improved or worsened compared to last week 10 .

First use

When opening the app for the first time, the user does not have a Health Report yet 11 . A brief explanation is given here. The health report is created when the app is used.

October 2021

18

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(65 Health Report Own picture 2022

Author

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Calendar

The calendar is - as already mentioned in earlier chapters a read only section. Appointments from the native calendar will be displayed in the LETHE calendar to make sure the user gets all information about upcoming events without changing the app.

General

Very remarkable, the selected date is shown at the top of the screen. This makes which day the user is looking at. Also, as already known, the navigation arrow on the left upper corner is displayed to navigate back to the dashboard.

Color coding

To separate between appointments which relate to the LETHE study and private appointments, we used two different colors: a blue for LETHE appointments like Tiny habits, doctor appointments or else and a gray for other appointments like social activities or other.

Day view

The standard view is the day screen, which is mostly known from the native calendar screen 12. By clicking on an appointment, a popup will open with more details about the meeting and, if existing, a "Attend Zoom meeting" for online appointments which directly link to the meeting 13.

Month view

The other screen at the calendar part is the month view, where the whole month is displayed. For each day, a maximum of two appointments will be shown as preview 14.

First the calendar was supposed to include the tiny habits called goals in this stage 15 . In multiple drafts they were marked in the monthly and daily view of the calendar. Also the edit mode of the goals was only reachable from the calendar view 16. But as many goals can be set, they were moved to the tasks section.

07 PM Left: (66) Calendar 08 PM Own picture 2021

10 11

16 17 18

23 24 25

30 31

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Right: (67) Calendar Drafts Own picture 2021

1 2 3 4 5.3 6 7 8

October 2021

Message log

Upcoming Completed Canceled

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Tasks

The task screen was content wise one of the most challenging screen. In the end, we decided for two tabs - the to-dos and the tiny habits.

To-dos

A classic to-do list where the user can see own tasks or individual tasks which were defined with the doctor 15. Additional to the task, an optional due date can be added. After the task is done, it can be checked on the list and will disappear. With the button on the bottom, a new to-do can be added to the list 16.

Tiny habits

The second type of tasks are the tiny habits, which are defined for every study participant and can be added out of a list. There is no possibility to check the tiny habits within the app since tiny habits are about things to be done during the everyday life and some of them are situation-related. So basically on the tiny habits screen 17 a list of current selected tiny habits is shown. By clicking on each item, a description of each tiny habit will be displayed.

There is an edit mode 18 of the tiny habits where new

tiny habits can be added 19, current tiny habits can be deleted and also the frequency of the tiny habits can be defined.

Depending on how high the frequency is, a push notification like shown on page 74 will pop up sometimes to remind the user of his or her tiny habits.

December 2021

Message log

Upcoming Completed Cenceled

January 2022

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Walk before breakfast	00 Evening walks +	() Till today
	Add new tiny habits	Walk before breakfast

s Overview	Tasks Overview	Tiny Habits - planing	Tiny Habits - planing	Tiny Habits - planing
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Walk before breakfast	Ready-made vegetables	Having nuts in my pocket	Add more tiny habits +	Add more tiny habits
Mental health Questionnaire	Evening walk	Push-ups before teeth brushing	- 2x + Having nuts in my pocket	∑ Having nuts in my pocket
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Add new task	A S D F G H J K L T Z X C V B N M C Sym & , typector , e1	Edit tiny habits	Save tiny habits	ee Evening waks Add new tiny habits

Left: (68) Tasks Own picture 2022

Right: (69) Calendar Own picture 2022

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Add new tiny habits

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February 2022

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-Walk before breakfast
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Save goals for next week

1 2 3 4 **5.3** 6 7 8

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Activities & Lifestyle

General

The actives & lifestyle screen ²⁰ is a mixture of information gathering and the main data input area. The upper three quarters are dashboard with multiple cards categorized into two categories:

Internal Cards

The internal cards in the first row are three jumps off possibilities, fitness, nutrition and education.

External Cards

By clicking on one of the three external cards on the second row, a simple screen appears which tells that this part is taken over by an external app.

Data input

The card section on the bottom is the main data input section. There are multiple cards which can be scrolled horizontally. By typing in the values the card turns disabled and swipes automatically to the left.

As wished at the user testing, it is also possible to see older values. The history can be accessed by the link "today's history". A popup will appear to show all past values **21** . From a design perspective it would be helpful to have a visual diagram, sorting options and also a marking of untypical values. In our case, this was technical too much.

Subcategory

Author

Cognitive training

The cognitive training is provided by the external app provider CTrain. Since it is hard to use CTrain on smartphones, there is the possibility to open the app on other devices like tablets or computers. But to make it trackable for the LETHE app how often CTrain is opened the app needs to be opened by the LETHE app.

To do so we designed a share area where a QR code is displayed to scan it with tablets and a link icon which displays the native sharing menu of the Android system to share the link via messenger or email.

After the user testing it was clear that some more description about the QR code is needed so we designed a popup which shows in three steps how to scan the QR code and open the link.

Social activity

A similar screen, is the social activity screen just without the sharing functions. With the button, the user will straight open the WhatsApp group.

