UNIVERSITY OF BERGEN

Department of Information Science and Media Studies

MASTER THESIS

Mobile Application Design to Engage Blood Donors in Norway

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Sometimes I get emotional over fonts.

Kanye West

Abstract

This master thesis presents a study of mobile application design created to support and engage current- and new blood donors. The application has been designed to help motivate existing blood donors to keep donating blood, but also to support new donors in the process.

A User-Centered design method was utilized to ensure close collaboration between users during the development; this laid the foundation for the requirement specification and design choices. The goal of the thesis has been to see how different methods and disciplines can provide an opportunity to engage blood donors as the most valuable user group.

A high-fidelity prototype has been implemented with five main modules: *Digital donor card*, *Appointments*, *Your blood*, *Impact*, *Blood journey*. The development process consisted of four design iterations, where usability goals, design principles, usability testing, system usability scale, and Nielsen's Heuristics were applied to ensure a user-friendly solution that covers the needs of young blood donors in Norway.

The Design Science framework allowed several prototypes from low- to high fidelity to take form. Users evaluated and gave feedback during the different iterations. The result of the research indicates that the application has appeal and the potential to engage donors by relying on minimalist design, gamified content, good user experience, and usability. The final System Usability Score (SUS) of 86 and evaluators' feedback suggest there is a potential to develop a product that could be valuable to donors and society at large.

Acknowledgment

I would like to thank my dear supervisor, Ankica Babic, for your endless amount of support, kind words, motivation, wisdom and expertise.

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S.S.

Contents

List of Figures

List of Tables

List of abbreviations

HCI Human-Computer Interaction

IxD Interaction Design

SUS System Usability Scale

NSD Norwegian Centre for Research Data

RQ Research Question

UCD User-Centered Design

UI User Interface

POC Proof of concept

Chapter 1

Introduction

Blood donation is a crucial part of the healthcare system today and is not unlikely to think that at some point in life, people will need to get a blood transfusion. In Norway, it is estimated that we lack about 30,000 blood donors at all times[25]. In rough terms, this means that if Norway were to be affected by significant health or natural disaster, there would not be enough blood to those in need. Work is continuously being done to recruit more donors, although it is an expensive and time-consuming process. The process today is heavily based on manual labor and traditional media outlets for both the recruitment and the registration of a donor who will carry out their first transfusion [25].

In addition, there are challenges such as attitudes, benefits, and risks impacting blood donating. Ferguson et al. posited attitudes towards blood donation by blood donors can be derived from either benevolence or altruistic standpoint[12]. From the benevolent standpoint, blood donation is viewed to benefit both the donors and recipients [12]. In this case, donors report to having a “feel good” attitude about themselves, upon donating blood [12]. From the altruistic standpoint, blood donation is viewed as an unselfish act with the goal of voluntarily and intentionally helping others without expecting a reward, whilst carrying a cost to the donor such as time, pain, blood. The study conducted by Ferguson et al. support that future blood donations are associated with attitudes from the benevolent standpoint, which carry an emotional reward [12].

Nonetheless, other studies report altruism as a motivation for blood donation [29]. Blood donors have reported both positive and negative health benefits associated with donation [13]. Some of the reported health benefits include; better mental health among young donors and physical health in older donors [37], reduced mortality [45], reduced risk of myocardial infarction. However, this is prone to selection bias as donors are from a healthier popu-

lation. Reported negative effects include evidence of donation resulting to long-term iron deficiency. Blood donations have also been associated with emotions of fear and anxiety, which increase the chances of donor fainting, and decrease willingness to donate [48]. Other issues that may determine the donor willingness to return include vasovagal reactions [20], negative experience such as long waiting times [11] and satisfaction with quality of the service [6]. A study by Newman et al. reported adverse effects such as fatigue (7.8%), vasovagal symptoms (5.3%), and nausea and vomiting (1.1%), arm bruise (22.7%), arm soreness (10.0%), and hematoma (1.7%) [34] In addition, a study conducted by Sojka and Sojka on effects of blood donation reported some donors to have exhibited negative effects that occur outside the donation setting such as fatigue (10% of the donors), and diminished physical working capacity (7% of the donors) [42]. This study also reported of positive effects such as a feeling of satisfaction, and more alertness.

The aim of this research is to investigate whether the blood donation situation can be improved by utilizing IT technology. Specifically if a mobile application has the potential of providing engaging and supportive design and functionality for new- and current blood donors in Norway.

1.1 Research Question

RQ1: How can a mobile application be designed to engage and support young blood donors in Norway?

1.2 Motivation

Mobile applications have great potential to improve services in countless areas, so it can be expected that blood donation could benefit significantly from mobile technology. A mobile application has the potential to help lessen today's process and can serve useful for the motivation of novice blood donors. This tool should be able to minimize the registration process, motivate the donor by visualization of content, information, and include aspects from gamification. The functionality should prove helpful and engaging for both donors and new donors, and help Norway to secure a better donor per habitant.

1.3 Project outline

The thesis will have the following outline:

Chapter 2: Literature Review & Related Work presents relevant literature and related work for the research.

Chapter 3: Artifact explains what the artifact will be.

Chapter 4: Methodology & Methods explains the different methodologies and methods applied to the research.

Chapter 5: Establishing Requirements presents the ethical considerations, target group, participants and explains the different requirements established for the application.

Chapter 6: Prototype Development information about tools that has been used and a overview of the four iterations.

Chapter 7: Features an overview of the final functions for the high-fidelity prototype.

Chapter 8: Evaluation an overview of the evaluation results.

Chapter 9: Discussion systematically goes through the methodologies, methods, development process and answers the research question for the research.

Chapter 10: Conclusion & Future work summarize the main findings and provides a proposition for future work.

Chapter 2

Literature Review

This chapter presents the an overview of relevant literature and research for this project. An introduction to the process of blood donation, a behavioural model, human-computer interaction and gamification. The background for this literature review is to see what types of applications that exist and what research has been done in order to get a better understanding of blood donors and their internal motivation.

2.1 Relevant Literature

Blood Donation Situation in Norway

Transfusion statistics for Europe shows that Norway has fewer donors compared to other countries in the same "category". Norway has about 20 donors per 1000 inhabitants, which is the second lowest in Europe. Countries which are natural to compare Norway to, as Finland and Sweden have respectively 25-30 donors per 1000 inhabitants. Denmark has 48 per 1000, and the average for Europe is 25[25].

Half of all blood donors are at all time relatively newly “drawn” of blood, meaning they have donated within the last three months. And are therefore not suitable to donate should a crisis occur. It is estimated that just below 40% are ready to donate each month. Blood is fresh and perishable and during an epidemic, there could be a shortage of blood supplies of any sort. If Norway is going to be self-sufficient, it is estimated that we need about 30.000 new donors[25].

2.1.1 The blood donation process

The blood donation process today consists of many manual steps that both the donor and the transfusion department must go though in order to achieve a successful donation. The process is different for new vs existing donors, an example for how the process works for new donors will be elaborated upon below:

1. **Sign up:** You have reported interest in becoming a blood donor and filled out your information on an online form.

2. **Registration:** After you have signed up you will be assigned a date to start the registration. When you enter the desired blood donation location you will be signed in, and health personnel will go over your overall eligibility. Then you will have to read some information about blood donation. Later you will be asked for your ID and other personal information.

3. **Health history:** The last step before your donation will be to answers queestions about you and your familis health history, medicine use etc - this is done through a private interviewe. Lastly, blood pressure and hemoglobin(blood percentage) levels will be tested[41]. For existing donors most of this step is skipped, when you arrive you will fill out a form and take a test to check hemoglobin or ferretin levels(ironstock)[41].

4. **The donation:** Most people will donate whole blood the first time. If you have donated before you might be asked to donate other types of blood products eg. pateletes The health personnel will sterilise the area and insert a needle for the blood to be drawn. A whole blood donation takes about 10 minutes[26][41], approcimately 450 ml will be collected.

5. **Recovery:** After the donation, you have given 10-12% of the blood in your body. The volume will quickly build it self up within a few hours[26]. You are then instructed to rest. eat and drink a lot for the next hour in order to cope with the fluid loss. The donation site usually provides you with drinks and snacks throughout the whole process in order to help you recover quickly.

6. **After the donation:** If you are new you will be assigned with a blood donation card, this is where they register each donation and you have to keep it until the next appointment. This card is made of paper in Norway. If your body did not have a bad reaction to the donation you will usually be assigned to a new appointment within three months time.

2.1.2 Motivational factors in a blood donation situation

Research has been done to investigate the motivations underlying blood donations. A study done on Italian donors talks about six types of "motivations" that can be applied to the blood donation situation [23]:

1. The social sphere - the opportunity to meet and familiarise with new people.
2. Values - finding a context in which one can express personal values.
3. Self-enhancement - growth, and development of oneself.
4. Ego-protection - a reduction of guilty feelings due to one's sense of being more fortunate than others
5. Knowledge - to learn new things or to experiment
6. Career

These particular factors assume that people are moved by a complex set of combinations, which then leads to their personal motivation. Volunteers and activists do not carry out these deeds based on one single motivational factor, but a combination of them. Recent studies reveal that this model, when applied to the blood donation situation, shows that the motivations are not consistent - they change over time. The most common change is from an egotistical motivation to motivational factors that are more altruistic. In short, this means that blood donation can be understood as a process; it is the different motivational aspects that sustain the change during a blood donor "career". In addition to these six motivational factors, it has been found that gender plays an important role. Findings suggest that women have a more altruistic motivation set when donating, while men tend to have a more individualistic motivation. [23].

Blood donation can be social and engaging. Donating blood regularly also means that donors interact with other donors, and they are able to share their experience.[23]

Prosocial behavior in blood donors

Steele et al. conducted a research to understand the blood donors motivation in context of prosocial characteristics like: altruistic behavior, empathic concern, and social responsibility. The background of this study was the big demand for blood supplies in the United States and how eligible donors lapsed and rarely returned to donate.

12,064 current and lapsed donors were interviewed an asked about different aspects, the answers were given on questions concerning altruistic behavior, empathic concern, and social responsibility and they were given a score. The data was analyzed to compare the different participants by their demographics and donor status. The results from the research showed that the majority of the participants appeared to have high prosocial characteristics. Moreover higher scores on altruistic behavior and responsibility showed a clear connection to the donation frequency. Initially, the results also showed that there was no association between empathic concern prior to donation. The biggest difference could be seen in the participant's age and donor status, donors who were older donated more frequently.[43]. Steele et al. propose that reqcruiting efforts should adress convience of blood donations, safety and personal benefits.

The importance of loyal blood donors

The national shortage of blood will likely heighten in the future, and keeping a loyal donor base is becoming very important[38]. Studies have shown that donor lapse and reduce their donation frequency[8], and that eligible donors rarely return to donate a second time[18][8][31]. Research has been done to try and understand the blood donors motivation, and how they can be committed to keep contributing to this "social responsibility". Ringwald et al. did a research looking at published literature of the last decade(2010) and made a suggestion of some key recommendations to help blood donation retention strategies:

10 keys to open the door for blood donors to come back to donate regularly[38]:

1. Communicate with the blood donors right from the beginning
2. Support the role of the blood donor's identity
3. Make blood donation convenient
4. Motivate and educate blood donor service staff
5. Reduce/prevent adverse events and the blood donor's anxiety
6. Increase the satisfaction of the blood donation process
7. Use appropriate incentives
8. Ask temporarily deferred blood donors to return
9. Use personal aspects to motivate blood donors
10. Some things remain difficult to influence, but work on enhancing the reputation of your blood donation service

2.1.3 Social and Mobile Interaction Design to Increase the Loyalty Rates of Young Blood Donors

This paper investigates how a social and mobile interaction can help the blood donation situation in Australia. 1 in 30 Australians donates blood, and 1 in 3 will at some point in their life require a blood product whether it is whole blood, blood components or plasma. In the period between 2010 and 2011 over 194,000 blood were administered in Australian hospitals. Young adults make up 29% of first-time donors but they tend to be the least loyal group. There is a growing demand for plasma which has a "short shelf life" of 5 days. People have to have made at least one successful whole blood(blood transfused in its original form) donation before they can convert to donating plasma. On the other hand, young people use the internet, smartphones and social media on a regular basis. And these types of technologies are constantly changing how young people interact with each other. "Social and mobile interaction design to increase the loyalty rates of young blood donor" is a collaborative research project between the Australian Blood Service and the Queensland University of Technology aims to look at how they can combine these social practices with interactive design to engage young donors. The project resulted in different design implications, a selection of these is listed below. [18]:

Service-oriented features:

- Reminders when a user can give blood
- General public announcements(urgent need for specific blood groups)
- Tracking of the individual blood donation process
- Information about blood and the blood donation process

Social media features:

- Posting experiences on social media, typically Twitter, Facebook, and Instagram.
- Status tires, badges or titles for public recognition, can be shared on different social platforms.
- Receive anonymous messages for blood recipients thanking for your donation

Visualization features:

- Displaying the local blood stock levels for the user's area.

- Visualized donations on a map
- Prevalence of different blood groups

2.2 Human Behaviour

2.2.1 Behavioural theory, a model

A model for understanding human behaviour has been presented by behavioural psychologist Fogg. According to Fogg for any behaviour to take place it is dependent on three factors. *Motivation*, the person must be sufficiently motivated. *Ability*, the person must have the ability to perform the behaviour. *Triggers* the person have to be triggered to perform the behaviour. Lastly, the three factors must happen at the same moment for the behaviour to occur. According to Fogg: *To increase the motivation is not always the solution. Often increasing the ability (making the behavior simpler) is the path for increasing behavior performance.* Fogg's Behavioural Model implies that people with low motivation may perform a behaviour if it is high on ability, meaning if the behavior is simple enough. In general, people are equipped with a modest set of both motivation and ability which can be manipulated[15]. Persuasive technologies have the means to manipulate motivation and ability and potentially giving them both a boost. However, the behaviour needs to be triggered and will not occur without. A trigger comes in different forms for example an alarm or a notification. A good trigger has three characteristics; we notice the trigger, we associate the trigger with the target behaviour and the trigger happens when we are able and motivated to perform the behaviour[15][40]. Constant triggers such as spam, ads, alerts can be irritating and are rarely a source of the wanted behaviour because of low motivation[15].

Three core motivators

According to Fogg; motivation has three core motivators with two sides:

1. pleasure/pain
2. hope/fear
3. social acceptance/rejection

In the first core motivation factor is related to seeking *pleasure* and avoiding *pain*. While pleasure can give a sense of achievement, the fear of pain can have the opposite effect. The

second core is characterized as the motivation by anticipating some sort of result or outcome of the behaviour. Seeking *hope* usually comes from the anticipation that something good will come of it. The anticipation for something bad to happening can cause *fear*. Fogg has recommended to use the motivational core of hope, he argues that hope is the most ethical and empowering motivator, and that it aligns with the basis of research and design. By designing for the anticipation for a reward one can have the ability to make an application desired and exciting to use. Introducing rewards as a variable in design has proven to bee a motivational factor[15][9][33]. The third motivator controls our social behaviour, it provides guidance on everything we do, from how we dress to the way we speak. People are generally motivated by some form of social acceptance, we want to be accepted and we want to avoid being rejected at all cost[15].

2.3 Human-Computer Interaction

Human-Computer Interaction (HCI) is a multidisciplinary field focusing on the design, evaluation and implementation of computer technology. The main focus is the interaction between humans (the users) and computers. HCI originated in the early 1980s and was seen as specialized field, drawing expertise from different disciplines such as computer science, cognitive science and design. HCI has emerged enormously over the last decades and is continuously developing[19]. The HCI discipline is applicable to this research project as it provide tools and insight that can be used to ensure a good result.

2.4 Gamification

Gamification is an "umbrella term" for the use of video game elements in non-gaming systems. By adding gamification to a system, one often has a goal of improving the products overall user experience as well as increasing the user engagement. Compared to serious games, gamification will be used for purposes other than just entertaining. It is important that you do not mix the concept of gamification with concepts such as playful interaction, playful design or designing for playfulness. Furthermore, research has shown that applications that utilize gamification could potentially bring playful behavior and/or a playful set of mind[9].

According to [9] gamification can help reward users who complete certain tasks. For example, a type of reward can come in the form of marks or a score. With a score, you can

also add features such as "leader-boards" where you rank the users with the highest score to those with the lowest. It is not uncommon for one to divide tasks into different levels, in this way the user completes a given number of tasks before they can be rewarded in the form of "moving up" a level. Adding gamification to a system wants this to result in motivation for problem solving, increased commitment, mastery and in cases where it can contribute to increased learning [39].

Gamification is thus a function that should encourage users to perform tasks that they might otherwise find boring and un-motivating. This can be anything from completing a survey, reading text, reading instructions, etc. The value of creating a system of gamification is that it could build personal incentive for the user to continue with the wanted behaviour[9].

Badges

One of the earlier adopters of badges were scouts, they use badges in order to signify the membership to their organization and to show different achievements[49]. In modern time badges are used to represent some form of achievement or progress. A lot of different platforms makes use of badges to engage their audience in different settings. A platform that has integrated badges in their solution is Audible. Audible is the world's largest producer and provider of audiobooks[3] and has implemented badges to provide their users with *"a fun way of tracking your audiobook listening information, including your listening time, listening level, and total number of audio books in your library."*[4] Another platform using badges are is the digital game distribution, Steam[50]. On Steam you get badges through achievements in different games and each profile has the possibility to showcase badges. The use of badges for motivational purpose has been researched in different areas[9], and results from a research done by Hamari shows that users exposed to badges and other gamified conditions were more likely to use the service provided more actively.