 Cutivities & Lifestyle

 Activities & Lifestyle

 Fitness

 Videos

 Videos

 Paranteria

 Display

 Print Training

 Game

 O5 April 2022

 Blood pressure

 O5 April 2022

 Blood pressure

 Store

 Store

(70) Activites & Lifestyle Own picture 2022 Lisa Fresser

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1 2 3 4 5.3 6 7 8 Author

October 2021

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Subcategorys- Fitness and Nutrition

As described in the chapter define, the preventive measures of dementia also include areas such as Nutrition or Fitness. These two areas of the app are the most uncertain at this stage, as there is no clear guideline yet. The following screens are intermediate states and show a possible solution.

Nutrition

In the nutrition section of the app, the user can pick up personal tips on specific topics in the field of diet or get general information about the topic 25 . Register cards were chosen as the design method here 26 . This has the advantage that the space of the screen can be used more optimally and there is a clear separation within the screen. According to ISO 9241 161, it must be clearly marked which tab is currently active (ISO/TC 2016, 72). Therefore the label is highlighted in blue.

Under the Tips sections, categories can be selected. If the user wants to learn more about the topic of meat for example, he can do it by choosing the chip meat. After the selection, only formations or recipes about the desired topic are displayed.

Fitness

The fitness section of the app has the same structure as the nutrition part. The content is adapted to the category and contains fitness videos as well as relevant information 27 .

Under the ,Training' tab, the user can select a training video to access the overview, which lists what exercises are coming up, how long the duration is and what fitness level the video will have 28 . The video starts by tapping on the dark blue button or tapping on the play button in the middle of the preview image. These fitness videos are recorded by physiotherapists participating in the study.

Left: (72) Nutrition Own picture 2022

<

Right: (73) Subcategory **Fitness and Nutrition** Own picture 2022

What Should I Eat? The Nutrition Source Mrg Harverts Healthy Eate

Lying Twist Play video

April 2022

February 2022

75

Tina Schart

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1 2 3 4 5.3 7 6 8

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Questionnaire

A major and important part within the study and within the app is the area for the questionnaires. Over the course of the study, physicians and researchers repeatedly send questionnaires at different intervals for the study participants to complete. Topics to be queried can be about health, fitness or diet. This part of the app can be accessed through the icon on the top right of the dashboard. This icon appears only when there are questionnaires to be filled. Tapping this icon takes the user to a screen that

shows how many questionnaires are currently pending including topic and date ²⁹ . In addition, the user sees a progress bar, as the questionnaire can be canceled at any time and completed at a later point in time 30 . If the study participant forgets the deadline for completing the questionnaire, he receives notifications and sees in the list which one should be completed first. This is marked with a red exclamation mark **31**. If the study participant selects a questionnaire, he or she is taken to a new screen with a description and the option to start the questionnaire 32 .

29 < Que 30

Questions

For the question types we met up with the team to discuss all possible input types for the questionnaires. Afterwards we designed every input type in three states: the initial state, the selected state and the error state.

Important for us was to show specific error message to give detailed information what was done wrong.

- Following input types are designed (from left to right):
- buttons
- decimal number
- number input with unit dropdown
- date

• test field input

select

 date with time text line input (75) Questions Own picture 2022

• select with possibility of own input

Also the "Next question" button is disabled if no input or no valid input is inserted

0. Clickdummy

(76) Figma Screenshot Own picture 2022

Loading Animation

To provide feedback to the user regarding the time it takes for a system to complete the user's interaction, progress bars or wait animations are commonly used. This feedback assures the user that the system has understood the input and is responding. If fast loading is not possible, it is recommended to use this type of feedback. Animations are rather unnecessary if the page takes only one second to load. If the loading time is 2-10 seconds, it is recommended to include an animation to give feedback (Sherwin 2014).

The ISO standard 9241-161 states that in addition to the animation or the progress bar, a short description is helpful to provide the user with suitable feedback (ISO/TC 2016, 56). Since this is a rather older target group that is more inexperienced with digital apps, this recommendation was taken into account.

The LETHE app takes about four seconds to update and load all content, especially after login. For this reason, several animations were created to make the waiting time more interesting.

In the following, samples of the animations are shown to get an approximate picture of these GIFs •

(77) Animation 1 Own picture 2021

Version 1 This animation was consi-

dered the favorite for a long time, as it captures both the Lethe logo and the waves. Due to the transparency and related problems when incorporating it into the app, this version was dropped. In addition, there was the problem that the animation would break at shorter load times.

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Version 2

Here the waveform was adopted in a different way. The problem with trying to incorporate this animation into the app was also present here and was therefore dropped.

(78) Animation 2 Own picture 2021

Version 3

This animation shows the outline of the Lethe logo and is considered the favorite. It is a clear simplification of Version 1. In addition this animation fits all load times and can be played for a short as well as a long period of time.

> (79) Animation 3 Own picture 2022

1 2 3 4 **5.5** 6 7 8

needs and this could lead to a complicated user interface

"Static prototypes take the emotion out of the ex-

perience and emotion is what makes the difference

between a good and great experience." (Rudle and

For a user testing, in our opinion, a functional and inter-

active prototype is essential. For our testing at the AKH in

- English for the team and the general concept and German

for the testing since our test participants were supposed to

be German speaking. This prototype could be accessed by a

Vienna we developed the clickdummy in two languages

because of adding functions which are not needed.

Jon 2019)

link on any smartphone •

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Clickdummy

For the user testing but also for having a better template for the developing team and a clearer visual imagination for the whole team we also built an interactive high-fidelity clickdummy using the software Axure RP.

So our standard workflow was to design all screens in Figma and import them later into Axure to include the interactivity.