2.5 Related work

2.5.1 Available applications

In Google Play store there are a lot of different applications regarding blood donation. The content varies from application to application, some have very limited functionality and are only concerned to function such a personal health card. Others seems to be for healthcare personnel to find emergency blood donors. There are just a handful of applications espe-

cially intended for blood donors. Some of the applications available for blood donors are: *Blood Donor*, *Blood Donors MT*, *Blodbank* and *Blodgiver*. A pervasive factor is that most of the apps intended for blood donors serve as a mobile encyclopedia with information surrounding the process. The app that stands out is the American Red Cross app *Blood Donor*, it has implemented a couple of functions such as *your blood journey*, *capture the moment* and a award system with badges. The two applications available on the Norwegian marked is mainly a source of information, with the exception of their "self test". A summary of the different functions found can be seen in table 2.1

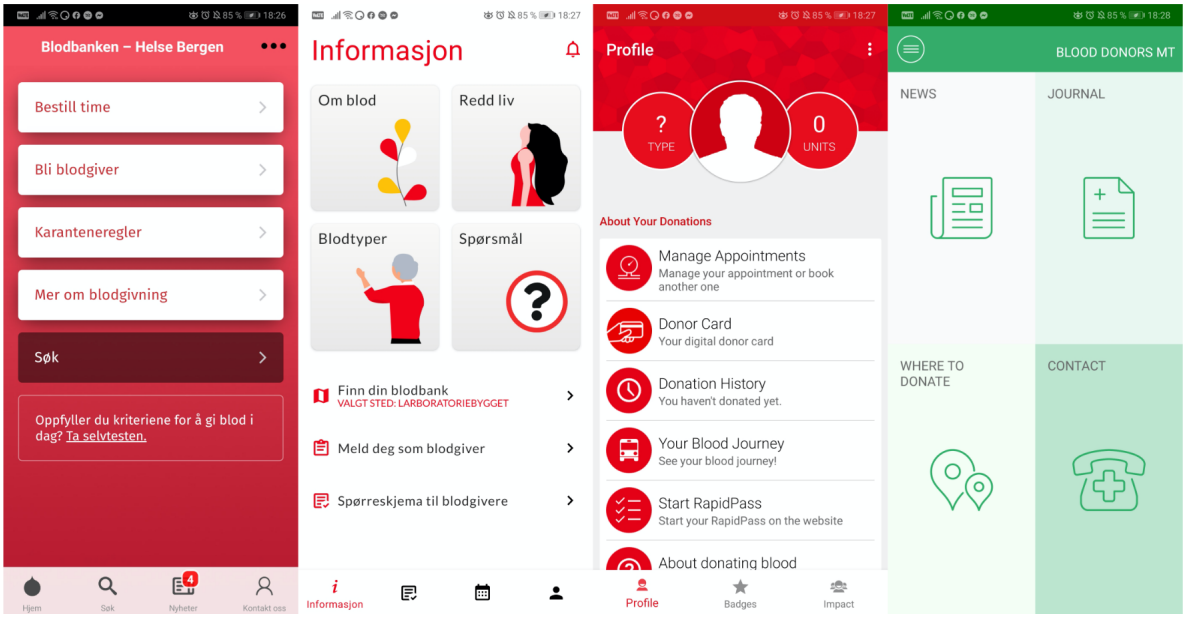


Figure 2.1: Applications found on google play store: Blodbanken, blodgiver, blood donor and blood donors MT

Table 2.1: A summary of functionality found in the different apps

Functionality	Blood Donor	Blood Donors MT	Blodbank	Blodgiver
Manage appointment	Yes	No	No	No
Digital donor card	Yes	No	No	No
Donation history	Yes	No	No	No
Blood journey	Yes	No	No	No
Share on social media	Yes	No	No	No
Reward system	Yes	No	No	No
Self test	No	No	Yes	Yes
General information	Yes	Yes	Yes	Yes

Chapter 3

Artifact

In this research project, the artifact is going to result in an interactive mobile application to help donors in Norway manage their own blood donation journey and to motivate already existing donors and new donors. The artifact is not going to be a finished and applied product meaning it will not be fully developed by the end of this research project. The result is, therefore, going to be an interactive prototype to illustrate the proof of concept. There exists two applications for blood donors in Norway, they work more as a mobile information platform or encyclopedia. There is no published evaluation using these existing apps.

Chapter 4

Methods

4.1 Design Science Research

Design science research is a research method were the goal is to come up with an artifact which serves a human purpose[10], and the artifact can be represented in different forms ranging from software to formal logic[27]. Specifically the Design Science Research aims to solve specific problems to gain an adequate solution to given situations. This applies even though the solution is proven to be inadequate[10]. The artifact intended for this research is not going to be a finished solution, but it will result in an interactive high-fidelity prototype which will clearly state the proof of concept. The goals of this research is to hopefully contribute to the field of science and the people in which the product is intended.

Figure 4.1 shows the link between two of the main factors in Design Science Research: rigor and relevance. Relevance should offer relevant research to organizations, the professionals may then use the the generated knowledge to solve practical problems. Rigor should determine if research is valid and reliable and can contribute to knowledge in the given areas[10].

Hevner et al. applies seven criterias or guidelines as seen in table 4.1, these were constructed to help and assist researcher understand the requirements for effective and proper Design Science Research. To be able to succeed with the creation and evaluation of an artifact it is important to complete each guideline, there is however no particular order in which they should be applied. By this Hevner et al. mean that anyone who wants to use these guidelines should use their creative skills and judgement to decide how, when and where.

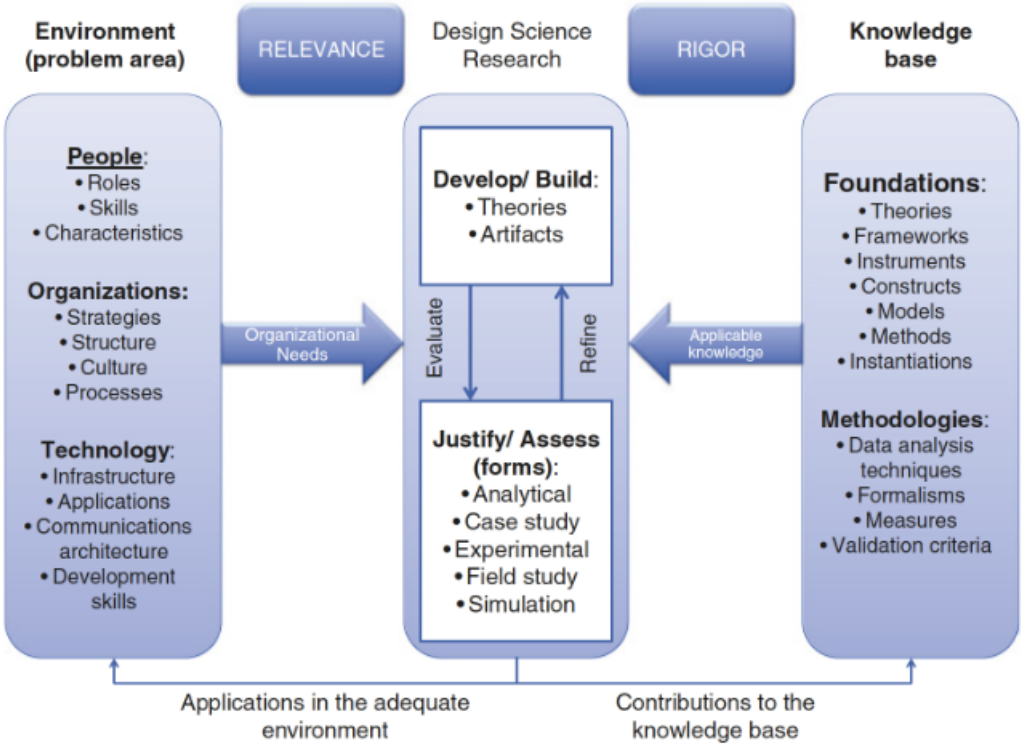


Figure 4.1: The Design Science Research model[10]

4.1.1 Design as an artifact

"Guideline 1: Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.[27]"

The first guideline in design-science says that one has to create an artifact as an instantiation, construct, model or method[27]. An artifact is defined as a product of human craftsmanship, or an object that is man-made[10]. Artifacts that are constructed in design-science research are seldom finalized information systems, which means that they can not be used in practice. Instead, artifacts constructed in design-science research should be viewed as innovations that can define different practices, ideas, technical capabilities and products [27].

4.1.2 Problem relevance

"Guideline 2: The objective of design-science research is to develop technology-based solutions to important and relevant business problems."[27]

There are several mobile applications that provide users with information about the blood donation process. However, there are no platform in Norway providing a combination of both informal and engaging content and functionalities.

4.1.3 Design evaluation

"The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.[27]"

Evaluating is a fundamental part of the research process, and in order to do so it requires definition of appropriate metrics and the gathering and analysis of relevant data[27]. According to [27] IT artifacts can be evaluated in different terms such as: functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality attributes.

The different methods considered to evaluate this project will be explained in later in the methods chapter. It is desirable to recruit participants with relevant background and/or education meaning people who donate blood on a regular basis, one time donors, people who consider becoming a donor, people who recruit new donors and healthcare professionals that work with blood transfusion. In addition to HCI/UX experts who can evaluate more in depth of the system.

4.1.4 Research contributions

"Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.[27]"

In order to maintain a effective and proper Design Science Research the project must provide clear contributions in regard to the design artifact. The possible outcome from Design Science Research is three types of research contributions and one or more is required in a given project: the design artifact, foundation and methodologies[27]. This project will result in at least one of these contributions with the main one being the artifact, an interactive and high-fidelity prototype.

4.1.5 Research rigor

"Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact[27]]"

The process of the project is going to be heavily based on several iterations, were each iteration is supposed to result in a prototype(ranging from low-fi to high-fi) that is going to be evaluated according to the methods chosen.

4.1.6 Design as a search process

"The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment[27]"

The design is essentially a result of a search process which should end in a effective solution to the stated problem. In order for the project to achieve an effective solution one must collect the appropriate knowledge from the application domain and the solution domain[27].

The design of the artifact will follow a user-centered design process and as a result it should acquire enough knowledge about the application- and solution domain resulting in a successful development and and a finished artifact.

4.1.7 Communication as research

"Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences[27]."

The research needs to provide sufficient information in order for the artifact to be implemented and used within a given context. Furthermore is should enable researchers to take advantage of the artifact, and to build on a growing knowledge base to further develop and evaluate. And it is therefore important to explain the process to be able to establish a repeatable process of the research project, this lays the foundation for further research by design-science researchers[27]].

4.1.8 A checklist for design science research

Design science research is a powerful method, and depends highly on the inclusion of users, experts and developers from different practices. To be able to secure a intact development with relevant result it is important to document each step in the process[27]. A more specific checklist of questions have been suggested by [27], this list contains eight questions that helps the researchers address the key aspects of the design science research[27].

Table 4.1: Checklist for design science research

	Questions
1	What is the research question (design requirements)?
2	What is the artifact? How is the artifact represented?
3	What design processes (search heuristics) will be used to build the artifact?
4	How are the artifact and the design processes grounded by the knowledge base? What, if any, theories support the artifact design and the design process?
5	What evaluations are performed during the internal design cycles? What design improvements are identified during each design cycle?
6	How is the artifact introduced into the application environment and how is it field tested? What metrics are used to demonstrate artifact utility and improvement over previous artifacts?
7	What new knowledge is added to the knowledge base and in what form (e.g., peer-reviewed literature, meta-artifacts, new theory, new method)?
8	Has the research question been satisfactorily addressed?

4.2 Data Gathering

This section will describe which data gathering methods that will be used for this project. There are several different approaches to data gathering, it is therefore important to choose the most fitting techniques in order to acquire the best results.

4.2.1 Literature review

A literature review is an extensive analysis of existing literature such as published articles, papers, reports and books. The aim of a literature is to provide a summary of the relevant findings within a specific domain. In this project, the literature review will help form initial information, and contribute to the requirements set for the artifact.

4.2.2 Semi-structured interviews

Semi-structured interviews are a combination of structured and unstructured interviews, and uses both open and closed questions [36]. This technique is going to be used to get a better overall understanding of the topic at hand. The interview are going to consist of some predefined questions to cover the same topic with each participant. Follow-up questions will be asked to the participants to get new information and will to a greater extent vary from

participant to participant depending on the answers given. The participants for the semi-structured interviews will be people who have experience with blood donation, both new- and existing donors. To recruit these participants information will hopefully be distributed at different locations where blood transfusion takes place, as well as using the snowball method among acquaintances to recruit participants that has hands on experience with blood donation.

4.2.3 Case study

A case study is an in-depth study of individuals, groups and communities in real-life context [30]. A close observation of individual cases help build a broader understanding and thus enable the generation of theories and hypotheses. Case studies are also used to present evidence of certain behaviour and are a method used to gather insight and information that would be hard to obtain otherwise.[30]

In this research, four individuals participated in a case study. The aim was to obtain information about the blood donation situation and to see how they interacted with the application.

4.3 User-centered design

"The process that ensures that the designs match the needs and capabilities of the people for whom they are intended" - Donald Norman [35]

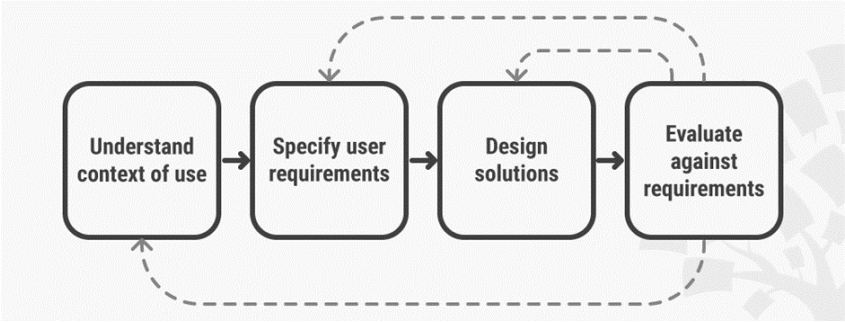


Figure 4.2: The user-centered design process[47]

User-centered design aims to keep to primary focus on the user and their goals, and not the technology. As a result of the user-centered approach you get a well-designed system which aims to make the most out of the humans expertise and that will embrace rather the restrict the user[36]. In 1985 Gould and Lewis designed three main principles: early focus on user and task, empirical measurements and iterative design. These principles form the basis of

the user-centered approach that we know today. By applying these Gould and Lewis believed that the designer would get better usability marks[22]:

1. **Early focus on user and tasks:** The designers must have a deep understanding of the user. This understanding will be required by studying how they think, behave and which attitude they have.

2. **Empirical measurements:** The designers must from an early stage simulate and prototype in order to simulate real work. And the users reaction and performance to scenarios, manuals, simulations, and prototypes are observed, recorded and analysed.

3. **Iterative design:** When the designer encounter problems during user testing they must be sorted out. The best way to achieve this is by a iterative design process: test and measure, (re)design and repeat this until you get the desired result.

In addition to these principles the user-centered design process has four main steps in order to ensure user needs, these can be seen in figure 4.3. The process resembles some of the cycles in Design Science research, but are more concerned with the overall design. The first step is *context of use*, the second is *specify user requirements*, third *design solutions* and lastly *evaluate*. These steps should be repeated until the product meets the user need[47].

4.4 Interaction design life-cycle

The interaction design life-cycle model has four basic activities, and these involve the following: identify needs/establish requirements, designing alternatives/re-design, build an interactive version/prototype, and evaluate. These activities are supposed to follow a iterative process, meaning they should be repeated until the cycle is "fulfilled"[36].

Establishing requirements we must know our target group to be able to provide a design which is supportive and useful. The identified needs are used to create a foundation for the products requirements, and later support the design and development process. Understanding these needs is obtained through a process of data gathering and analysis[36].

Designing Alternatives/(Re)Design is the key activity of the design process, and consists of proposing ideas that can meet the requirements. The design activity can be divided into two sub activities: conceptual design and concrete design. Conceptual design deals with how requirements can be transformed into a conceptual model[36]. In this research project the conceptual design will consist of a sketches to illustrate the idea and also low-fidelity prototype(s) to showcase the different functionalities of the design.

Prototyping/Build an interactive version building interactive products which a user can interact with, this is usually achieved by making a prototype. You do not need to have a piece of working software to prototype, there are many different ways to do this. One usually distinguish between to types of prototyping, low-fidelity and high-fidelity. Low-fidelity is usually a type of paper based prototyping and is characterized by the fact that it is a cheap way of building prototypes, as well as quick and easy. High-fidelity prototypes are usually more functional and looks more like the final version of the design, it is often made in prototyping softwares and are in some form clickable[36].

Evaluation is the process of evaluating the design. During this process we want to measure how good the design is by looking at user experience and the acceptability[36]. I will talk more about different evaluation methods and what I am going to use in the chapter "5.6 Evaluation".

4.5 Design principles

The design principles was created as a way to help aid designers achieve a good user experience. These principles are intended to help orient the designers on different aspect of the given design concerning the user, and not how to design an actual interface [10]. In the book Interaction Design: Beyond Human Computer [36]. describes the following to be the most common principles:

Visibility Visibility is concerned with how different functions are displayed on a product. By this it means that is should be very clear to the user what actions that are available to them, and how these actions can be carried out. If the functions are visible to the user, the easier it is for the user to know what options are going to be the natural step in the next direction.

Feedback Feedback is concerned with sending information about which action that has been done, and what the user has potentially accomplished by doing the action in question. In addition feedback wants to inform the user about what is going to be done next. There are several types of feedback, and it is distinguished between: audio, tactile, verbal and visual or a combination of these.

Constraints Constraints is concerned with making sure the user has some restrictions to possible actions. As a result of these restrictions it is supposed to help prevent the user from selecting incorrect options, and thereby reduce their chance of making mistakes. Constraints is usually obtained with the use of different techniques, it can either be graphical like graying out options, physical like the fact that cables can only be inserted in a specific way, or it can be a textual.

Consistency Consistency is concerned with the design of the interface, it should have similar operations and use similar elements to achieve similar tasks. It is usually distinguished between internally(within an application) or external(across applications. An example of a consistent element across applications is the play and pause button. These looks the same in every system, whether it is application for playing music on a mobile phone or it is a physical stereo system.

Affordance Affordance is the term used to refer to attributes or objects which allows a user to understand how to use it. When the affordance is present it provides strong clues as of how to operate the attribute or object correctly. If a designer takes advantage of the term the user will immediately know how to operate certain things just by looking, no pictures, labels or instructions needed. Knobs are for turning and slots are for insertion.

4.6 Usability goals

The usability of a products refers to how easily the user can learn a product, how effective it is to use and the overall feeling of satisfaction from the users point of view[36].The usability goals are concerned with helping people to better their everyday life, whether it is at school or work. [36] describes them as the following six goals:

1. Effectiveness says something about how effective the product is, how good the product is doing what it is supposed to.
2. Efficiency says something about how the product can help users to accomplish their goal/task.
3. Safety the product need to be safe for the user, meaning it should protect from undesirable situations and dangerous conditions.
4. Utility in order for the user to be able to do what they want and what they need the product needs to provide them with the right type of functionality.
5. Learnability it should be easy to learn how the product works. The user should not have to put much effort into learning a system.
6. Memorability once the user has learned how to operate the product it should be easy to remember how.

In order to maintain a user-centered approach the development will follow a set of established usability guidelines from usability.gov[46]:

- Learn if participants are able to complete specified tasks successfully
- Identify how long it takes to complete specified tasks
- Find out how satisfied participants are with your Web site or other product
- Identify changes required to improve user performance and satisfaction
- And analyze the performance to see if it meets your usability objectives

4.7 Evaluation

4.7.1 System Usability Scale

System usability scale or SUS is a scale that consists of a ten question questionnaire, and offers a quick and accurate way of measuring the usability if a system[7]. It is similar to likert-scale in the way that it is supposed to measure opinions, attitudes, and perceptions by providing the respondent with different answer options.

The scale is often used after participants has tried the system that is being evaluated. Participants should give their immediate response to the scale. All the boxes must be checked, and if a respondent is unsure they should check of the middle box.[7]

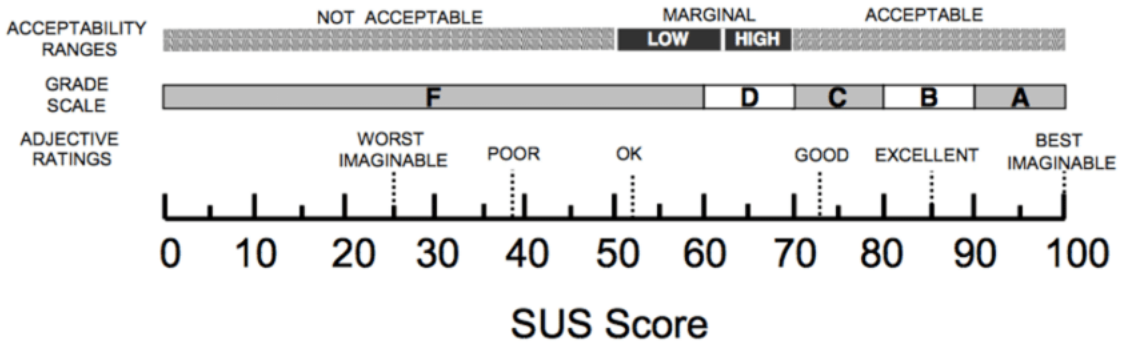


Figure 4.3: System Usability Score overview[7]

4.7.2 Usability testing

The main goal in usability testing is to test if the product that is being developed is usable by the intended users. Usability testing is usually done in controlled settings to reduce distractions and to remove other disturbing elements from the surroundings[36]. Controlled settings can be anywhere from a laboratory to other more natural settings like an office etc.

Users get a set of tasks and are observed and timed while solving them. This is not to test the users but to test how user-friendly the product is. While observing it is common to record the session and if possible log the keys that are being used. The data collected is used to calculate the performance and to identify errors. After a usability testing the participants is usually interviewed or given a short questionnaire e.g likert scale or SUS. The goal of this process is to identify problems with the product[46].

4.7.3 Heuristic evaluation

Heuristic evaluation is a set of usability principles made to evaluate the usability of a user-interface. This method was developed in 1990 by Jakob Nielsen and Rolf Molich, and has since then been altered and refined to ten main principles[36]. A heuristic evaluation should follow these principles as sited from nngroup.com[1]:

Visibility of system status: The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between system and the real world: The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom: Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

Consistency and standards: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Error prevention: Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

Recognition rather than recall: Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily re-

trievable whenever appropriate.

Flexibility and efficiency of use: Accelerators — unseen by the novice user — may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Aesthetic and minimalist design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Help users recognize, diagnose, and recover from errors Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

Help and documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

Chapter 5

Establishing Requirements

This chapter presents the ethical considerations made in this research as well as the appropriate approvals from the Norwegian Centre for Research Data. The target group, users and usability experts is also presented. Lastly the requirements made for the prototype will be presented.

5.1 Research ethics

Appropriate measures has been taken throughout the research process to ensure that all participants have been treated with respect. In short, this means that each participant was informed about their right to anonymity and confidentiality. Before they would take part in the research each participant was asked to read and sign the consent form. The consent form and interview guides are provided in Appendix B. This research has been approved by the Norwegian Center for Research Data(Norsk senter for forskningsadata - NSD), their approval is provided in Appendix A.

5.2 Target group

The target group for this research has been young adults between the age of 18 and 35. The target group was divided into two groups, one being people who had given blood or recently signed up and the other group were people who were healthy enough to give blood but chose not to. The reason behind this was that statistics show that young donors give blood 1-2 times and then stop[31], so it was therefor important to look into why they stopped. The reason for choosing only healthy individuals in the other group was because blood donation has certain restrictions when it comes to illness and medicine use. This meaning that some

people are totally excluded from the donation process, and therefor to no interest or use in this project. Both genders were required, numbers show that women are more willing to donate vs men. There is a 50/50 distribution between the genders in this research. Another important note is that the participants had to be comfortable with mobile technology, and that they should have experience with different mobile applications.

Table 5.1: Requirements for the target group.

Gender	Male/female
Age	18-35
Donation history	Recently signed up as a blood donor, given blood 1-3 times. OR able to give blood, but has not signed up.
Skillset	Knowledge about applications and smartphones, active on social media.

5.3 Research Participants

5.3.1 Users

The users in this research has been recruited through social media and through personal connections. The users consisted of ten males and ten females, who took part in a semi-structured interview. Four of the participants(two men, two female) were part of a case study, twelve participants in total performed a usability test and conducted a SUS.

5.3.2 Usability experts

Five usability experts contributed to the research, all of whom have degrees/experience in the UX/HCI/Design field. Three of the participants currently work as UX-designers, one works as an software developer and the last one has a bachelor degree in Information Science from the University of Bergen. They evaluated the applications using a usability test, Nielsen's Heuristic's and SUS.

5.4 Establish requirements

To establish the right set of requirements one must know who the users are and identify their needs. There are two different sets of requirements, functional and non-functional requirements. Functional requirements captures what the product should do while non-functional requirements says something about how the product should behave[36].

The requirements for the prototype were established through a literature review, a conversation with the Norwegian Red Cross and interviews with existing blood-donors. All of which gave insightful information about what a application for blood donors should and should not do. The stipulated requirements for the research can be seen below.

5.4.1 Functional requirements

The functional requirements says something about how the system is supposed to work[36]. These are the functional requirements for the prototype:

The functional requirements for the prototype:

- store information about your blood-type
- display information about your impact
- show a map of nearby donation stations
- connect you to a chat/assistant
- search in relevant information
- find a blood donation card
- see your last blood values
- see where your blood is in the process
- book an appointment to draw blood
- cancel an appointment
- get messages directly from you chosen donation station
- see latest accomplishments

5.4.2 Non-functional requirements

The non-functional requirements says something about how the system should behave, e.g how it should look. It also explains the constraints for a system and its development [36]. These are the non-functional requirements for the prototype:

The non-functional requirements for the application:

- the application has to be user-friendly(easy to use)
- have an aesthetically pleasing yet minimalistic design
- the design should work on both apple and android OS
- has a good use-ability(easy to understand the flow of the app)

Chapter 6

Prototype Development

This chapter will present the development process and which tools that were used to design and create the final prototype. During the research there were a total of four iterations, each with their own intention and goal which are elaborated upon below.

6.1 Development Tools

6.1.1 Hubspot - Make my persona

"Make my persona" is an online tool at Hubspot to help companies make and illustrate a buyer persona [28]. It comes with a couple of pre-made traits for your persona, mostly aimed at companies but these can all be altered to fit the specific case.

6.1.2 POP - Prototyping on paper

Pop is a prototyping software created by Marvel that helps to transform pen and paper ideas into interactive applications. The software enables users to create a clickable product on desired platform by uploading paper wireframes and define their information path[32].

6.1.3 Balsamiq Mockup

Balsamiq mockup is an online prototyping tool for mobile and web platforms. It is a rapid low-fidelity UI wireframing tool that aims to reproduce the experience of sketching on paper, but using a computer[5].

6.1.4 Adobe XD

Adobe XD is a digital prototyping tool for designing interactive solutions for web and mobile. It is created and published by Adobe studios. With Adobe XD the designer can easily make highly interactive prototypes. It comes with several built-in features that allows the designer to draw, shape and form different widgets, buttons and functions. There are also assets available to download online[44],

6.1.5 Adobe Illustrator

Adobe Illustrator is a vector graphic editing tool that is created and distributed by Adobe Studios. Illustrator illustrations is vector based, which means that they can be scaled down or up without loosing quality[2].

6.2 Iteration Overview

The table below shows an overview of the different iterations during the research. Each iteration is following a user-centered design process.

Table 6.1: Table showing user-centred design in steps.

Iteration	**1**	**2**	**3**	**4**
Define/Redefine	Define Literature review	Redefine (After users)	Redefine after usability test and SUS	Redefine after case study, usability test and SUS
Fidelity	Low-fidelity	Low/Mid-fidelity	Mid-fidelity	High-fidelity
Method	Interviews with existing blood donors	Interviews with non-donors Design Principles	Case Study	
Evaluate	Evaluated by users	Usability test and SUS with users	Usability test and SUS with experts	Nielsen's Heuristics with experts

6.3 First iteration - Conceptualizing

To investigate the concept of motivational application for blood donors: a conversation with the Norwegian Red Cross and a literature review was conducted. The goal was to get a better understanding of the challenges faced with recruiting donors, and what research existed on the domain. With the information gathered from the conversation and the literature review, the target group was set to be young adults, a list of requirements was set, and a low-fidelity prototype made of pen and paper sketches were made. Then a semi-structured interview with existing blood donors in the target group was conducted. After the interview, the participants were presented with some of the existing applications; the aim was to see what functionality they felt were missing, and if they had any thoughts in regards to the designs. Lastly, they were presented with the low-fidelity prototype, where they gave valuable feedback that was later reviewed in the second design iteration. The first iteration followed a

user-centered design approach, which also firmly unites with the method in design science research and the interaction design life-cycle. Both methodologies share a mission for developing relevant and user-centered artifacts, with the starting point being to get a better overview of the existing domain.

6.3.1 Persona

Preece et al. explains personas as *"rich descriptions of typical users of the product under development that the designers can focus on and design the product for.* The goal of a persona is not to describe real people, but to base the persona on a realistic image of people. Personas are characterized by their set of information and should include skills, attitude, task, environment, and a set of unique goals. The personas information should be specified in some details, such as their name, age, hobbies, desires, and habits. Personas have proven to be a powerful way of communicating a user's characteristics and needs, and it is widely used in the field of interaction design[36]. Two personas were made for this purpose; their aim was to help keep the focus on the user and to establish a clear picture of their needs throughout the process. The personas can be seen in figure 6.1 and 6.2.

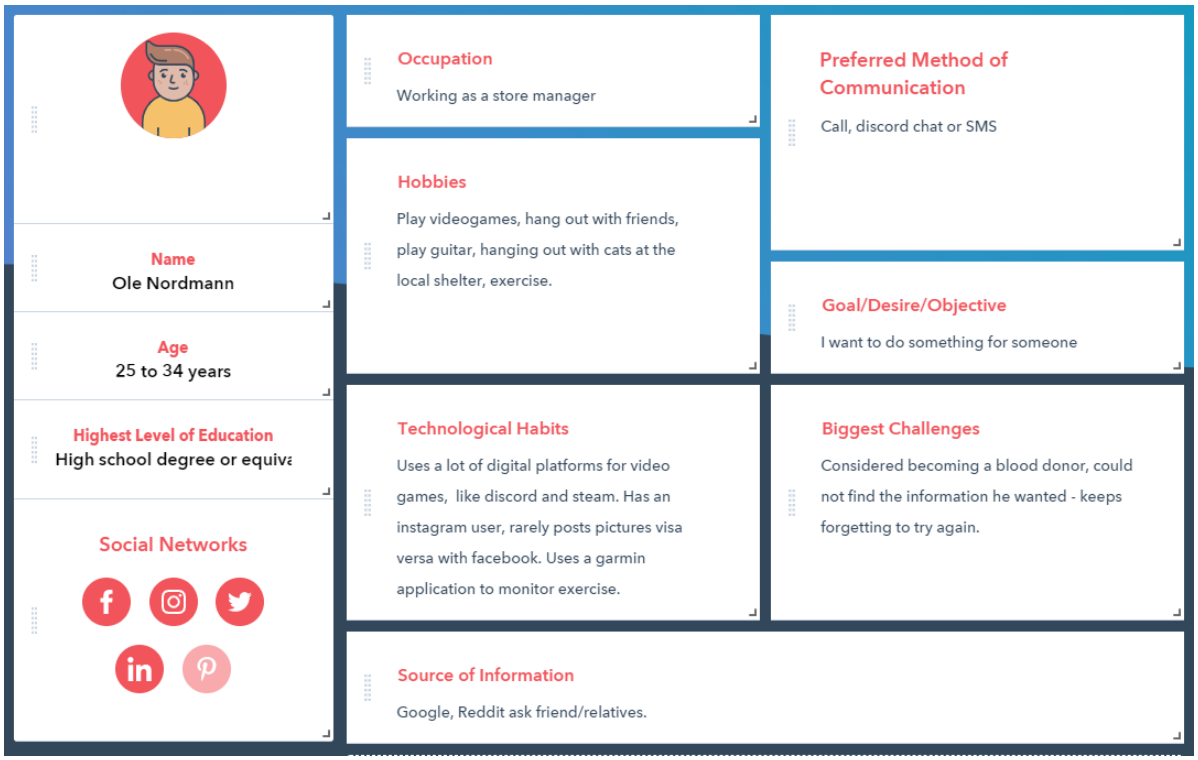


Figure 6.1: Persona 1: Ole Nordmann.

Figure 6.2: Persona 2: Tora Torden

6.3.2 Low fidelity prototype

A low-fidelity prototype is a visual representation of the basic design of a product. It is not meant to be similar to the final product and is often used to explore different design ideas. Low-fidelity prototypes are often represented with the use of simple materials such as pen and paper drawings. This is useful to keep the process simple, reduce cost, and the prototype is easily modified to explore different design ideas. A low-fidelity prototype will often have a limited set of functions; this is to represent them visually rather than being able to perform the given function.[36]

Sketch and low-fidelity prototype

The first version of the blood-donation application was created with pen and paper, and several sketches were made to explore different design ideas and the app layout. Figure 6.3 is showing the sketches making up the first prototype. It includes a homepage with the users information and the main functionalities in the first prototype included *my appointments*, *blood journey*, *my vitals*, *my contribution* and *donor card*.

My appointments is an overview of the donor's upcoming appointment to donate blood; it also provides the user with the possibility to change their appointment or set a new appointment.

Blood journey is a visual representation of the different steps after a donation. It enables the user to see what happens with their blood after a donation. Processing, testing, storage, distribution, and lastly, transfusion.

My vitals an overview of the donor's last blood values. Before donating, test samples are taken to ensure the donor is healthy enough, for example, checking iron levels. This enables the user to see if they need to take supplements before their next appointment.

My contribution a visual representation of the donor's impact. See how much blood they have donated and how this has helped, hopefully, this will serve a motivational factor.