For us this was an important step since it was sometimes hard for the project team to understand the click flows within the app and to imagine the different screens one after the other. A clickable dummy is always a huge enrichment thinking about the conceptional part of a digital product. Ideally a clickdummy feels like a real product just without the data based functionality.

There are multiple advantages an interactive prototype has:

1. Realistic preview

Prototypes are a perfect tool to fix the gap between user and client expectations and the current state of the product. Interactive prototypes are most realistic to the final product, thus giving a real-like preview.

2. Emotional connection

By using static prototypes the user has very little emotional connection to it. For him or her it is only a screen which cannot be interacted with as very little of the experience has been customized to the mindset of the person viewing it. It can happen that the user starts to think how he would develop the product to make it more individual to his or her

(81) Clickdummy Freepik n.d.

6 Test

As the second last part of this thesis, the prototype was tested. The following chapter describes the setup and execution of the user test and analyzes its results.

6.1 Teststructure	96
6.2 Results and Analysis	100
6.3 Incorporation of Testing Results	104

Teststructure

In order to launch a product that is perfectly tailored to user needs, it should be regularly tested during the process. Realistic scenarios are simulated for this purpose. Ideally, the test is carried out in the environment and on the premises where the product will later be used.

UX testing is done to "measure" user experience and uncover comprehension problems early on. Testing should take place as early as possible and is best repeated after each design of a major feature.

In our case there was only one big testing regarding the time restrictions. Also the test took place in the Allgemeines Krankenhaus der Stadt Wien (AKH Wien) which obviously is not the location the product will later be used by the users. The test focuses on the product. Thus, the test person cannot do anything wrong or right, it is only about finding out if the product is usable (Hofmann 2019). In this case, the following questions should be clarified by the test:

- Does the content of the app make sense?
- Would the product be used?
- · Is the prototype intuitive and can be used without explanation?
- Is it usable for the age group?
- How easy is the product to use?
- Is the scenario successfully executed?
- · Are users satisfied with the design and functionality?

Guide

The test is divided into five parts: An introductory part, an exploratory part, a given task to be performed, an A / B testing and as a conclusion a reflection and evaluation of the prototype:

Introduction

In order to familiarize the user with the subject, he or she was informed about the reason for the work as well as the aim of the test. After that, the test persons were asked to report on his or her smartphone usage.

Explorative part

As a next step, they were asked to click freely through the prototype while thinking aloud. The main purpose here was to describe expectations, evaluations, and feelings. If necessary, "W-questions" were used to ask more specific questions again and go into more depth. This part helped to understand what the user expects. In addition, their needs were compared with the existing functions.

Scenario

The first scenario that was tested was to plan a "Tiny habit". Those are smaller tasks which are planned weekly to be done during the week.

As second scenario, the user should enter his or her blood

pressure values into the app.

A / B Testing

Since we were not sure how granular the user want to have their feedback on how they are doing with the app, we decided to make an A / B Testing. For this we printed two versions of the Score Screen, one with absolute numbers and one with percentage values.

Conclusion

Finally, feedback was given. This was divided into two parts: The feedback interview, in which concrete questions were asked about feelings, suggestions, improvements and impressions.

The second part consisted of a questionnaire based on the user experience questionnaire.

Location

The test was carried out at the university hospital AKH in Vienna which is one of the biggest hospitals in whole Europe.

Test participants

The team for the testing consisted of us two designer - Lisa who led the user through the practical test, Tina who was the recorder and also responsible for the A / B testing and the questionnaire. Additionally Helena Untersteiner from the department of Neurology at the AKH supported us during the testing which was also a big enrichment as it was the first time for us designer to get in touch with this stakeholder group.

Organized was the test by project coordinator Sten Hanke and associate professor Priv.-Doz.Dr.med.univ. Elisabeth Stögmann.

P1		P2
Gender Age Language Dementia	Female 65 German Not diagnosed	Gender Age Langua Demen
Р3		P4

Gender	Male
Age	75
Language	German
Dementia	Not yet diagnosed

All of our participants had a control examination appointment with Dr. Stgmann on this day and came to the testing room afterwards. Each of the tests lasted about one hour. As one of the patients were sick that day, we had 4 testing participants.

General problems while user testing

We had some issues during the testing since the communication between us - the designers - and the team who acquired the test participants was not ideally. So it came up that we translated the whole app in German since we were told that all the participants are older German speaking people, but our second patient was from Italy, speaking only English and Italian. Also, this man was already diagnosed with dementia, so not really a potential future user. We tried to translate the app, but this testing was not really countable. Also, the other people were older than expected and as it came out afterwards not exactly the age of the study participants •

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2

Male der 70 guage nentia

Italian / English Diagnosed

Gender	Male
Age	85
Language	German
Dementia	Not yet diagnosed

(82) Test participants Own picture 2022

1 2 3 4 5 **6.2** 7 8

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(83-85) User test insights Own pictures 2022

(86) User test insights Own pictures 2022

Results and Analysis

General

In general the user testing was very helpful and we learned a lot. Some parts worked out very well and some parts showed us the partial lackof content. There are still a few topics which need to be discussed but mainly on the content side. A lot of misunderstandings happened in two main parts: the Score screen and the Tiny habits part. Also, some naming like cTrain or cognitive training were not clear understood.

Regarding the complexity of the app, especially the first person came along very well, P3 and P4 needed some smaller hints but understood it quickly afterwards. Just, as already mentioned, for P2 it was hard to concentrate and focus on our questions. The fact that he did not speak German was already disadvantageous and in combination with the diagnosed dementia it was hard to go through the test.