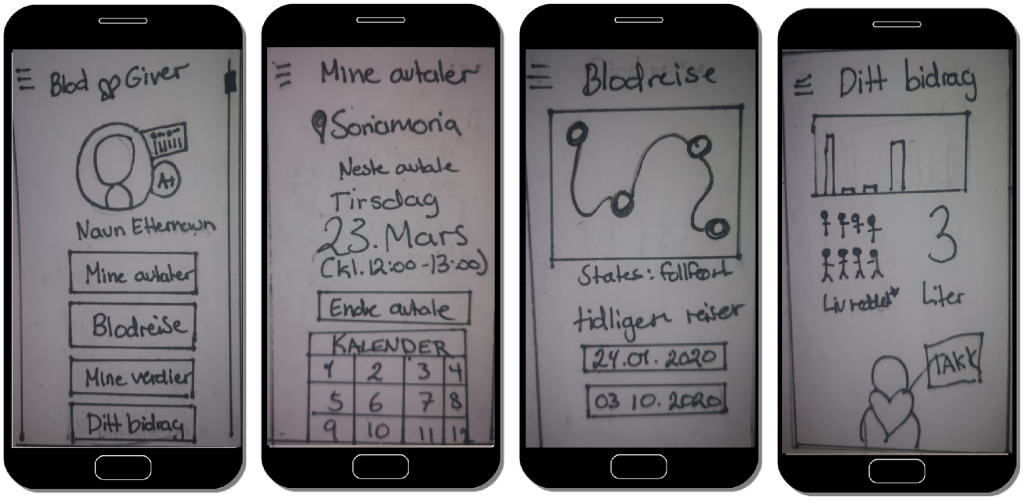


Figure 6.3: The first prototype

6.3.3 Semi-structured interviews with blood-donors

Ten blood-donors, five male and five female, were interviewed. The background for the interview was to get a better understanding of how they perceived the donation process, what factors that motivate them, and what app/social media habits they had. First, there was a presentation of the project outline, including the research project's ideas and goals. The interview conducted was a semi-structured interview with a set of pre-defined questions, the interview guide as a whole can bee seen in Appendix B. Then the participants were presented with some of the existing applications which functions and design were discussed in depth. Lastly, they were presented with the low-fidelity prototype. The participants could come with suggestions regarding functions or other usability related issues.

The donors found it to be an exciting idea, and they gave much insightful information regarding useful design implementations and functions. Some questions were raised about the blood-journey function and whether it would serve as an unmotivating factor. Blood is perishable; it is often stored over more extended periods of time, meaning there is a risk of the blood never being used. One of the donors was concerned this might be perceived as a negative factor for the user, seeing that their contribution never reached its full potential. Most of the other users disagreed and expressed their interest in the blood-journey function and how it offered insightful information. Different ways of letting the user know about their blood expiring were investigated.

6.3.4 Proof of concept

The conversation with the Norwegian Red Cross, the literature review, and the interview with existing blood donors gave a good indication that an application would be an excellent contribution to motivate and assess blood donors. It was also clear that it would be necessary to change some of the already established requirements and conduct some further research. The Norwegian Red Cross is continually working to assess more donors, and they were positive that an application had the means and the possibility to help the cause. The blood donors voiced opportunistic opinions regarding such an application.

6.4 Second iteration - Low/mid fidelity prototype

The second design iteration consisted of implementing and redefining requirements after feedback from the blood donors. These were used to create a new low/mid-fidelity prototype in Balsamiq Mockup, that would later be evaluated using POP. There was also conducted more research, and a group of non-donors was interviewed. The design principles were reviewed to make sure they were present in the prototype. Lastly, the participants performed a usability test and a SUS evaluation on the second prototype.

6.4.1 Redefining after feedback from blood donors

After the interview with the blood donors, some changes to the prototype were implemented. They requested a message box, a communication channel, and that the blood donation card was more visible in the app. The "blood journey" function was still under investigation and explored further with the non-donors and the usability test. Testing with a sketch does not give the same feel and result as testing with an interactive product. The new prototype was

therefore made in Balsamiq Mockup and later added to the POP tool, making direct interaction possible.

6.4.2 Semi-structured interview with app-users/non-donors

Before making any adjustments to the prototype, it was essential to explore the other half of the target group. The interview process followed the same routine as the first: a brief presentation of the project outline, a semi-structured interview, a short evaluation of the existing apps, and lastly, an evaluation of the existing prototype with a usability test followed by SUS. The interview-guide for the non-donors can be seen in Appendix B.

6.4.3 Design principles

To ensure the quality and usability of the current prototype, the design principles were reviewed. The goal of this was to see if they were well-integrated, or if there were design choices that needed to be reassessed to fit the principles better.

Visibility was accomplished by presenting the main functionalities at the homepage, while other less critical functions are "hidden" behind the hamburger menu. This is making the "main" functions more visible. The functions are also highlighted with a button with both icons and text.

Feedback was accomplished by adding titles to each page, enables the user to see where they are located in the application. The buttons change colors when they are pushed, providing the user's visible feedback that compliments their action.

Constrains: This was one of the principles that had to be assessed further in the upcoming design. How does the design make sure the user is not pushing the wrong buttons and putting themselves in unwanted situations.

Consistency was accomplished by making a red-thread throughout the application by reusing design elements. The buttons had the same design throughout the application, as well as colors, fonts, and icons.

Affordance was accomplished by using recognizable layouts for mobile applications, such as

placing the hamburger menu where the user would expect it to be.

6.4.4 Low/mid fidelity, wireframes

As mentioned, the second prototype was made with Balsamiq Mockup. The prototype had evolved from pen and paper sketches to digital wireframes, making it a low/mid-fidelity. There was still a focus on functionality and a user-friendly layout. Colors and other definite elements such as icons and illustrations would be introduced in the next iteration. The second prototype can be seen in figure 6.4. The main page has a set of buttons; by pressing them, the user would be directed to one of the sites as seen in chronological order.

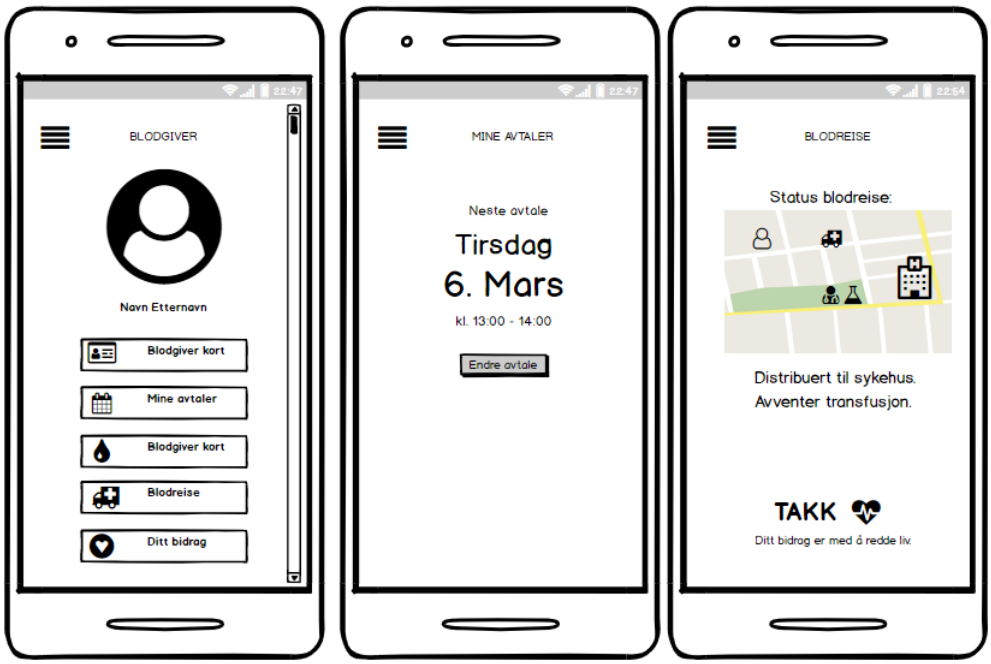


Figure 6.4: Low/mid-fidelity prototype balsamiq

6.4.5 Usability test and SUS with users

Twelve users did the evaluation of the design of the second prototype. Both a usability test and a SUS were conducted to ensure the usability of the application. The testing was done over a video call. A brief presentation of the prototype was done. The user was informed not to focus on the design of the icons and so forth since they were not final. The users were sent a link to the prototype and tested it on a phone-sized window on their computer. The users were also explained that the goal of the usability test was to see how the application worked, it was not a test to see if they understood it but rather to see that the application was user friendly and understandable. After the usability test, the users could comment or

give feedback. After the usability test, they were presented with a SUS. The SUS score ranged between 72,5 and 87,5, which corresponds to a grade C or B. More elaborate number in the SUS is displayed in the evaluation chapter 8.

6.5 Third iteration - Mid/high fidelity

The feedback from the interviews, usability test and SUS was integrated and explored further. A case study with four users, two blood donors male and female, two non-donors, both male and female, was conducted. They did an extensive walkthrough of the prototype and gave feedback accordingly. Lastly, the prototype was evaluated with five experts, who did a usability test and SUS.

6.5.1 Redefining after feedback from users

Based on the feedback from the usability test, interview, and the indications from the SUS, a couple of changes were made to the prototype. Both the donors and the non-donors seemed to have a union when it came to the blood journey function, so that was kept in the final design. It was also suggested to implement some gamification elements to keep up the motivation. Some of the users suggested a badge system, with badges for different achievements such as "first blood drawn" and so on. Other suggestions were to implement a QA page and a contact page. During the review of the five design principles constraints turned out to not be adequately covered, this was improved in the third prototype.

6.5.2 Mid/high-fidelity prototype

The third prototype was made with Adobe XD. There were still some functions that had to be integrated. The focus were to make a badge page and to start finalizing the design elements such as colors, icons, and illustrations. The third prototype can be seen in figure 6.5:.

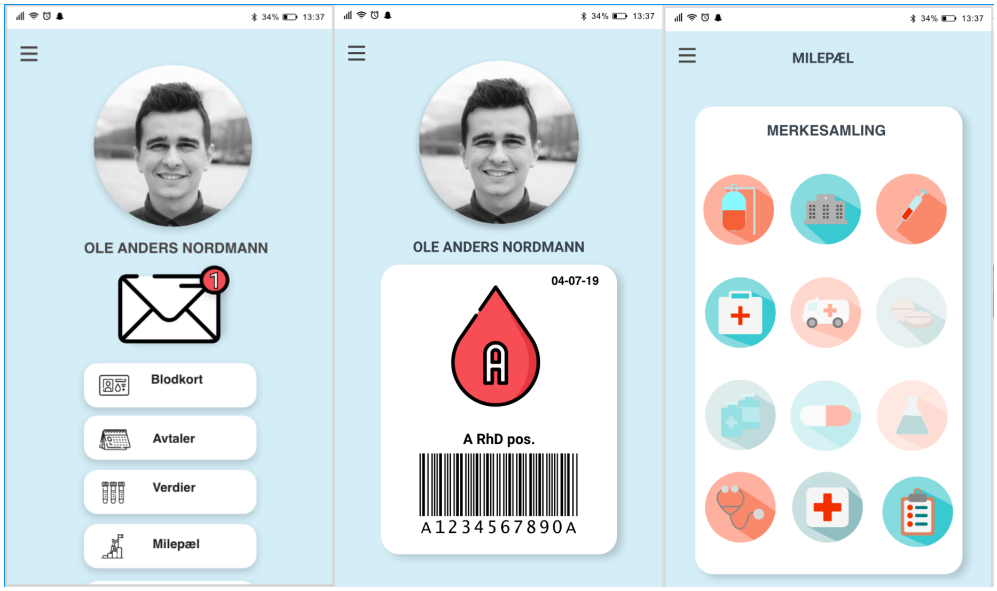


Figure 6.5: A selection of frames from the third prototype

6.5.3 Case study with users

There were a total of four participants in the case study, who were initially contacted from the initial group. The users consisted of two blood donors and two non-donors. C2a signed up as a blood donor this year and has given blood once, C1a has been giving blood for a couple of years, C1b and C2b have never given blood.

The users were observed while they were interacting with the application. First, they were instructed to go through each page, before navigating or clicking on a module they were asked to say what they thought would happen after their action. They did not get any help during the observation. C1a and C2a seemed to have a more structured approach to exploring the application, and they were very clear about what they were missing or if they were searching for specific information. While C1b and C2b were taking their time, reading the mock-up text, and generally using more time to explore the application as a whole. A summary from the case study can be seen in Appendix C.

6.5.4 Usability test and SUS with usability experts

After the case study, there was another round with usability testing and SUS, this time with the usability experts. The tests were executed over a video call. First, they were asked to do a set of tasks while being timed and after they had to fill out a SUS sheet. All the users seemed to enjoy the design, and they all managed to complete each of the tasks. The result of the

usability tests and the SUS test can be seen in section 8.2.3 and 8.3.2.

6.5.5 Finishing design elements

Color scheme

The color scheme was established during the third design evaluation. Feedback from participants regarding design on similar apps was that they were way to intensive and red and that they wanted a more neutral color scheme. The color scheme was made to be comfortable for the eye and also avoid the "blood red" color to make the design less intense. The prototype is using light blue background color and a variety of black for the text. This ensures a distinct contrast between the background and text, making the text more visible as well as increases the readability.

Figure 6.6: Color scheme for final design

Font

The fonts used in the final design is called Roboto and Open Sans. Both fonts were found on Google Fonts, a library containing a variety of free licensed font families. Roboto is characterized as grotesque and sans-serif font, the font was used in bold style for headings. Conventionally grotesque fonts distort their letters to force a rigid rhythm. However, Roboto allows the letters to be in their natural width which makes it suitable for a more natural reading rhythm more commonly found in serif fonts.[17] Open Sans is a sans-serif font that was used for the text body. Open Sans is optimized for web and mobile interfaces, providing high readability for the user.[16]

ABCDEFGHIJKLMNO
PQRSTUVWXYZÆØÅ
abcdefghijklmno
pqrstuvwxyzæøå
1234567890

(a) Roboto in bold style

ABCDEFGHIJKLMNO
PQRSTUVWXYZÆØÅ
abcdefghijklmno
pqrstuvwxyzæøå
1234567890

(b) Put your sub-caption here

Figure 6.7: Open Sans in regular style

Icons and illustrations

The icons used in the final design are from Flaticons. Flaticons is a platform with both free and licensed icons[14]. The icons used in the final design were minimalist, and one criterion was that they should be able to convey the function without the need for explanatory text. The illustrations used were downloaded from Freepik, the same concept as Flaticons with both free and licensed illustrations[21]. It was essential to use illustrations that fit the overall theme and color. They should also be pretty to look at in addition to conveying messages evolving around blood donation.

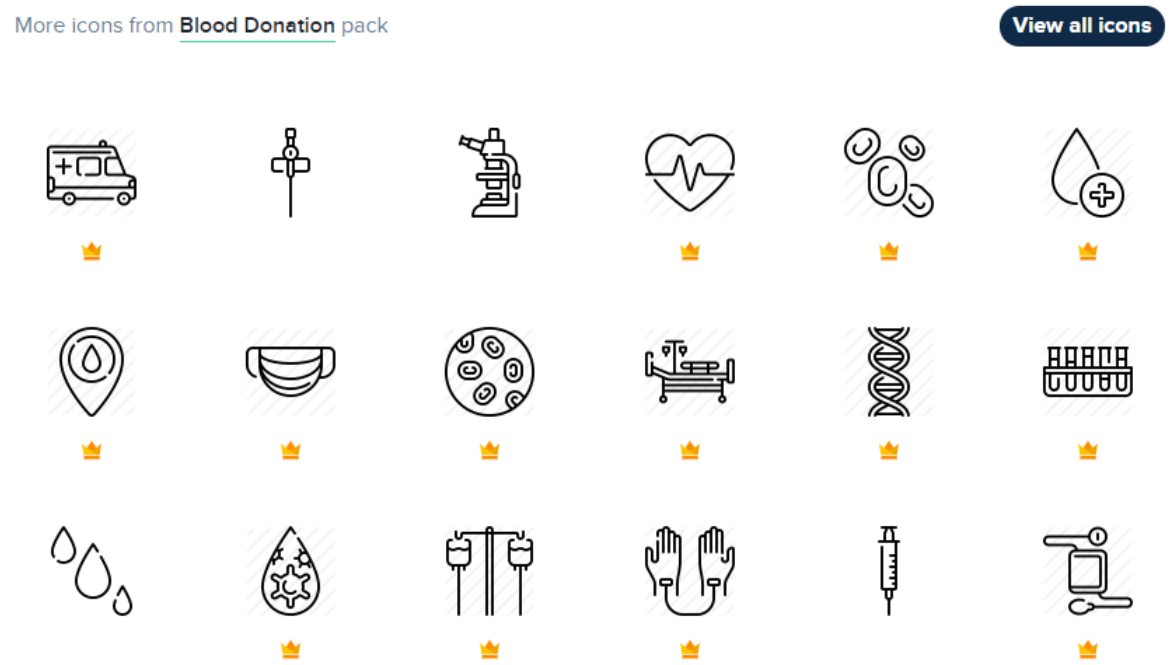


Figure 6.8: A selection of icons from flaticon

Figure 6.9: Illustrations from freepik

6.6 Fourth iteration - High fidelity

The fourth and last design iteration consisted of the implementation of results from the case study and evaluation. Some changes were made from the feedback given by the usability experts. Lastly, the application was evaluated by the same group of usability experts using Nielsen's heuristics.

6.6.1 Redefining after feedback from usability experts and use case

The feedback from both the case study participants and the usability experts concerned the same. They wanted a smaller message box, and they wanted to make the list of functions on the homepage smaller. The participants from the use-case suggested that there should be some motivational factor on the front page e.g showing a couple of badges. It was also suggested to implement facts from the motivational illustrations to the page with the badges.

6.6.2 High fidelity prototype

The changes suggested in the last evaluation were implemented in the fourth prototype. The module that previously consisted of only badges was now merged with information about the donor's impact. The message box was moved, and the layout of the menu was changed. Lastly, a row of badges and other impact information was added to the front page as seen in figure 6.10. More details of the final functions and the design can be seen in chapter 7. After the prototype was finished, one last evaluation was conducted with the usability experts, they used Nielsen's heuristics to evaluate the final prototype.

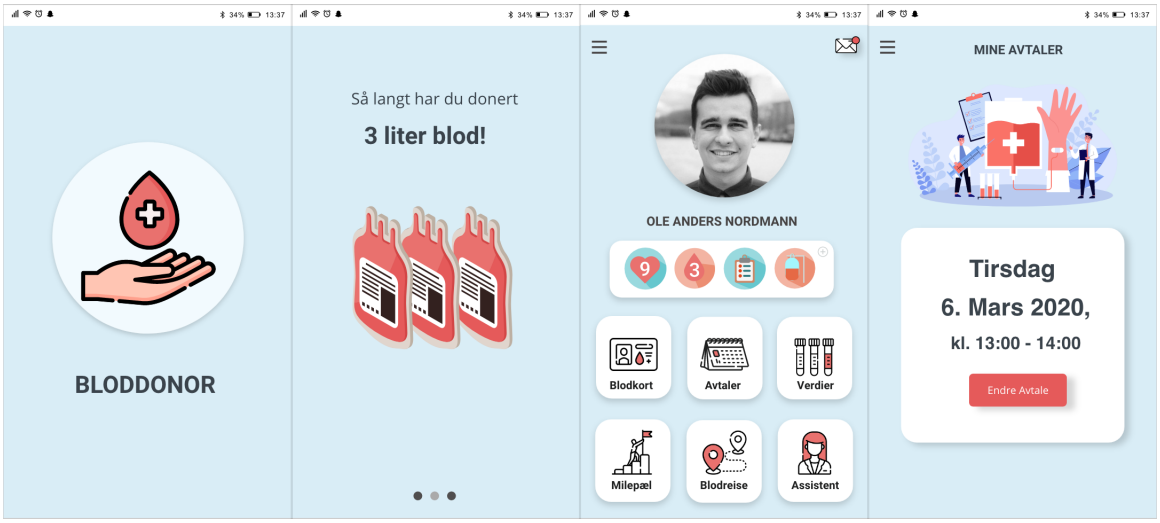


Figure 6.10: High-fidelity prototype

6.6.3 Nielsen's Heuristics with usability experts and future iterations

The five usability experts conducted an evaluation using Nielsen's Heuristics. They got a link to the XD prototype on their computer and were instructed to test it there. They then filled out their results, which can be seen in section 8.4. No significant issues were found, but the usability experts had some suggestions. The experts suggested to implement more elements for gamified content as well as fascilitate an onboarding process for the app. They also recommended doing another evaluation round with the intended user to locate errors and other shortcomings that the experts did not capture in their last evaluation. Due to time limitation, these changes and evaluations have to be met in a possible future design iteration.

Chapter 7

Features

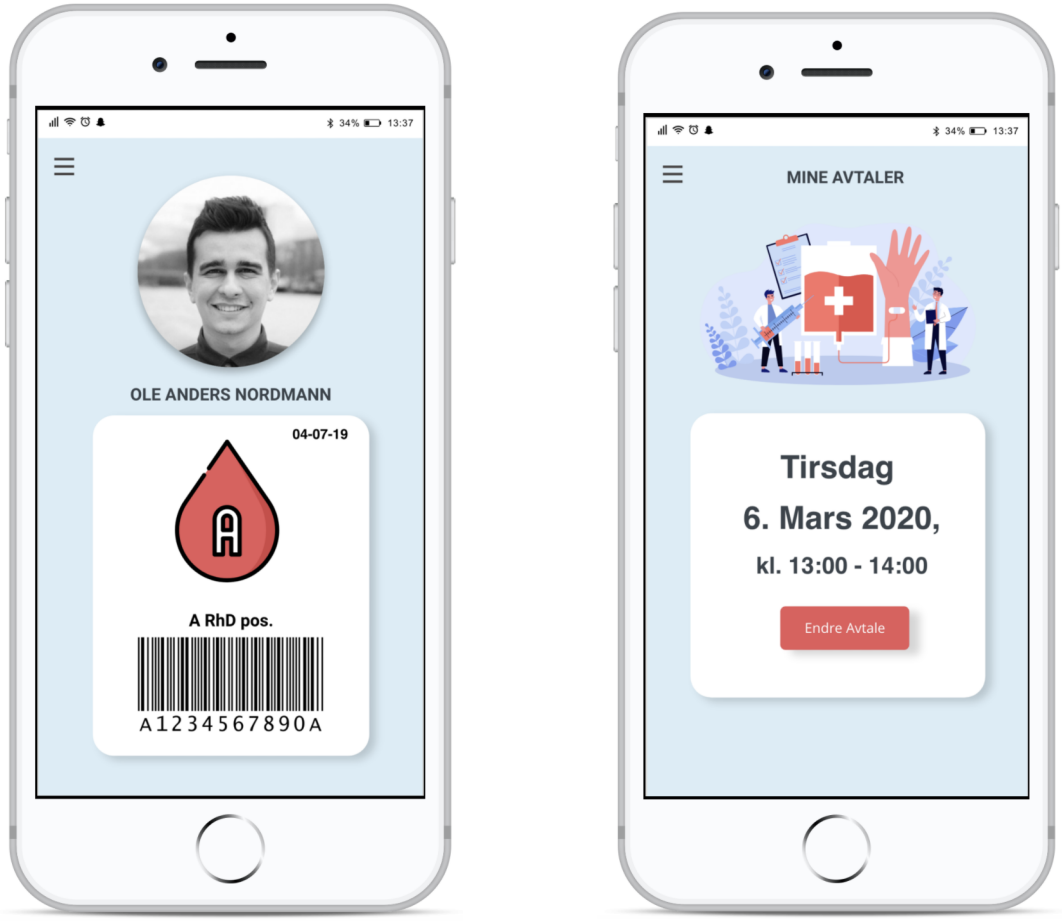
This chapter features an overview of the last high-fidelity prototype and the main functions, a result of four design iterations following methods and evaluation.

7.1 Digital blood card

The first function in the application was very important for the donors, a digital donor card (figure 7.1a). At the donation site in Norway users are provided with paper donor card which is stamped each time a user donates. This was something the donors found tedious, and some of the donors interviewed mentioned that they had lost their card on several occasions. Furthermore, the donation card distributed in Norway often contains sensitive information such as full name and birth number. With this functions the donors do not have to worry about forgetting or losing their card, it easily accessible through the application. The digital donor card has a bar-code that can be scanned at the donation site, the idea is that the bar code should contain sensitive information making it only available to the staff at the donation sight.

7.2 Appointments

Appointments let the user see and change their current appointment (figure 7.1b). To give blood is a voluntarily act, it is not so uncommon that it is deprioritized for the benefit of other things viewed as more important by the donor. It was therefor important for existing- and new donors that they could change their appointment without having to do several steps. This ensures that the process itself becomes more flexible, the user is not dependent on calling the blood donation site, they can just easily change the time and date with a simple click.



(a) Digital donor card

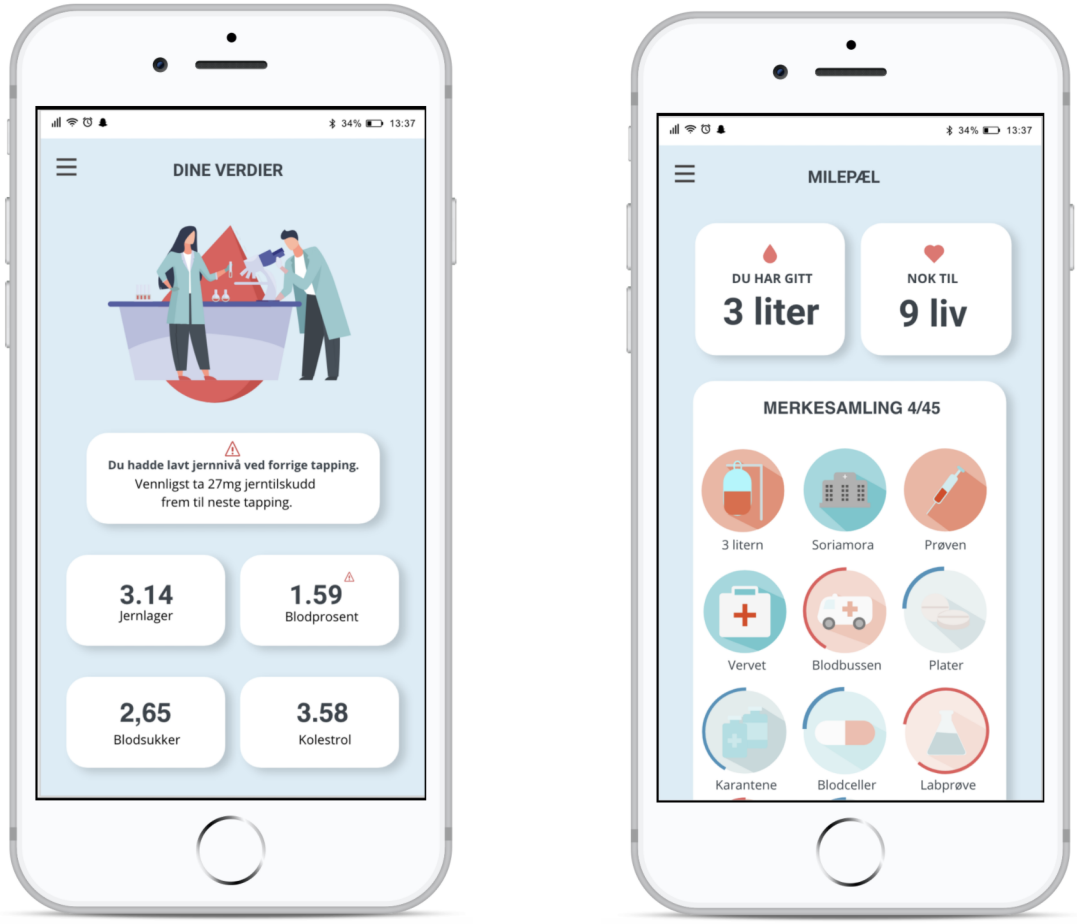
(b) Appointments

Figure 7.1: Module donor card and my appointments

A lot of the participants from the interview commented that it would make them more likely of returning if they themselves where in charge of time and date.

7.3 Your blood

A vital part of giving blood is that the donor needs to be healthy, and that the values in the blood are high enough for them to donate. To be able to donate a donor needs to be within the normal hemoglobin range(blood percentage) and ferritin levels(how much iron is stored in the body)[26]. It was therefor suggested to implement a function where the users could monitor their own values based on their last blood sample. An example: it is not unknown that many women are prone to lower levels of iron. It could therefor be useful to be able to see the last values, in order to try and manage them to the next appointment. Hopefully this way users wont have to skip a donation because of low iron percentage. The function is also featured with tips, as seen in figure 7.2a the persona is recommended a dosage of iron until the next donation in order to maintain normal levels.



(a) Your blood

(b) Impact and badges

Figure 7.2: Modules: your blood and impact

7.4 Impact and badges

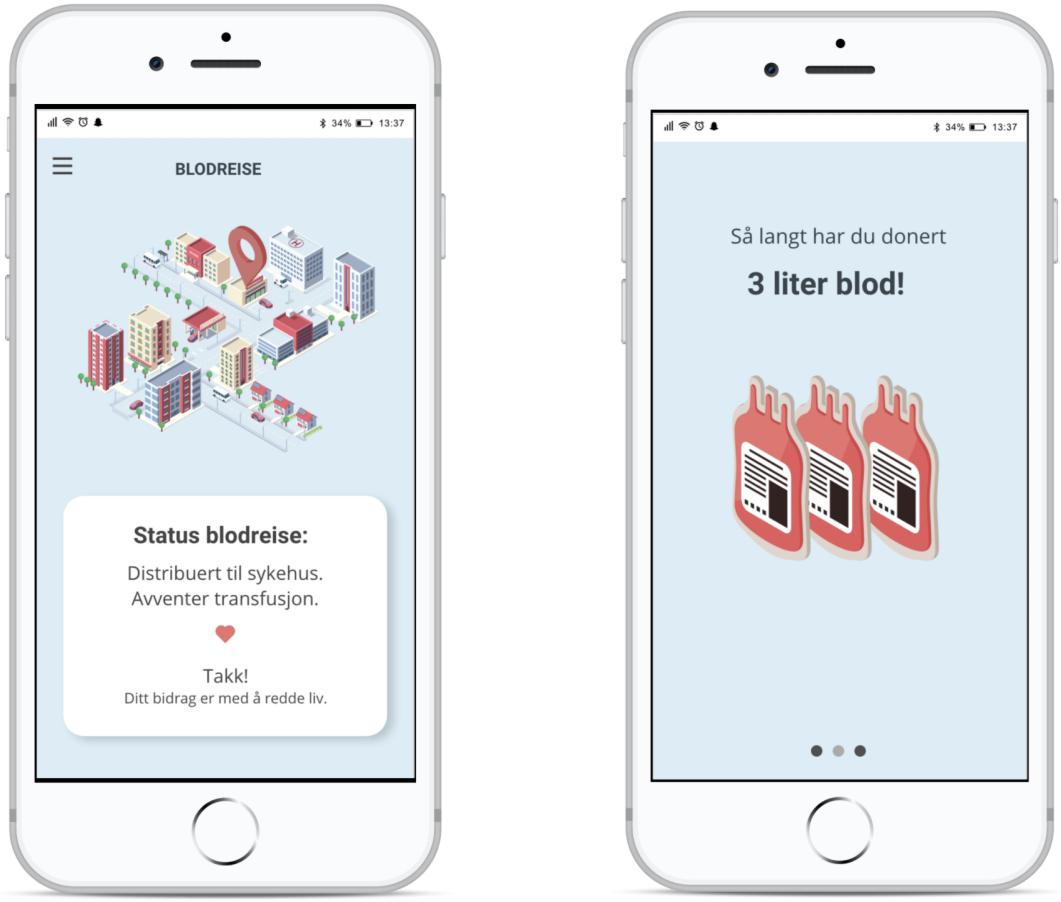
The impact and badges module is easily accessed through the front page. This site is meant to give the user a overview of their personal impact in addition to keep track of different achievements in the form of badges. The badges are unlocked according to different blood donation activities that the user have available. All the badges are available on the page, and the top keeps a score of how many badges are unlocked. The badge also provides the user with a progress bar, some badges are given during one particular activity but some has to be done several times in order for the user to unlock it. Furthermore, the user can click on an unlocked badge and get information about that particular activity and why its important. It also provided with a possibility to share the badges on social media see figure 7.2b.

7.5 Blood Journey

The blood journey module, figure 7.3a, serves an informative module where the user can see the different processes that the blood has to go through before reaching transfusion. It also gives the user a notifications whenever the blood has been used. This gives the user value in the way that they see that they have contributed to something, this can work as a trigger to keep them motivated to donate.

7.6 Motivational illustrations

This is not really a module, but an important feature. After a donation has taken place, the user will be presented with data of their impact as shown in figure 7.3b. The though behind this closely relates to the impact module, it wants to boost the users altruistic behaviour by providing consequences of their action. The information seen in the motivational slides will change according to how the impact increases with number of donations.



(a) Blood journey

(b) Motivational illustration

Figure 7.3: Module blood journey and motivational illustrations

Chapter 8

Evaluation

This chapter presents the evaluation results from the second, third and fourth design iteration. The results are gathered from a usability test, SUS and Nielsen's Heuristics.

8.1 Participants in the evaluation

There were three different groups who evaluated the design. Group one and two(table 8.1) consisted of intended users, both donors and non donors(see section 5.3.1). They were split into two groups to see if the result varied based on their background and knowledge of the process. The users participated on both the usability test and the system usability scale. The third group(table 8.2) consisted of usability experts(see section 5.3.2) all of whom has experience with the human-computer interaction field and interaction/UX design. The experts participated in the evaluation with a usability test, system usability scale and Nielsen's Heuristics.

Table 8.1: Users - group one and two

(a) Non-donors, group one

Participant ID	Age	Gender
P1	22	Female
P2	25	Male
P3	25	Female
P4	27	Female
P5	30	Male
P6	32	Male

(b) Blood donors, group two

Participant ID	Age	Gender
P7	20	Female
P8	22	Male
P9	25	Male
P10	26	Female
P11	30	Female
P12	30	Male

Table 8.2: Uability experts, group three

Participant ID	Age	Gender	Educational level	Profession
U1	25	Male	Bachelor's degree	Student
U2	28	Female	Master's degree	UX-designer
U3	28	Female	Master's degree	UX-designer
U4	36	Male	Bachelor's degree	Software developer
U5	40	Male	Master's degree	UX-designer

8.2 Usability testing

The usability test were done via video call meaning the participants used their private computer. They were sent a link to the prototype, the prototype simulated a mobile screen. The participants shared their screen so that their tasks could be observed. It is worth mentioning that the application and prototype is meant for physical interaction, meaning that of touch. But because the testing was conducted on computers and laptops, the users interaction was with either a computer mouse or a touch pad. Each participant are identifiable with their participant ID shown in table8.1 and 8.2.

8.2.1 Tasks for evaluation

To be able to evaluate the prototype, each participant had to get familiarized with the application. This was achieved by giving the participants a set of specified tasks that covered some of the key functions. The aim for the usability test was to see how the intended users would interact with application. During the usability test the participants were not informed on how to complete the tasks, they were however allowed to ask questions or ask for help if necessary.