NEGATIV

STRUKTUR

UGAN APP

KOHPLIZIERT

HONATS-

üBERSICHT

GEBRAUCH

SJ. WOCHE

Score

WIRD NICHT

BEI

The analysis of the test is divided into two parts. The first part of the analysis is based on the protocols that were created during the tests.

From this, so-called key findings are formed, i.e. the most important and most serious findings from the test. The statistical data, like the evaluation of the questionnaire, represents the second part.

To get a good overview, we wrote all findings on post-its. We used color coding to organize the findings quickly: negative findings were written on red pos-its, positive findings on green post-its, ideas on blue and statements or quotes on yellow paper.

Afterwards both of us decided for ourself which findings are the most important and those which were for us both the most important were defined as so-called key findings.

TINY HABITS

FARBEN WE

NICHT IN

GEBRACHT

TAG / HONAT

UON NIEMAN

AUSICHT

ERKANNT KLAR)

BINTPRUCH: EINGABE-UORHAT(/)

HNKLAR

CTRAINT 77

FRAGEBOG EN

UNSCHEINRAR

WARNA -A

TING HABITS FU

-1 +

IGON

LLA

HORIZONTAL

SWIPE NICHT

四+图+图+回

0

BRKANNT

SCHRIFT

24 KLEN

SCORE :

INTERAKTION

REGISTER KARTEN

NICHT KLAR

SCORE

SINN? LARUM WELLER

WAS FOR ZAHLEN SIND DAS?

(87) User test results

Own picture 2022

ALLES KA UERSTÄNDUCH	BILDUNG FINDET SIE GWT	
KALEN DER .	SCORE :	
200M LINK	L'BERSICHT-	
WIRD GERUNDER	LICH	

ZITATE

ES IST BELASTEND

WERNI HAN SOUAS NICHT VERSTEND ... DA KOMMT HAN

SICH DULL UCE

IDEEN & ANMERKUNGEN

KLICH AUF

KATEGORIEN

UM TH ZUZU

TUGEN

üBERSICHT

24 GEQUETACH

ALLES GROSSER

AUTGABEN

GAR NICHT

VERSTANDEN

ENTEILTER.

+ BEI TH

ZU KLEN

->INTERAKTION

UNKLAR

UNKLAR

WIE NEWF

TH ZUFICER

GR + UNK:

NICHT UERSTALDER

NICHT VERWENDER

WEISS NICHT

	TINY HABITS ÜBERSETZEN 1	HONATLICAER SCORE	TEXT: HEWTE IST 21 TAG UNNÖTIG	COGNITIVE -> ANDERER BEGRIFT	KURPERL AK.: ERWARTET TIPPS & HATERAN INSPIRATIONEN D	SPEICHERN STATT SICHERN
wä PDE APP Täguch NATZEN A	BILDANG UNNETIG	HIN WEIS, DASS ER Obst Essen Soll	DIGITALER KALENDER WIRD GAR NICHT GENUTE	SWIPE HOWAT/ TAG	WURDE APP WECHEUTT. NUTZEN, TÄGLICH NICHT 3	LIEBER BLÄTTBEN STATT SCROLEN 3
EMOTIONEN ANIMIEREN NACH KLICK H	HARKIERUNG VON (BD) NERTEN WENY BESONDERS	NICHT 24 VIEL AUF EINER SEITE	NJTERUENTIGUS ???	WIE LANG MUSS SPATZIER- GANG SEINJ	EIIXAABEN HISTORIE: C.A. G. MONATE	ALC: BILDER GURDEN VERSUCHT ZM VERSTEHEN

"Going for a WALK before **BREAKFAST**? I am not INSANE!"

"It is **STRESSFUL** when you do not understand something like that. It makes you feel STUPID."

Participant 2

NUORHERSAGE

WAS IST DAS?

HODELL !

SPATZIEREN

VOR DEM HEGHSTUCK ')) ICH

BIN DOCH NICHT

UERRÜCKT!

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Participant 3

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1. Key Finding

Size of UI elements and fonts Since this is an older target group than originally communitcated and expected

- Font is too small in general
- Buttons need to be bigger

(88) Key findings pexels.com n.d.

2. Key Finding

Usefulness and content of Score Since this is an older target group than originally communitcated and expected

- Expandables not recognized
- In general not understood
- Comparison from this weeks score to last week or last month not understood
- Rngs were not associated with numbers
- No big change in one week, better monthly score

(89) Key findings Free mockup n.d.

3. Key Finding

Usefulness and content of Tasks

- Some did not get this part at all (after explanation it was for some users understandable)
- Categories of tiny habits and intervention were not understandable
- Red colored tasks were unclear why they have a different color

4. Key Finding

Dashboard tiles were not recognized as larger buttons

- · Participants tried to interact with content of tiles
- Tasks were clicked on the dashboard already
- Small pictures of activites & lifestyle were clicked on (confusing why everything ends up on the same page after tapping on the picture)

5. Key Finding

Sharefunction of CTrain app by QR code / link

- Only one person did now what the QR code is but would never use it in the app
- Connection of opening content from smartphone to computer was not understandable
- Link icon was not understandable

6. Key Finding

Wording

- CTrain
- "What is CTrain?"
- Score / Tiny habits
- German translation missing, no information how English speaking people would understand it
- Interventions
 "I know the word but I don't understand it in this
 context"
 •

Lisa Fresser

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(91) Key findings De Lotz 2021

(92) Key findings pexels.com n.d.

(93) Key findings pexesl.com n.d.