The tasks for the usability test:

1. Navigate to the homepage
2. Locate Ola Nordmann's blood type
3. Find your next appointment
4. Move your appointment to another date
5. Find Ola Nordmann's impact

6. Find the last message
7. Find information about quarantine

8.2.2 Usability testing with users

Twelve users conducted the usability test on the second prototype, each participant got a set of seven tasks they had to do while they were being observed and timed. The goal for the usability test was to find how efficiently they could use the application, in addition to get an idea of the learnability of the application. The users had no prior experience with the prototype other than seeing and discussing the sketches of the low-fidelity prototype in the first iteration. An overview of the results can be seen in table 8.3.

The most noticeable difference in the user group where how most of the non-donors(P1-P6) struggled to find information about blood type. They found it eventually, but they had to navigate through a couple of the modules first. The donors seemed to have a certain idea of where this information would lie. P1 and P4 struggled to navigate to the homepage, they tried to click on the pictures instead of dragging them. This was most likely due to confusion regarding the interaction, all the participants had to use a mouse or a touch pad when the design is intended for touch. P6 and P7 tried to look in the hamburger menu for a module that was on the front page. P5, P7 and P9 tried to click the calendar instead of the edit button when they were asked to change their appointment date. P9 tried to click the profile picture when searching for the impact, thinking it would lead to the same module as the one at the front page. P1, P3, P7 and P10 tried searching in the modules instead of checking the intended hamburger menu. Every participant was able to successfully complete the tasks, but there were some noticeable confusion in how some of the different functions worked.

Table 8.3: Summary of data from the usability test with users

User ID	Category	Task	Problem	Tag	Issue
P1, P4	Navigation	Navigate to homepage	Tried to press the pictures instead of swiping	Confusion	Minor
P1, P2, P3, P4, P5, P6, P8	Blood card	Locate Ola Nordmann´s blood type	Hard to locate specified information	Confusion	Serious
P6, P7	Appointment	Find your next appointment	Tried to search in the hamburger menu	Menu	Minor
P5, P7, P9	Appointment	Move your appointment to another date	Clicked the calendar instead of the edit button	Icon	Minor
P9	Navigation	Find Ola Nordmann's impact	Clicked on the profile picture	Button	Minor
P1, P3, P7, P10	Menu	Find information about quarantine	Clicked the wrong module	Confusion	Serious

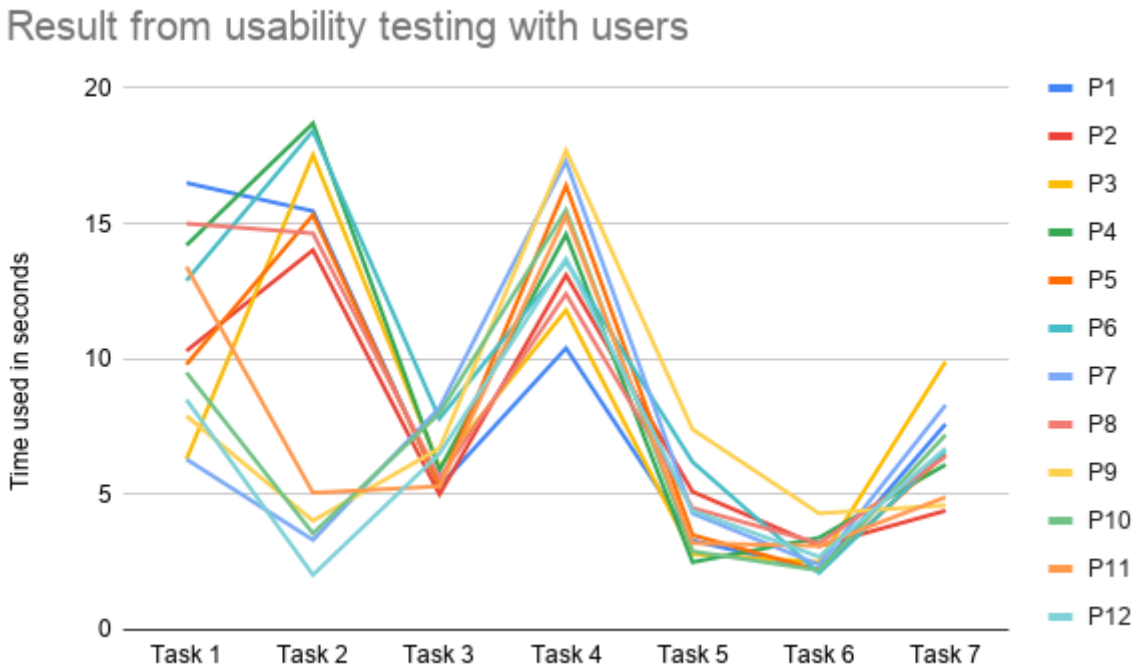


Figure 8.1: Time spent on each task per user

The amount of time each participant used to complete their given task in seconds can be seen in figure 8.1. There are some variations in the time spent on each task, the explanation for this is mostly related to the problems in table 8.3. Other small time differences is mostly likely due to the fact that some participants uses more time to read than and explore.

8.2.3 Usability testing with experts

Five usability experts conducted a new usability test on the third prototype. They got the same tasks as the first usability test, and were also observed and timed. The goal for this usability test was to see if some of the problems found in the first usability test were sufficiently improved, and to see how efficiently they could use the application. The experts had no prior knowledge of the prototype. An overview of the results can be seen in table 8.4

Table 8.4: summary of the findings from the usability test with experts

User ID	Category	Task	Problem	Tag	Issue
U1, U2, U3	Blood card	Locate Ola Nordmann´s blood type	Checked 1 or 2 modules before finding the right one	Confusion	Minor
U2	Appointment	Move your appointment to another date	Did not click the “confirm” button after changing the appointment	Too quick	Minor

When presented with the task of locating the blood type U1, U2 and U3 checked one or two

modules before they were able to find the right one. U2 used more time during the task of changing the appointment, the reason for this is that she forgot to press the "confirm" button after the changes was made. The experts were able to complete all of the seven tasks. The time used for each task can be seen in figure 8.2. Here too, the problems in table 8.4 is reflected in the use of time on the different tasks.

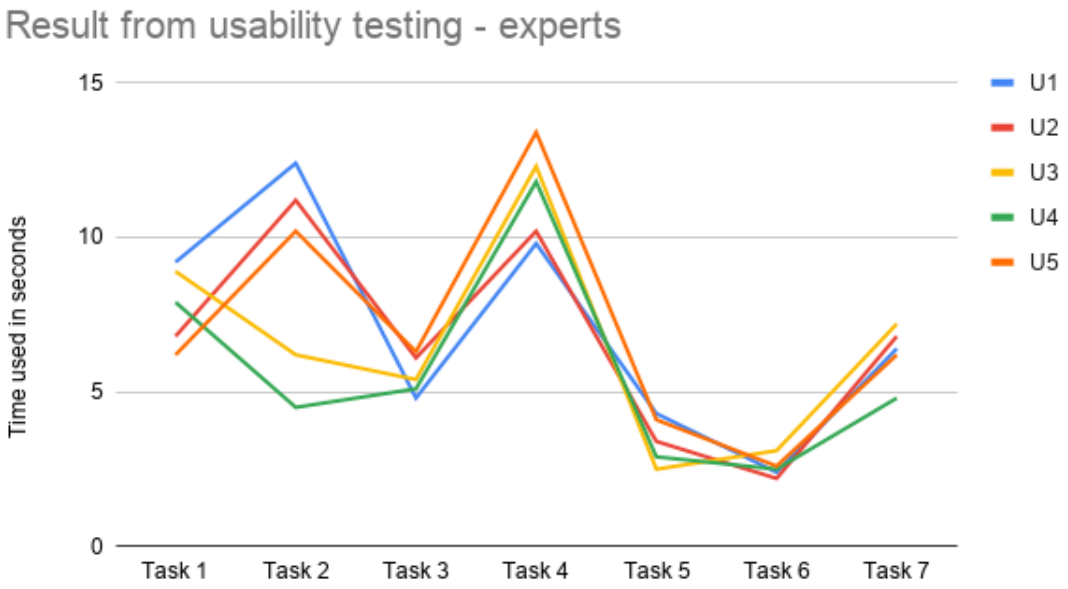


Figure 8.2: The average time used on the seven tasks

8.2.4 Comparing usability test results

Overall there were no significant differences in the two groups. When comparing the results in the time spent per task, the usability experts are slightly faster than the users. The reason behind this can be that the usability experts have an IT background, as well as a more structured approach when it comes to problem-solving. The average time used is shown in figure 8.3.

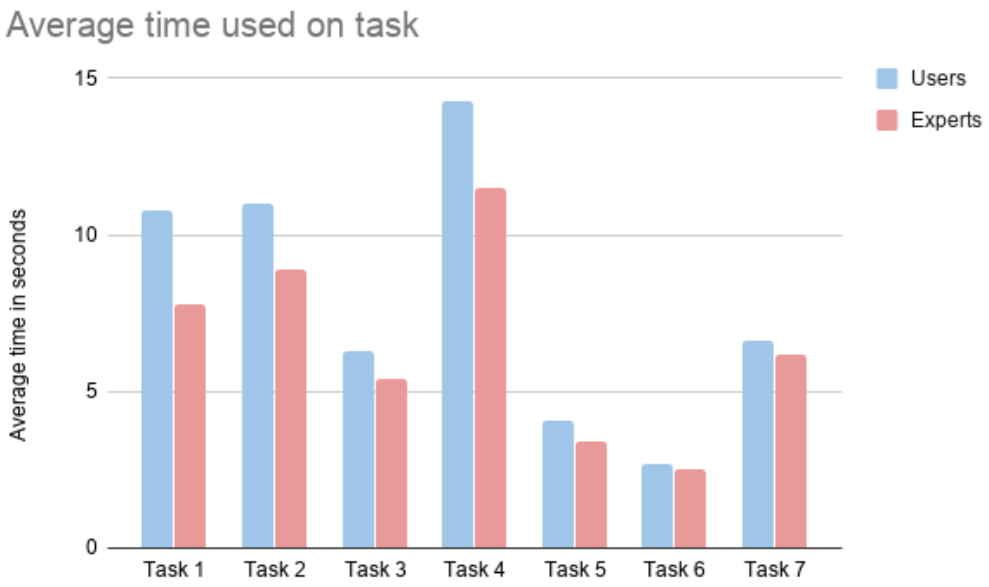


Figure 8.3: Average time used on the tasks for users and experts

8.3 System Usability Scale

After the participants had completed their usability test, they were instructed to measure the system using a System Usability Scale (SUS).

8.3.1 SUS with users

The users took the SUS evaluation in the second design iteration. The first group to evaluate was the non-donors; their score ranged from the lowest being 67.5 points to highest being 90 points(figure 8.4). The average for the first group was a score of 77.5, between 68 and 80.3, is considered good, or a grade B. The second group was the donors; their score ranged from 72.5 to 87.5(figure 8.5). The average score for the second group was 80 points, meaning the result was considered as good or a grade B. The overall average score for the users was 78.7. The user's individual score can be seen in figure 8.4 and 8.5.

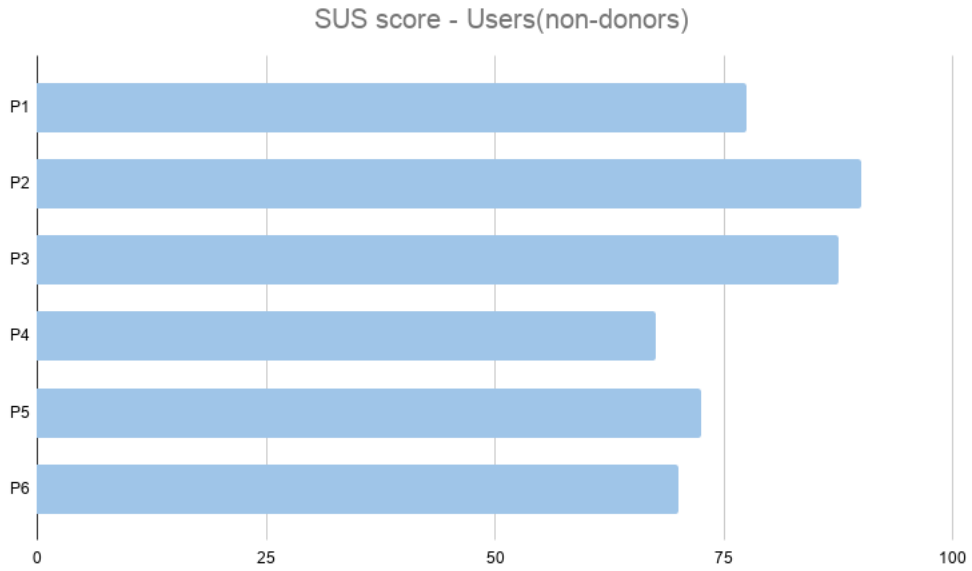


Figure 8.4: System usability scale result for non-donors

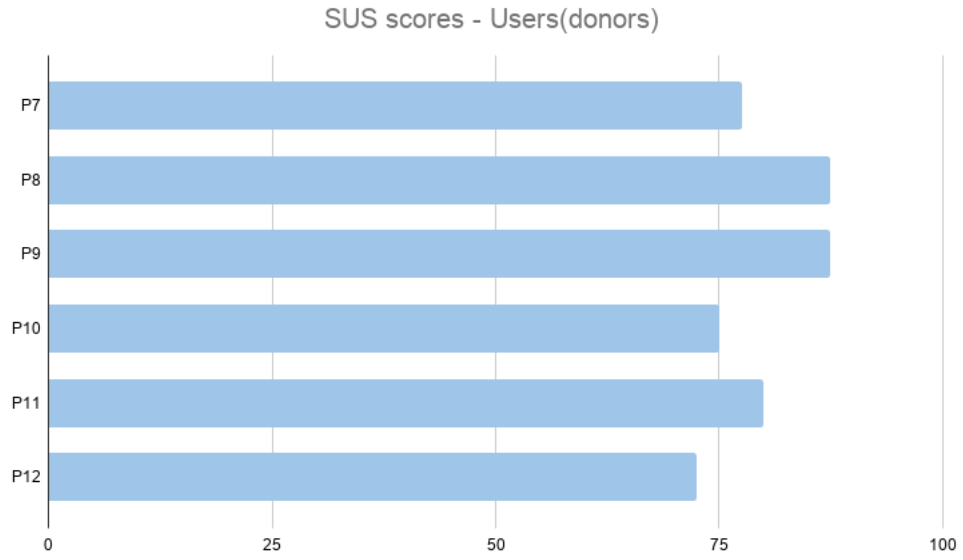


Figure 8.5: System usability scale result for donors

8.3.2 SUS with experts

The usability experts took the SUS evaluation in the third design iteration. Their score ranged from the lowest being 77,7 and the highest being 90. The average score for the usability experts were 86 points, above 80.3 is considered as excellent or a grade A. The experts individual score can be seen in figure 8.6.

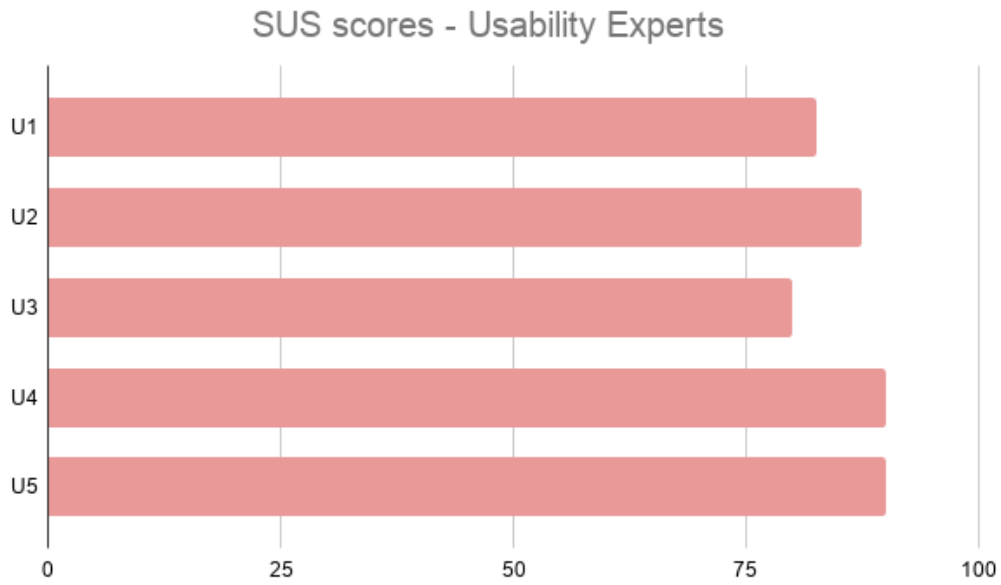


Figure 8.6: System usability scale result from usability experts

8.3.3 Comparing SUS test results

A total of 17 participants were used to measure the usability of the application. The second prototype ended up with a score of 78,7 points, and the third prototype ended up with a total of 86 points. Both scores are over average, and the score was improved significantly from good to excellent between iterations.

8.4 Nielsen's Heuristics

Nielsen's Heuristics was the last step in the iteration process and the evaluation of the final prototype. The evaluation was conducted by the same five usability experts participating in the usability test and SUS. The experts got a link to the final high-fidelity prototype, ten heuristics that would be evaluated and instructions/documentation. The heuristics was rated from the number 1 to 10, where 1 was the worst and 10 was the best. Figure 8.7 displays the overall result.

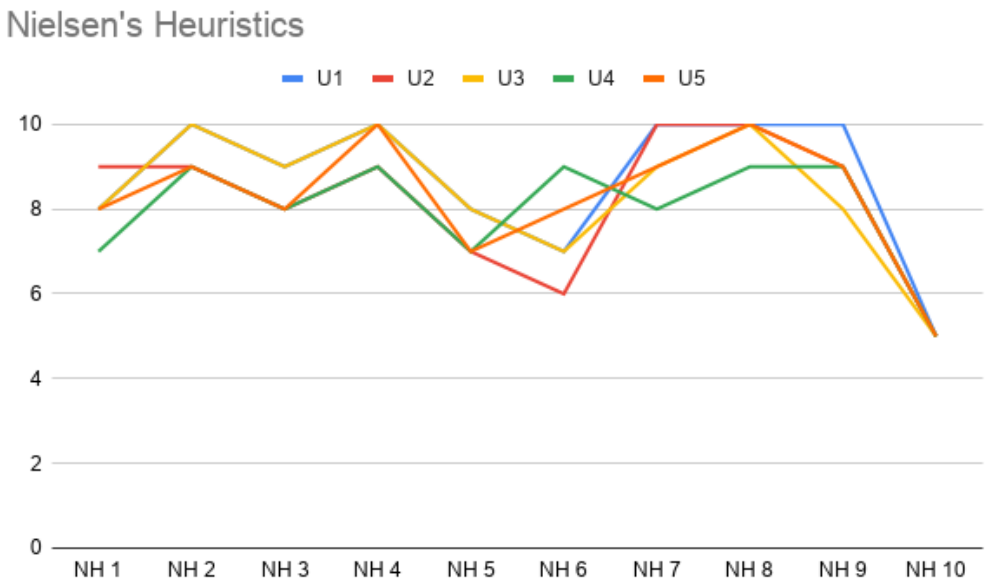


Figure 8.7: Nielsens's heuristics result from usability experts

8.4.1 Heuristic evaluation summary

The overall results from the evaluation is regarded as good, with a couple of suggestions for improvement. The feedback on each heuristic and comments from the experts are summarized in the list below:

1. *Visibility of System Status* The users get appropriate feedback, but experts pointed out that it

2. *Match Between System and The Real World* There were enough real-world words, concepts and conventions implemented in the application. The experts felt that the language were appropriate and that the application followed a natural order that was easy for the user to understand.

3. *User Control and Freedom* The user are presented with enough exit points and possibilities to leave unwanted situation. However, the experts noted that the application did not support any undo or redo functions. It was suggested to implement these at a later stage.

4. *Consistency and Standard* The application were consistent and followed platform conventions.

5. *Error Prevention* Sufficient error prevention was implemented where needed.

6. *Recognition Rather Than Recall* Objects, actions and options are visible for the users. The experts pointed out, however, that it is easy to remember for people familiar with the process but harder for users new to the process.

7. *Flexibility and Efficiency of Use* There are sufficient shortcuts, and the flow of the app makes it easy to use for borth experienced and inexperienced users.

8. *Aesthetic and Minimalist Design* The application has a minimalist design, it does not show irrelevant and redundant information. Experts agreed the design was aesthetically pleasing and modern.

9. *Help Users Recognize, Diagnose and Recover from Error* Error messages was presented in plain language, no code, that was easily understandable for the users. It also indicates the problem and suggest a solution.

10. *Help and Documentation* The application had no help or documentation implemented. The experts suggested making onboarding pages for new users.

Chapter 9

Discussion

This chapter discusses the methods and the four design iterations through which the prototype was developed. It reflects on the different methods used and answers the research questions.

9.1 Methods

9.1.1 Design Science Research

The design science research framework was used throughout the research project. Design science enabled the research project to conduct proper research by applying methods that fit the problem domain. The checklist in table 4.1 was used during the development to ensure that all the key elements in design science research were met. Each item in the checklist will be answered and elaborated upon in the section below:

What is the research question (design requirements)? Research questions (section 1.1) and requirements (section 5.4) were established early in the process. The research questions were formulated to fit the problem domain and bring new insight to the field in addition to being relevant and help the intended users. The requirements were established to be relevant for the intended user group along with the design solution. Furthermore, the early establishment of both questions and design requirements proved useful for the creation of different design solutions when moving from one cycle to the next. The design solutions that emerged at the end of these cycles proved to be useful for new- and existing blood donors.

What is the artifact? How is the artifact represented? This research has produced a high-

fidelity prototype (chapter 7) resembling a mobile application that was developed through four design iterations. The prototype has been designed with specific set of requirements and principles in mind. The artifact is represented as an interactive prototype built in Adobe xD. The features in the app includes medical knowledge in regard to blood donation, human behaviour theory and gamification to engage and motivate the blood donors.

What design processes (search heuristics) will be used to build the artifact? There were several design processes used during the research project; user-centered design, interaction design life-cycle, design principles, usability goals and Nielsen's heuristics. The main focus was on the user-centered design process(section 4.3), closely overlapping with both IxD life cycle(section 4.4) and design science research(section 4.1). The design principles, usability goals and Nielsen's heuristics were also applied upon building the artifact.

How are the artifact and the design processes grounded by the knowledge base? What, if any, theories support the artifact design and the design process. To form a knowledge base first literature review(chapter 2) was conducted to get an overview and collect data of existing literature and medical theory. Conversation with a knowledgeable organisation gave information about the problem domain and how the situation is looking today. Interview with both sides of the intended user group gave information and formed the basis for the requirements. Intended users together with experts evaluated the artifact at the end of each design iteration(chapter 8).

Which evaluations are performed during the internal design cycles? Which design improvements are identified during each design cycle? The evaluation performed during the design cycles was based around building different design solutions and getting feedback and/or evaluate in iterations before reaching the last and final product. There were three main methods used for evaluating the product; system usability scale, usability testing and Nielsen's heuristics. One, two or a combination of the different evaluation methods were used at the end of each iteration. Design specific problems were identified and improved, they are elaborated upon in chapter 6 and 8

How is the artifact introduced into the application environment and how is it field tested? What metrics are used to demonstrate artifact utility and improvement over previous artifacts? The artifact was tested using different methods; usability testing, system usability scale and Nielsen's heuristics. The metrics that was used were specific to the method itself, mostly based on task completion in seconds or returning a calculated score. Information

leading to improvement of the artifact was feedback from interviews, results from usability, SUS and case study. Metrics from the different test can bee seen improving from iteration to iteration(chapter 8).

What new knowledge is added to the knowledge base and in what form (e.g., peer-reviewed literature, meta-artifacts, new theory, new method)? It has contributed to the knowledge base in the field of medical informatics in the form of a master thesis documenting the research and an artifact. The artifact developed in this research is a high-fidelity prototype which was built according to the needs and wishes of both blood donors together with organizations in the blood donation system.

Has the research question been satisfactorily addressed?* The research question is answered at the end of this chapter (section 9.2).

9.1.2 Data gathering

Literature review

A literature review was done in the first iteration(chapter 2) the aim of the review was to gather data on existing research, and to get a better understanding of the theories and practices behind the research. The literature review showed that there was research done to investigate which motivational factors affected the blood donors, and how these could help the donation situation. However, it became clear that there was a need for more specific research on how IT technology could help the different aspect of the donation process. One of fact that kept recurring in the review was that especially young adults was less likely to sign up as a donor.

Semi-structured interviews

The semi-structured interviews were conducted with ten blood donors and ten non-donors, the aim was to collect qualitative data for the research project. User experience have been a central focus during the project, therefor the interviews proved to be an especially useful tool. The semi-structured interviews gathered information on the users experiences, preferences as well as useful discussions regarding a mobile application. This particular method made it possible to gather vital information directly from the source, namely the end user, which would have been hard to attain otherwise.

A total of 20 potential users were interviewed, where 10 of the users were currently donating blood. 10 males and 10 females in the age of 22 to 32. They provided useful insight into how the donors experience the process today. The participants made it possible to define and establish requirements, and gave useful insight into the potential functions needed. It is therefore reasonable to assume that the functions displayed in the prototype(chapter 7) would cover the users needs. The challenge would be to develop an application that can be of use for most donors. Ideally, a bigger set of users interviewed over a longer period of time would ensure a even better picture of currenet challenges and which functions would prove useful in regards of motivation and engagement. This could be done using a form of questionnaire to sample quantitative data, which would also give a better understanding of the situation. There was no formal interview with medical personnel in this research, only a conversation with a persons working for the Norwegian Red Cross who dose the most work of recruiting donors. An interview with medical personnel and employees working with blood tranfusion could uncover potential challenges and opportunities on how an application could be applied to benefit more than just donors.

Case study

The case study was conducted with four participants, two males and two females(section 4.2.3). They where observed as they used the app and explored the different functionalities, this gave a clear picture on how potential users would operate using the application. The participants gave feedback regarding the functionality, design, user preferences and usability.

9.1.3 User-Centered Design

The four phases of user-centered design was implemented in the research process. It proved to be a good method to help the development move forward. It is a process that relies on constant feedback and evaluation from the users, and helps the product to improve over the course of different iterations. The main goal of UCD is to ensure the users satisfaction when it comes to their preferences and needs.

9.1.4 Interaction design life-cycle

The interaction design life-cycle is based on four basic activities; establish requirements, design alternatives, prototyping and evaluating. The life-cycle has an overlap with both UCD and design science research. This method was also utilized to drive the project forward but

also to ensure the quality of the different iterations.

9.1.5 Design principles

The design principles was applied to the prototype early in the process to ensure the usability of the application. The five principles were reviewed in the second design iteration(section 6.4) where it was discovered that *constraints* was not well enough integrated. This was improved in the third and in the final design solution. The design principles were critical in order to ensure a user friendly and intuitive design which would secure a good user experience.

9.1.6 Usability goals:

As mentioned earlier, the focus during the development has been the user and their need. Five usability goals were presented in section 4.6 and has proved to be useful in order to secure the usability.

Effectiveness and efficiency The products effectiveness was demonstrated in the evaluation as seen in section 4.7. The usability test (table 8.3 and 8.4) and SUS(section 8.3.3) was conducted with both users and experts, task completion time was good and the final SUS score was considered excellent.

Safety: The product is designed to support the users, and the safety is perceived as good. This means that there are no known errors that enables the user to end up in dangerous- or undesirable situations.

Utility: The product provides utility; the application contains functionality and information that covers the users basic needs. The content is based on the different research methods applied, and includes functions based on feedback from the intended user group.

Learnability: Feedback provided from users and result from the evaluation suggests that learnability is achieved. The system usability scale has three questions 4, 7 and 10 that respectively points in the direction of how easy the system is to use, and that they would not need help from an expert to use the system.

Memorability: This is a more challenging goal to prove since memorability measures how

easy it for a user to remember the app after an inactive period with no use. Since the app is high on learnability, one can assumee that the user would have little to no problem using the application after a longer break.

9.1.7 Evaluation methods

Usability testing

The usability testing proved a useful method to test the overall usability of the application. The users and experts got seven different tasks they had to complete while they were being timed. All the participants managed to complete the test without interference or help, which gives a good implication on how easy the application is to understand. The only drawback from this was that the usability test had to be done over video call, this made it hard to observe and some data from the testing might have been lost.

System usability scale

SUS provides an evaluation method which is quick and easy and suitable for most artifacts. The system usability scale was conducted with 17 participants in total, 12 were defined as users and 5 as usability experts. It is important to note that the users tested the second prototype while the experts tested the third. The last SUS result ended up on 86 points, which is the equivalent of "excellent". However, despite the good results there are some improvements that could have been done. It was only one SUS test conducted on the third prototype, it would have been beneficial to evaluate with users at a later stage when the prototype had reached a higher fidelity. The reason behind this is that it most likely would have uncovered issues that the experts did not have.

Nielsen's heuristics

A heuristic evaluation was conducted using Nielsen's heuristics with five usability experts on the fourth and final prototype. The aim of the evaluation was to uncover if there were any potential errors in the final prototype. The experts discovered aspects of the application that could have been improved, none of the issues found were critical and due to time limitations were not fixed. All 10 heuristics were included in the evaluation, even though the last concerning "help and documentation" was not of relevance to the prototype at that stage. However, suggestions to improve the last heuristic was recommended, but at a later iteration. The overall results from the heuristics were considered good. Despite the fact that

heuristics are a popular and effective way of evaluating a system, there are still disadvantages. As mentioned, the experts can be blind to certain aspects that users find important. It would therefor be beneficial for the prototype to undergo further testing, especially with the intended users. This is to ensure that important problems have not been missed.

9.1.8 Prototype

The prototype was designed and developed through a set of iterations where both users and usability experts were involved. The development process used low-, mid-, and high-fidelity prototypes which proved useful for implementing new functions, visualization and for evaluating. The prototypes proved to be a crucial method when it came to rapid implementation of functionality and for receiving feedback from participants. Even though the application was tested by both users and experts, it is recommended to further test the artifact, especially by involving medical expert and more users. The finished artifact is still a prototype, meaning its not a fully developed system. The final prototype was made in Adobe xD and tested on a computer, since the prototype wants to mimic a mobile application but are unable to function with touch this might have affected the evaluations.

9.1.9 Limitations

The research project presents several limitations. As mentioned earlier, the prototype was supposed to resemble a mobile application. Due to constrains in the form of testing, most of the tests were conducted on computers with computer mouse and touch pad. It would be beneficial to test the system with a touch based system to see that all the modules work with the intended interaction. Another limitation is the lack of input from medical personnel and staff in the transfusion division. There were several attempts to reach out, but the transfusion division in Norway is very busy and hard to get a hold of. Ideally, interviews with experienced persons in the transfusion division would shed light on other challenges/solutions that was not considered in this project. Furthermore, the last evaluation of the system was done by experts. As mentioned this is not ideal since there might be problems present that the experts could not detect. More design iterations with design implementations and evaluations with users and medical personnel probably help improving the application accordingly.

9.2 Research question

RQ1 *How can a mobile application be designed to engage and support young blood donors in Norway*

Data gathered from literature review showed that research is constantly being conducted to understand how donors are motivated. The reason behind this is that many donors, especially young donors, lapse and reduce their frequency of donations. There are little research done as to whether IT technology and design has the ability to help and this particular problem domain. The purpose of this research was to see what possibilities a mobile application offered, and if it had any potential to keep donors engaged.

A total of 25 persons, current- and new donors, in addition to usability experts were involved in a user-centered design process to answer this question. Information from a literature review, conversation with the Norwegian Red Cross and interview with the intended users were formalised in to a set of requirements(section 5.4). Concepts were tested through a iterative process suggesting different design solutions(chapter 6). These were evaluated by both users and usability experts to ensure both usability and requirements(chapter 8). By adding the user-centered process, knowledge from fields like human behaviour, interaction design and gamification in addition to close collaboration with intended user. The result of this was a high-fidelity prototype that implemented five modules: *digital donor card*, *Appointments*, *Your blood*, *Impact*, *Blood journey*. Based on these results, one can assume that a mobile application can be designed to support and engage blood donors.

Chapter 10

Conclusion and Future Work

The goal of this thesis was to investigate whether the blood donation situation could be improved through the use of mobile technology by providing engaging and supportive design and functionality for new- and current blood donors in Norway. The Design Science framework was applied throughout the research project to help secure an artifact and to ensure its relevance, rigor, and quality. Based on initial feedback from the different cycles and the evaluation conducted by intended users and usability experts, the final results show a contribution to the knowledge base, and the results can be deemed as significant.

This Design Science research has contributed with a high-fidelity prototype resembling an application for blood donors in Norway. The application focuses on assisting blood donors with relevant and engaging information and wants to simplify the process from what it is today. A total of four iterations were carried out, where user requirements and user feedback were a crucial part of the development process. Ethical considerations such as confidentiality and privacy were met by obtaining approval from the Norwegian Centre for Research Data (NSD). Literature reviews, semi-structured interviews with users, and a conversation with the Norwegian Red Cross gave insight into the problem domain and helped establish a set of requirements that would be a central part of the final artifact. Based on these requirements, a set of design solutions were made, and the design concepts were tested. An application was built considering several concepts and solutions and was explored in different iterations. The first design solution was a low-fidelity prototype meant to rapidly test concepts using pen and paper sketches. Subsequently, the fidelity increased with the iterations and was tested and evaluated with both users and usability experts. An interactive high-fidelity was the result of the final iteration.

In addition, the Design Science framework, User-Centered design, has been a convenient

method to ensure close collaboration with users in which would result in a relevant and user-friendly application. Interviews with new- and existing donors were held to gather information in addition to discuss existing solutions. Based on input and feedback from these interviews, both a low- and a mid-fidelity was developed. Design principles were implemented early in the process to ensure an intuitive and user-friendly design. These solutions were then evaluated by the users using usability testing and SUS. The evaluation methods returned good results, both in success rate and calculated score. During the third iteration, a case study was conducted with the aim of gathering more specified information regarding the design solution at hand. A new evaluation was conducted with usability experts using usability testing followed by a SUS. The last SUS score was calculated to be 86 points and the equivalent of the top grade "A". The last design iteration was evaluated with usability experts using Nielsen's heuristics to identify problems associated with the usability of the application.

To conclude, this research has provided a good foundation for future development. Mobile application design for blood donors in Norway has the potential to engage and eventually increase the donor frequency amongst young donors. It is relevant because work is continuously being done to ensure that donors do not lapse and reduce in frequency, in addition to the constant need to facilitate new donors. This indicated that there is a need for a mobile application, which enables the support and engagement of donors.