Incorporation of Testing Results

Based on the testing analysis and the key findings we optimized some of the screens. In general we decreased the font size and also the contrast. We changed the shades of blue to make it clearer and to make the white font more readable.

(94) Dashboard after Testing Own illustration 2022

At the testing, it was noticable that the users do not understand the tiles on the dashboard as link. They tried to interact with the elements on the tile. So we highlighted the tiles with the four blue stripes on the tile border. Also we changed the content of tiles. Especially at the Activites and Lifestyle tile the users tried to identify the little images and expected different content between each square. So we got rid of the images and replaced them with just blue squares to teaser a sub-dashboard.

Tiny Habits Interventions O/1 tasks Ready-made vegetables Evening walk Till Mon, 28th February 2022 V Good enough Till Mon, 05th March 2022 \sim

zed that the to-dos are color coded in two shades of blue for the two categories on top. Also, the content was not clear. So we decided with the whole team together to display self-written to dos which are defined by the patient with the doctors and the tiny habits. We used tabs like already known from the education screen for separating between, not tiny habits and interventions any more but to-dos and tiny

habits.

While the wording of tiny habits and

understood, it was also not recogni-

interventions was not really clear and

Health Report From 27 March – 03 April From 27 March – 03 April From 04 April – 10 April 42 42 93 ↑ last month 52 🕹 93 🕇 52 🕹 Today is the **21** day on the road to master your physical and mental healt Today is the **21** day on the road to master your physical and mental healt Get more insights App Interaction More insights More insights) Fitness App Interactio \sim App Interact \sim Physical Activity) Fitness \sim) Fitness ~ You took part in 4 *³ Physical Activity Sessions J Cognitive Training \sim You took part in Your perfor 4,03 ⁻¹ Miles 4,03 1 Miles 56 4 Minutes z^Z Sleep 8 h 15 min -30 m Time in bed Sleep 8 h 15 min ↑ 7 h 58 min ↓ 66 % ↑ Time in bed Time asleep Time asleep Brain Training Cognitive Training \sim

The score was also not clear so we first of all renamed it into "Healt report". As the circles were not really interpreted at all we also labled it to clarify what the circles are for. As further development we skiped the "last week" and "last

As the useres had some trouble with the QR codes, we added a help popup which shows how to use this QR code.

(95) Tasks after Testing Own picture 2022

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month" number and replaced it with a smiley. This emotional indicator should communicate the user how well he or she is doing by a happy, neutral or sad smiley.

(96) Health Report after Testing Own picture 2022

(97) QR Code after Testing Own picture 2022

7 Addons

The work of the LETHE project has ended for us with the delivery of our clickdummy prototype. But for this master thesis we developed some more ideas and went further into some parts which we documented in this chapter.

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App Marketing in Healthcare

Assuming that the app would be further developed and would continue to help the participants after the end of the study to support a healthier lifestyle, appropriate marketing would be necessary. In the medical spectrum, marketing an app differs from marketing an app in the entertainment field.

There are now numerous apps in the medical field in the respective app stores. Every app developer can make his app available in the store, there is no regulation so far. For this reason, national and international rating portals, scientific evaluation tools, orientation aids in the form of checklists for consumers have been developed.

Seals

Since there is no existing general information source about the seriousness of medical apps, seals could help people

to trust into digital products and also to give a feeling how reliable it is. Two of the most important seals are the CE marking and the quality product Internet Medicine BiM

CE marking for medical apps

Only a product that has undergone a legal testing process (the so-called conformity procedure) may be labeled with the medical device mark.

This certification is mandatory for apps that are marketed for the diagnosis or therapy of diseases based on the Medical Devices Act. However, it should be noted that this certification does not say anything about the health benefits of the app. Unfortunately, to date there is no regulatory body where every consumer and patient can view the CE-marked medical apps (Kramer and Ursula 2018).

Quality product Internet Medicine BiM

Since 2015, the German Association of Internet Medicine is supporting companies in the certification process of medical applications that are to be marketed as medical

devices. The association limits itself to apps of risk class I, which can be certified without a so-called notified body. The association prepares the necessary documents for the acquisition of the CE mark on behalf of and at the expense of the manufacturer. The catalog of requirements for the "Quality Product Internet Medicine" seal is based very closely on the legal requirements for Class I medical devices, but is only issued to the app manufacturer after the order has been placed (website). How many apps have received the "Quality Product Internet Medicine" seal from the association to date cannot be viewed on the association's website. One CE-certified medical app that advertises the BiM seal on its website is the app Femisphere (Kramer and Ursula 2018).

Beside of seals and the same as for entertainment products, the seriousness can be supported by a professional and convincing brand appearance. This can be reached by having a well-designed and content filled website, but also further possibilities to get informed about the product. This includes for instance an image video in which the product is explained, described and shown. Furthermore, recommendations and reviews from other user can be very helpful and convincing.

Of course the website needs to be search engine optimized and with a high chance google awards could also be very helpful.

Next step would be to reach more attention and spread the product through the market. For a medical app, there are some strategies overlapping with common apps and some would be different

Since the target group of a dementia prevention app would be older people, it is likely that posters on train stations or waiting rooms at the doctor would make sense. In general, places where the target group feels safe and trusty would be very suitable for hanging up posters.

This works probably not only with places but also with people who recommend the app. Maybe this marketing strategy is one of the most important. It could be called old-fashioned or more primal influencer marketing to convince people who the target group trusts.

Also if the doctor is total convinced with the digital product, it is likely that he or she recommends the app to patients, which is perfect since there is nobody who works closer

the way to go.

here.

Profitability

According to Felicitas Viegas the increase in the use of telemedicine products is great. This is mainly caused by the fact that the concrete benefits for customers are increasing. The statista study "Revenue forecast for the global digital healthcare market by segment from 2013 to 2020" it is shown that the market volume of the wireless healt sector is expected to increase from just under 60 to over 100 billion US dollar by 2020 (statista 2014).

E-health offerings are promising, and not just because of their wide range of customers: For example, the average revenue per user in the "e-health applications for diabetes" segment is currently EUR 62.80 worldwide. This is expected to rise to 93.41 euros by 2020 (Viegas 2017) •

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with people at risk of dementia.

As summary, a combination of all marketing possibilities is

Three impoartant things which should be considered for selling a digital product:

1. Flexibility in purchagin

Nowadays transparent cost systems and felxible purchases is one main part in customer experiences. The more effortlessly the user can get a product the better. No matter if pay-per-use, leasing or purchasing maintenance service and spare parts are also increasingly being taken for grated

2. Personalization

Individuallity is one of the big megatrend at the moment. No metter in which fieald, it needs to be considered. People feel important and taken seriously when individual and personalized products are offered to them.

3. Creative Communication

Digital developments enable people and products to communicate and cooperate. These opportunities should be considered in any case when trying to sell a product. Reaching potential customers has never been easier. With a targeted marketing strategy, you can put your products and services easy on the wanted market place.

(99) Octalysis Framework

Own illustration

based on Chou n.d.

Gamification

Most systems or products are function-oriented. They are designed to complete a task quickly and target the user's sense of duty. The integration of gamification in these platforms can help motivate users to perform certain activities in order to provide them with a better user experience while supporting them.

The term gamification refers to the integration of playful elements in environments that are not games. Examples of this are websites or apps. This makes applications or systems that are rather unattractive to users more interesting. They engage with the system on their own initiative and with their own motivation (Interaction Design Foundation n.d.). The integration of gamification into platforms can bring many advantages for users. In language learning apps, it makes the user enjoy to learn and motivated to do their lessons. In medical apps, it can help users take medication or improve their lifestyle in a sustainable way.

Advantages of Gamification in Healthcare

Gamification is also increasingly being incorporated in the healthcare sector to eliminate unpleasant or negative aspects for users. Gamification is mainly implemented

through success progress bars, social interactions with each other or through competitions, challenges or the collection of virtual elements such as badges or stars. Through these elements, the user gets a sense of achievement which can lead to more positive results (Terehin n.d.). In the case of studies or the development of new innovations within the healthcare sector, the integration of gamification increases the number of users and thus the collection of relevant patient data. The user is motivated, more feedback can be collected or new trends can develop, which can be better adapted to the needs of the target group (Ibid n.d.).

Octalysis Framework

Yu-kai Chou spent several years developing the Octalysis framework. This framework analyzes reasons that drive human motivation and also show how these human drives can be used to create rewarding and engaging experiences for users. The following eight reasons were defined (Chou n.d.):

Epic Meaning and Calling

This method gives the user the belief that they have been

chosen or are doing something that is greater than themselves. The goal is to make the user feel valued and wanted by the product or service.

Development and Accomplishment

The focus here is on the user's development and progress. By mastering challenges, the user can collect trophies or badges and thus knows that he is making progress. This method only works if challenges can be mastered and provides positive reinforcement and an encouraging feeling after passing a hurdle.

Empowerment of Creativity and Feedback

Here, users are involved in a creative process, can discover new things themselves and try them out. By being involved, users can live out their creativity and also receive positive feedback. This keeps the activity exciting.

Ownership and Possession

If the user owns something, he wants to improve it, protect it or have more of it.

Social Influence and Relatedness

Social influence means acceptance, camaraderie, competition, envy or even mentorship. Social elements within an app drive the user to reach the same level, for example.

Scarcity and Impatience

This is where the human impulse to want something that cannot be had comes into play. For this reason, many products use a deadline dynamic to give rewards and thus encourage the user to think about it on a daily basis.

Unpredictability and Curiosity

Since people want to find out what happens next, this method also works well to keep users engaged.

Loss and Avoidance

Here, the user's motivation is the fear of losing something or experiencing undesirable experiences.

Gamification player types

Professor Richard Bartle defined four different player types: the Achiever, the Explorer, the Socializer and the Killer. (Kumar, Herger and Friis Dam n.d.)

When deciding which methods to use, it is important to keep in mind that nobody is the same, but rather has individual reasons, motivations, or motives in life as well as in using the platform. Bartle's player types are often questioned and are a rather controversial topic among many. Nevertheless, the analysis of player types can be an assistance in deciding the right resources: Players are known to move between those player types over time. These player types are not strictly separated but can blend together, but one player type is usually dominant. The following four player types are:

The Achievers

The Achievers care about their status and the number of points they have. They like to collect objects and show them off. This is where leaderboards work (Kumar, Herger and Friis Dam n.d.).

The Socializers

The Killers are similar with Achievers and want to earn points or increase their status. The difference is the urge to see other teammates lose and to have clearly won. This type of player does not have to have evil intentions, but can also be a friendly competitive spirit (Kumar, Herger and Friis Dam n.d.) •

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The Explorers

The Explorers like to explore within the platform. As long as they see new areas or uncover secrets, tasks can be repetitive (Kumar, Herger and Friis Dam n.d.).