10.1 Future work

Future development includes technical implementation of the different functionalities in order to make the application fully functioning systems. Ideally, the product should be enrolled as a test in the blood donation system to be able to further test and evaluate the concept of the application. In addition, medical personnel and staff at the different transfusions divisions should be involved to uncover challenges and solutions to possible problems that were not uncovered in this research. The application only addresses the donor's needs. It would prove useful to examine if any functionalities could help the other side of the process, which means the transfusion divisions and personnel working to ensure that we have enough blood products to support the medical system.

References

[1]

[2] Adobe studios, title = Kjøp Adobe Illustrator | Program for vektorgrafikk, u. . h. u. . .

[3] Audible. About Audible.

[4] Audible. What are stats and badges?

[5] Balsamiq. Balsamiq Wireframes - Industry Standard Low-Fidelity Wireframing Software.

[6] Bednall, T. C., L. L. Bove, A. Cheetham, and A. L. Murray (2013). A systematic review and meta-analysis of antecedents of blood donation behavior and intentions.

[7] Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability evaluation in industry*.

[8] Charbonneau, J., M. S. Cloutier, and É. Carrier (2016). Why Do Blood Donors Lapse or Reduce Their Donation's Frequency? *Transfusion Medicine Reviews 30*(1), 1–5.

[9] Deterding, S., R. Khaled, L. Nacke, and D. Dixon (2011). Gamification: toward a definition. *Chi 2011*.

[10] Dresch, A., D. P. Lacerda, and J. A. V. Antunes (2015). *Design science research: A method for science and technology advancement*.

[11] Ferguson, E. (1996). Predictors of future behaviour: A review of the psychological literature on blood donation. *British Journal of Health Psychology*.

[12] Ferguson, E., K. Farrell, and C. Lawrence (2008). Blood Donation is an Act of Benevolence Rather Than Altruism. *Health Psychology*.

[13] Ferguson, E., C. Murray, and R. E. O'Carroll (2019). Blood and organ donation: health impact, prevalence, correlates, and interventions. *Psychology and Health*.

[14] Flaticon. Free vector icons - SVG, PSD, PNG, EPS & Icon Font.

[15] Fogg, B. (2009). A behavior model for persuasive design. In *ACM International Conference Proceeding Series*, Volume 350, New York, New York, USA, pp. 1. ACM Press.

[16] fonts, G.

[17] fonts, G. Roboto - Google Fonts.

[18] Foth, M., C. Satchell, J. Seeburger, and R. Russell-Bennett (2013). Social and mobile interaction design to increase the loyalty rates of young blood donors. *ACM International Conference Proceeding Series*, 64–73.

[19] Foundation, I. D. What is Human-Computer Interaction (HCI)?

[20] France, C. R., A. Rader, and B. Carlson (2005). Donors who react may not come back: Analysis of repeat donation as a function of phlebotomist ratings of vasovagal reactions. *Transfusion and Apheresis Science*.

[21] Freepik. Free Vectors, Stock Photos & PSD Downloads.

[22] Gould, J. D. and C. Lewis (1985). Designing for usability: Key principles and what designers think. *Communications of the ACM*.

[23] Guiddi, P., S. Alfieri, E. Marta, and V. Saturni (2015). New donors, loyal donors, and regular donors: Which motivations sustain blood donation? *Transfusion and Apheresis Science*.

[24] Hamari, J. (2017). Do badges increase user activity? A field experiment on the effects of gamification. *Computers in Human Behavior 71*, 469–478.

[25] Helsedirektoratet (2013). Rapport: Blodgiversituasjonen i Norge: Forslag til tiltak som kan bidra til et bærekraftig tilbud for blodgivning. pp. 1–25.

[26] Helsenorge. Vil du bli blodgiver.

[27] Hevner, A. R., S. T. March, J. Park, and S. Ram (2004). Design science in information systems research. *MIS Quarterly: Management Information Systems*.

[28] Hubspot. The Definition of a Buyer Persona].

[29] Kasraian, L. and M. Maghsudlu (2012). Blood donors' attitudes towards incentives: Influence on motivation to donate. *Blood Transfusion*.

[30] Lazar, J., J. H. Feng, and H. Hochheiser (2017). *Research Methods in Human-Computer Interaction*.

[31] Lemmens, K. P., C. Abraham, T. Hoekstra, R. A. Ruiter, W. L. De Kort, J. Brug, and H. P. Schaalma (2005). Why don't young people volunteer to give blood? An investigation of the correlates of donation intentions among young nondonors. *Transfusion 45*(6), 945–955.

[32] Marvel, title = POP by Marvel - Turn sketches into iOS and Android prototypes, u. . h. u. . .

[33] Matthews, M. and G. Doherty (2011). In the mood: Engaging teenagers in psychotherapy using mobile phones. *Conference on Human Factors in Computing Systems - Proceedings*, 2947–2956.

[34] Newman, B. H., S. Pichette, D. Pichette, and E. Dzaka (2003). Adverse effects in blood donors after whole-blood donation: A study of 1000 blood donors interviewed 3 weeks after whole-blood donation. *Transfusion*.

[35] Norman, D. (2016). *The Design of Everyday Things*.

[36] Preece, J., Y. Rogers, and H. Sharp (2015). *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

[37] Rigas, A. S., A. Skytthe, C. Erikstrup, K. Rostgaard, M. S. Petersen, H. Hjalgrim, H. Ullum, K. O. Kyvik, and O. B. Pedersen (2019). The healthy donor effect impacts self-reported physical and mental health results from the Danish Blood Donor Study (DBDS). *Transfusion Medicine*.

[38] Ringwald, J., R. Zimmermann, and R. Eckstein (2010). Keys to open the door for blood donors to return. *Transfusion Medicine Reviews 24*(4), 295–304.

[39] Ruhi, U. (2015, aug). Level Up Your Strategy: Towards a Descriptive Framework for Meaningful Enterprise Gamification. *Technology Innovation Management Review 5*(8), 5–16.

[40] Ryan, R. M. and E. L. Deci (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*.

[41] Services, R. C. B. Blood Donation Process Explained.

[42] Sojka, B. N. and P. Sojka (2003). The blood-donation experience: Perceived physical, psychological and social impact of blood donation on the donor. *Vox Sanguinis*.

[43] Steele, W. R., G. B. Schreiber, A. Guiltinan, C. Nass, S. A. Glynn, D. J. Wright, D. Kessler, K. S. Schlumpf, Y. Tu, J. W. Smith, and G. Garratty (2008). The role of altruistic behavior, empathetic concern, and social responsibility motivation in blood donation behavior. *Transfusion 48*(1), 43–54.

[44] Studios, A. What is Adobe XD? | Adobe XD tutorials.

[45] Ullum, H., K. Rostgaard, M. Kamper-Jørgensen, M. Reilly, M. Melbye, O. Nyrén, R. Norda, G. Edgren, and H. Hjalgrim (2015). Blood donation and blood donor mortality after adjustment for a healthy donor effect. *Transfusion*.

[46] Usability.gov. Usability Testing .

[47] UXOMHA.

[48] Viar, M. A., E. N. Etzel, B. G. Ciesielski, and B. O. Olatunji (2010). Disgust, anxiety, and vasovagal syncope sensations: A comparison of injection-fearful and nonfearful blood donors. *Journal of Anxiety Disorders*.

[49] wikipedia. Scout badge - Wikipedia.

[50] Wikipedia. Steam (service).

Appendix A

A.1 Approval from NSD

NSD NORSK SENTER FOR FORSKNINGSDATA

NSD sin vurdering

Prosjekttittel

Mobile Application Design to Engage Blood Donors in Norway

Referansenummer

865751

Registrert

24.02.2020 av Sara Stegane - Sara.Stegane@uib.no

Behandlingsansvarlig institusjon

Universitetet i Bergen / Det samfunnsvitenskapelige fakultet / Institutt for informasjons- og medievitenskap

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

Ankica Babic, Ankica.Babic@uib.no, tlf: 4755589139

Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

Sara Stegane, sara.stegane@uib.no, tlf: 4794832151

Prosjektperiode

01.03.2020 - 01.08.2020

Status

28.04.2020 - Vurdert

Vurdering (1)

28.04.2020 - Vurdert

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet 28.04.2020 med vedlegg, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde:
https://nsd.no/personvernombud/meld_prosjekt/meld_endringer.html
Du må vente på svar fra NSD før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle særlige kategorier av personopplysninger om helseforhold og alminnelige kategorier av personopplysninger frem til 01.08.2020.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a, jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Kajsa Amundsen
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix B

B.1 Consent form

Forespørsel om deltagelse i forskningsprosjekt

"Mobile application Design to Engage Blood Donors in Norway"

Bakgrunn og formål: Dette studiet er en del av en masteroppgave ved instituttet for Informasjon- og Medievitenskap ved Universitetet i Bergen. Studiet søker unge voksne som allerede er blodgiver eller som har potensiale til å bli det. Fokusområdet til dette prosjektet er å se på om en mobilapplikasjon har potensiale til å motivere og tilrettelegge for blodgivere i Norge, hvilke insentiver har man for å være blodgiver, hvorfor er man ikke blodgiver, hvordan er prosessen og hva slags informasjon som er tilgjengelig.

Hva innebærer deltagelsen i studiet? Ved å delta i studiet, vil man hjelpe til med å tilpasse en applikasjon etter ens behov. Dette vil skje via personlige intervjuer, spørreundersøkelser på nett eller evaluering av prototype. Deltakelsen vil ikke ta mer enn i 60 minutter. Under intervju og evaluering vil det bli tatt skriftlige notater og om nødvendig vil det bli tatt lydopptak, dette gis beskjed om på forhånd.

Hva skjer med informasjonen om deg? Alle personopplysninger vil bli behandlet konfidensielt. Det er kun masterstudenten eller veilederen for prosjektet som har tilgang til personopplysninger. Personopplysningene lagres ikke direkte med navn, men vil bli anonymisert ved hjelp av referansenummer. Navnelisten med

kodenøkkelen vil oppbevares separat fra oppgaven og annet materiale, slik at det ikke vil være mulig å identifisere brukerne. Deltagere i studiet vil ikke kunne gjenkjennes i publikasjonen.

Prosjektslutt og data

Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er 01.08.2020. Eventuelle andre opplysninger som lydopptak vi slettes.

Frivillig deltagelse

Dette er er en frivillig undersøkelse og du kan når som helst trekke ditt samtykke uten å oppgi grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller hvis du ved en senere anledning ønsker å trekke deg.

Dine rettigheter

Så lenge du kan identifiseres i datamateriale, har du rett til:

1. Innsyn i hvilke personopplysninger som er registrert om deg
2. Rette på personopplysninger om deg
3, Slette personopplysninger om deg
4. Få utlevert en kopi av dine personopplysninge(dataportabilitet)
5. Sende klage til personvernombud eller datatilsynet om behandling av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitetet i Bergen har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

Masterstudent	Sara Stegane	948 32 151	sara.stegane@uib.no
Veileder	Ankica Babic	555 89 138	ankica.babic@uib.no
Personvernombud	Janecke Helene Veim	555 82 029	janecke.veim@uib.no

Studiet er meldt til Personvernombudet for forskning, Norsk senter for forskningsdata.

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ❑ å delta i intervju
- ❑ at mitt navn kan publiseres i oppgaven
- ❑ at mine opplysninger behandles frem til prosjektet er avsluttet

Signatur:_____

(Signert av prosjektdeltaker, dato)

B.2 Interviewguide donors

Intervjuguide for brukere som er donor

"Mobile application Design to Engage Blood Donors in Norway"

Eksempler på spørsmål:

Del 1, personalia:

Hvor gammel er du?

Kjønn:

- ❏ Kvinne
- ❏ Mann
- ❏ Annet

Er du student? Jobber? Arbeidsledig?

Del 2, blodgiver:

Er du blodgiver?

Hvorfor gir du blod?

Hvordan fant du ut at du kunne gi blod?

Hvor lenge har du gitt blod?

Hvor mange ganger?

Vet du hvor mange liter du har gitt sånn ca?

Hva er din motivasjon for å gi blod?

Hva er dine tanker rundt det å gi blod?

Benytter du deg av blodbussen eller sykehus?

Hva syntes du om informasjonen du får før og etter?

Hvordan er informasjonen du finner på nett?

Hvordan synes du blodbanken synliggjør seg?

Snakker du om blodgiving med venner/familie?

Er det noen i din omgangskrets som gir blod?

Visste du at Helse Bergen har kommet med en app for blodgivere?

Hva syntes du om denne?

Benytter du deg av webportalen for booking av blodgivning time?

Hva syntes du er vanskelig med prosessen slik den er i dag, førstegangs tapping, booking av timer, karantenetid osv?

Del 3, forhold til apper:

Bruker du noen apper?

Hvilke apper bruker du?

Har du noen apper som motiverer deg til diverse ting(gå x antall skritt, spise sunt, bruke telefonen mindre, slutte med tobakk/sukker, gjennomføre dagligdagse arbeidsoppgaver), eventuelt hva heter de?

Hvordan hjelper disse å motivere deg?

Hvor lenge har du brukt denne appen?

Kunne du brukt en app for blodgivere?

Ville du brukt appen til å finne informasjon om

- ❏ Booking av time
- ❏ Blodreise (se hvor i løpet blodet befinner seg)
- ❏ Personlig assistent
- ❏ Sjekke karanteneregler
    - ❏ Medisiner
    - ❏ Reise karantene
    - ❏ Sykdommer
    - ❏ Legeundersøkelse, tannlege, vaksine og operasjoner
- ❏ Melde seg opp som førstegangs giver
- ❏ Sjekke kriterier for å bli blodgiver
- ❏ Selvtest, kan jeg gi blod?
- ❏ Visualisering av din påvirkning som blodgiver(hvor mange liv du potensielt har reddet)
- ❏ Melding når blodet blir brukt
- ❏ Kontaktinformasjon

B.3 Interviewguide non-donors/app-users

Intervjuguide for brukere som ikke er donor

"Mobile application Design to Engage Blood Donors in Norway"

Del 1, personalia:

Hvor gammel er du?

Kjønn:

- ❑ Kvinne
- ❑ Mann
- ❑ Annet

Er du student? Jobber? Arbeidsledig?

Del 2, blodgiver:

Er du blodgiver?

Hvorfor gir du ikke blod?

Kunne du tenke deg å gi blod?

Hva stopper deg fra å melde deg som blodgiver?

Hva kan motivere deg til å gi blod?

Hva er dine tanker rundt det å gi blod?

Hvordan synes du blodbanken synliggjør seg?

Synes du det finnes tilstrekkelig med informasjon om blodgiver prosessen?

Er det noen i din omgangskrets som gir blod?

Visste du at Helse Bergen har kommet med en app for blodgivere?

Hva syntes du om denne?

Del 3, forhold til apper:

Bruker du noen apper?

Hvilke apper bruker du?

Har du noen apper som motiverer deg til diverse ting(gå x antall skritt, spise sunt, bruke telefonen mindre, slutte med tobakk/sukker, gjennomføre dagligdagse arbeidsoppgaver), eventuelt hva heter de?

Hvordan hjelper disse å motivere deg?

Hvor lenge har du brukt denne appen?

Kunne du brukt en app for blodgivere?

Appendix C

C.1 Case study

Case Study - Donors	*C1a*	*C2a*
Color	Really like the colors, the colors are harmonious and calm.	Enjoys the light blue, reminds me of my doctors office.
Font style	I like the font, it is very clean and minimalistic.	No specific opinion, looks ok.
Text size	It is easy to read, I think the size is right.	OK, easy to read.
Icons	Pretty design, looks good and are easy to understand.	I immediately know what they indicate, minimalistic design.
Illustrations	I really enjoy the illustrations.	The illustrations look good, nice colors.
Information quantity	Seems to be enough information, I can't think of anything I am missing.	Just enough information, it is not too overwhelming.
Motivational factors	I already give blood on a regular basis. But I like the information included and illustrations, it is great to see my contribution matter. This kind of give me a "stronger bond" to the cause.	I really enjoy collecting badges, I would really enjoy watching and collecting my badges. It is also cool to look at my impact, how many lives I save etc.
Usefulness	I find this app very useful. I would probably use it before my blood donation appointments.	It has a lot of useful functions, I would probably use the app.
Dislikes	I can't really think of anything.	I was not a fan of the big "message" box at the homepage. It takes up a lot of space, I don't get messages from the hospital that often.
Improvements	The list with functions on the homepage is a little long? Try and compress them so they are displayed without having to scroll.	I would make the message box smaller, and maybe display something fun like a couple of badges on the front? Maybe this will keep the donors motivation up?
Other	I really enjoyed the app, I think it has great potential.	Nothing to add.

Case Study - non-donors	*C1b*	*C2b*
Color	Colors are nice.	I like the colors, it is very clean looking.
Font style	Easy, clean font.	Nice font, like that it is very minimalistic.
Text size	I am not sure, I think it is fine.	The font size looks appropriate, it was easy to read.
Icons	I really like how the icons look, easy to understand.	Pretty icons, very readable.
Illustrations	I enjoy the illustrations	Pretty illustrations, I like the “calm” colors.
Information quantity	Looks like the right amount of information, not too much not too little.	I don’t miss anything, nothing seems overwhelming.
Motivational factors	I have thought about giving blood many times, I think this could help me see the benefits.	I think there are a good mix of motivational factors.
Usefulness	I think this app has potential, I think I would find it useful if I was a blood donor.	Its useful.
Dislikes	Can’t think of anything.	Nothing.
Improvements	Nothing.	The first thing you see is the homepage, maybe add something motivational so you see it when you open the app.
Other	Nothing.	Nothing.

Appendix D

D.1 SUS - System Usability Scale Form

System Usability Scale