Socializers are represented the most and are motivated by interacting and connecting with other players (Kumar, Herger and Friis Dam n.d.).

The Killers

Author

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Gamification within the LETHE App

During the design phase of the LETHE app, a health report was included. This report is composed of rings that change weekly depending on the user's performance. The gamification aspect has already been used to some extent here. Here the curiosity of the user plays a role, and also the desire to improve in order to reach the next point to fill up the ring.

Through several meetings with the target group it became clear that lack of motivation is also an important factor in using or not using the app daily. The goal and benefit for the study participants is to develop a healthier lifestyle through the app to work preventively against dementia. If the motivation to follow the personalized suggestions provided by the app is lacking, a positive outcome is less visible and the app will not be used daily. This could be counteracted by including several gamification elements within the app. However, there was no time during the project to incorporate more aspects of gamification.

This chapter will present suggestions on how the current LETHE app could be improved to make it more motivating and attractive for users to use the app on a daily basis.

Framework

It is necessary to be clear about who the target group is, what types of players there are and what makes sense to include:

It should be remembered that each person goes through different player types over time. For this reason, there is usually a need to cover all player types so as not to lose any users. In the LETHE project, however, it must be kept in mind that there are two specific goals: To change lifestyle positively and to collect data. And the target group is between the ages of 60 and 77. Gamification elements should neither reduce the goal of the app, nor be overwhelming to the target audience.

The player type ,The Achievers' is highly implementable here. The aspect of collecting points or unlocking achievements can contribute to the motivation of the user and lead to more activity, at least for a certain number of participants.

,The Explorers' is rather not usable in the LETHE project, because all areas have to be unlocked from the beginning. Discovering new areas within the app is more of a hindrance to the goal of the app here.

,The Socializers' could be an idea for further steps. At this stage of the work, it is under discussion whether a chat function would be useful. However, only to support each other or to ask for help.

,The Killers' is also a hindrance, as this type of player is based on social contact within the app and aims to defeat other participants or users. In addition, the participants in the study do not know each other but are selected by the technical staff.

Certain gamification elements, such as achievements, streaks or motivating and reminding notifications, could be incorporated into the app at this point in time to have a motivating effect.

Proposals

To develop a healthier lifestyle, consistency is crucial. A streak could help build new habits and achieve all goals and tasks on a daily basis **1**. Here the user can clearly see how well he or she is doing. So if the user has a seven-day lucky streak, then he or she has completed all tasks for seven days in a row. If a single day is missed, the streak is reset to zero.

The second gamification method is achievements or badges 2 + 4 . They are a form of reward that symbolize the user's achievement and show that their success is appreciated and noticed. This can often encourage them to do even more to earn more badges. These achievements are awarded when a user has done a certain number of, for example, workouts or meditations.

If a certain action has been completed and finished, the user gets a golden badge 5.

The health report is already included and a fixed component of the app. Motivational messages are displayed under the rings. The dots distributed on four axes within the rings are also meant to be motivating, which symbolize how much still needs to be done to reach the point and thus fill the ring more 3.

The last suggestion is to integrate fitbit to motivate users more 6 or remind them of their personal tasks and goals 7 . The fitbit is also already an integral part of the project and tracks the steps of the users, for example •

Do Brain training

Fill out 5 questionnair

Reach a 3 day strea

Visit every category

5

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(101) Day Streak (l) and Achievement (r) Own picture 2022

(102) Health Report Gamification (l) Own picture 2022

(103) Health Report Achievements (r) Own picture 2022

(104) Smartwatch Motivation Own picture 2022

8 Conclusion and References

The last chapter gives, among other things, an overview of the app development and provides a summary, conclusion and outlook about the project and the work of the designers.

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App Development

The project started for the designers from July 2021. The development of the wireframes began in September 2021. At the beginning of the project, some sub-areas within the app were not yet known or clearly defined. In addition, both the screen size and the target group of future study participants changed during the course of the project, which resulted in many additional changes.

Several screens are shown on the following pages. The left side shows screens after about 2 months of progress on the development of the app. The right side shows the current state (May 2022) of the app, that is how it has changed and what additional content was added ullet

Notification

O Weekly meeting with Dr Maus

Medical

 \sim

 \sim

 \sim

 \sim

Categories

Personal

Tasks and m

O Take a walk

O Phone call with sister

O Practice Daily Medit

Sunch with Lilly

8

>

Dashboard

Good morning, Anna

Latest To Do / Mes

Calenda

Lunch with Lill

Author

Dashboard

- Notifications
- Calendar
- Daily Score
- Activities & Lifestyle

Dashboard

- Popups to query specific topics
- Settings and Impressum
- Extra Icon for Questionnaires

Notification • Tasks are categorized Content not defined

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(106) Dashboard: Wireframe (l) and final screen (r) Own picture 2021 / 2022

(107) Tasks: Wireframe (l) and final screen (r) Own picture 2021 / 2022

1 2 3 4 5 6 7 8.1

Author

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< Activities & Lifestyle Physical Activity External Cognitive training

(109) Activities & Lifestyle: Wireframe (l) and final screen (r) Own picture 2021 / 2022

Physical Activity

(110) Fitness: Wireframe (l) and final screen(r) Own picture 2021 / 2022

Calendar • Personal calendar should be

- linked No own entries
- Schedule Tiny Habits in calendar

Calendar

- Personal calendar should be linked
- Display monthly or daily

- Tiles for external and internal content
- Own blood pressure entry option
- Other input fields not defined

Activities & Lifestyle

- Own blood pressure, cigarette
- consumption entry option

Activities & Lifestyle

< 05 Monday April

Month

Day

09 AM

10 AN

12 AM

01 PM 02 PM

07 PM

08 PM

- Activities & Lifestyle Internal Phsyical Activity
- Nutrition Log

Activities & Lifestyle Internal

- New wording for Phsyical

Tap here to leave app		

Score

• Weekly

< Cognitive Training

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(111) Meditation: Wireframe (l) and final screen (r) Own picture 2021 / 2022

(112) Questinnaire: Wireframe (l) and final screen (r) Own picture 2021 / 2022

(113) Health Report: Wireframe (l) and final screen (r) Own picture 2021 / 2022

Conclusion

Summary

The goal of this thesis is to present the conceptualization and design process of a user interface for a smartphone app. This app is to be used daily by 160 participants in a study on reducing the risk of dementia through lifestyle change. The LETHE project is ongoing until 2024. The app will be launched at the end of 2022.

This thesis tries to answer one main research questions and one sub-research question:

- How should a smartphone application be designed to help study participants develop a healthier lifestyle?
- How can the conceptual work of a designer contribute to making a medical app a reality?

This master thesis documents the development process of the app. It covers the process starting with the research and ending with the final high fidelity clickdummy of the app. The main body covers all points of operation and development. A brief summary of the thesis as follows:

Before starting the idea development, it was necessary to get more information about the medical topic and understand what will be the main components of the app.

With the help of the definition phase, it was clearly defined who the target group is and also what the general constraints are.

The subsequent ideate phase included several creativity methods that laid the foundation for the app. Above all. many ideas were generated and helped to clarify the concept. This not only laid the groundwork for the user interface, but also cleared up content misunderstandings within the team and defined initial visualizations, which were also presented to the entire international project team. With each scribble and wireframe, the future structure and function became clearer and the concept more concrete. These wireframes were transformed into a high fidelity click dummy that the programming team could use as a basis for their development.

A large part of the work is taken up by the practical part of the master's thesis - the prototype phase. The conclusion of the work piece is a high fidelity prototype as visualization of a concept for a digital data input system. It helps the participant to have a simple and easy possibility

to be part of the study. At the same time it saves time for the Medical and the data scientists to evaluate the data as this can be partly done with help of an artificial intelligence using the digital input from the users. Additionally they can focus on their main tasks and do not need to spend time on evaluating paper questionnaires or supporting the participants.

By designing and incorporating certain features, all the needs of the study participant as well as the medical professionals are met. By using the app, data can be collected and shared with physicians and researchers. The goals defined together with the physician can be organized and adapted to the user's personal requirements at any time. The calendar helps to display appointments and social activities associated with the study.

With the help of the activity and lifestyle area, the user receives information about the activities to be performed as well as a knowledge base for important areas of their lifestyle. This area also includes manual data entry, which is presented as cards with input fields. As desired in the user tests, the input adds value for the user, as a history of the inputs can be displayed, for example to see older blood pressure values.

Those smaller additional benefits can be the starting of an application which will be kept used after the completion of the study or even of people who did not participate in the study.

Team cooperation

The cooperation in the team worked very well. Weekly meetings were held since the beginning of the project to define goals, tasks and new findings or requirements and to stay on a common level. Participants in these meetings were programmers, designers, the project manager as well as a researcher.

The designers and authors of this master thesis were in daily exchange about the design and conceptualization of the app to minimize all use-errors and to generate ideas that puts the user in the center.

One area for improvement was the very late involvement of the medical professionals. Through the user testing, the designers came into contact with the study's medical professionals for the first time. Closer contact would have led to more efficient meetings and insights, but was owed to the tight schedule.

Mode of operation

The frequently changing requirements for the app posed a challenge. A structured way of work during the project was therefore only possible to a limited extent. Here, a high degree of flexibility and good communication among each other were very important. In the course of their participation in the project, the designers repeatedly brought suggestions to address topics and areas within the app in order to be able to define a direction. Here there was often jumping back and forth between rough conception, fine conception and implementation. The app was both designed and programmed at the same time due to the tightly calculated time. This led to more optimized screens to value the work of the programmers. The programmers were therefore typically included in the designers' design process as well, in order to work more efficiently.

On the whole, however, the good cooperation between the programmers and designers has led to a good result.

Outlook

The goal of the master thesis was therefore achieved by designing an interface design of a smartphone application for early detection and reduction of risk factors for dementia in the context of an EU study, which will be launched at the end of the year.

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With help of the clear and intuitive user interface, the familiarization and learning time will be minimized. Furthermore, it motivates to use the app more frequently and simplify the participation of the study.

The positive feedback suggests that this work is a successful part of a project which builds on this application.

At this point in time, the designers' work is complete with the finalization of this master's thesis and all screens have a final state. The app will be further developed during the project period and adapted to specific needs of medical professionals. The design of the app favors this enhancement through the design of the tiles. The app is expected to be used for two years, but it is already being discussed that certain parts of the app will also be used afterwards.

This thesis demonstrates that the goal was achieved and thus both research questions could be answered •

Author

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Lisa Fresser and Tina Schart

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40	Own Illustration. User Flow Persona 1	65	Own
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75	Own picture. Questions.	96	Own picture. Health Report after Testing.
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95 Own picture. Tasks after Testing.

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Appendices

User Experience Usabilty Test – Guide

User Experience Questionnaire

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