Alias

Developing a cross-platform application for creating personalised comics aimed for the Children and Youth Clinic at Haukeland University Hospital

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Abstract

To be written.

Acknowledgements

To be written.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 About the thesis

This thesis describes an application development project that was held from August 2018 to December 2019. The project supervisor, Carsten Helgesen, proposed the project as a continuation of a bachelor project from the spring of 2018. Both of these projects aim to facilitate non-verbal communication and to visualise information and emotions.

Around middle of 2018, the project gained interest at the Children and Youth Clinic at Haukeland University Hospital. Ideas for the project have been discussed since then with senior consultant psychiatrist Paul Joachim Bloch Thorsen.

1.2 Motivation

Hvorfor, hvilken nytte det vil ha

1.3 Problem description

Information that is handed out at most hospitals

Mange informasjonsbrosjyrer, ikke tilpasset

> Age-appropriate interactive technology can be used to promote young children's understanding and to facilitate their situated participation in healthcare situations Stålberg et al., 2018

1.4 Research question and expected results

Research question:

> How can national guidelines - pakkeforløp - be made more personalised towards children and youth at hospitals?

The problem area was presented first and foremost by the Children and Youth Clinic. During meetings, Thorsen stated that they wanted to improve the ways of which children were informed about upcoming procedures. Currently, the information that is given here is primarily textual and of varying interest for younger patients.

At project completion, the desired result is a functional prototype (?) that can be developed further on by Helse Vest IKT. Given the positive outcome of E-LAN (see 2.2), it is anticipated that the application will be used among children at the clinic.

Since the clinic has planned a bigger project involving the use of avatars and comics, the outcome of this project will become an indication of whether it is valuable to invest in it. This project will also provide useful knowledge that may come in handy for an eventual succeeding project.

1.5 Thesis outline

The thesis is structured as follows: Chapter 2 describes relevant terminology and the theoretical foundation while giving an insight into preceding projects. The development process is detailed out in its entirety in Chapter 5. This development is then evaluated in Chapter 6 while Chapter 9 concludes the project and discusses further work.

Chapter 2

Background

2.1 Preceding projects

This project builds upon experience from a bachelor thesis named *PictogramApp* which was based on another project named *Pictogram-me*.

2.1.1 Pictogram-me

Since 2011, associate professor in graphic design Linda Lien and professor in visual communication Ashley Booth have researched on creative usage of pictograms. A pictogram, also called a pictograph, is a simplified figure that resembles and represents a physical object. They vary in shapes and sizes, but they are ultimately designed in a way that make them easy to interpret and understand their symbolic meaning.

Lien's and Booth's artistic research project, named *Pictogram-me*, experiments how pictograms can be used to express complex social messages (Lien and Booth, 2018). The aim is to illustrate challenging situations that people who have a difficult life may endure. Despite pictograms being flat and simplified, Lien and Booth wanted to show how pictograms also can visualise difficult topics and promote empathy.

Pictogram-me presents a new set of pictograms that are designed for the purpose of the project. In addition, the project has resulted in various concepts including

- *PictoBooth*, a photo booth that translates the body and gestures into real life pictograms,
- *PictoFont*, a symbol typeface consisting of various pictograms, and
- *PictoTheatre*, a small-scale theatre where pictograms can be arranged on a scene. A tablet can be placed behind the scene and function as a background as illustrated in 2.1.

2.1.2 PictogramApp

In 2017, the Western Norway University of Applied Sciences issued out a bachelor project in collaboration with Linda and Booth, with the purpose of creating a smartphone application. The application, which was later named *PictogramApp*, was meant to be a digital version of PictoTheatre where pictograms can be arranged on the screen and form visual messages in a mobile manner (Fure et al., 2017). The application allows users to place pictograms in context in order to create their own stories – see figure 2.2. PictogramApp was targeted towards the Church City Mission, a voluntary organisation which offers help and services for people living near the street. A functional prototype of the application was released in June 2017.

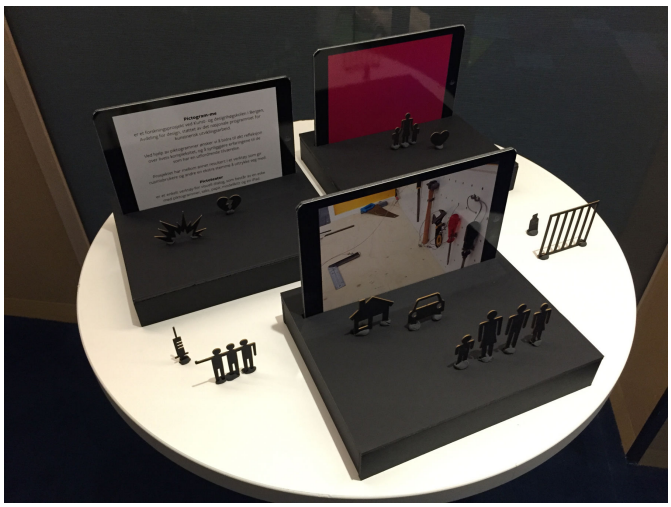
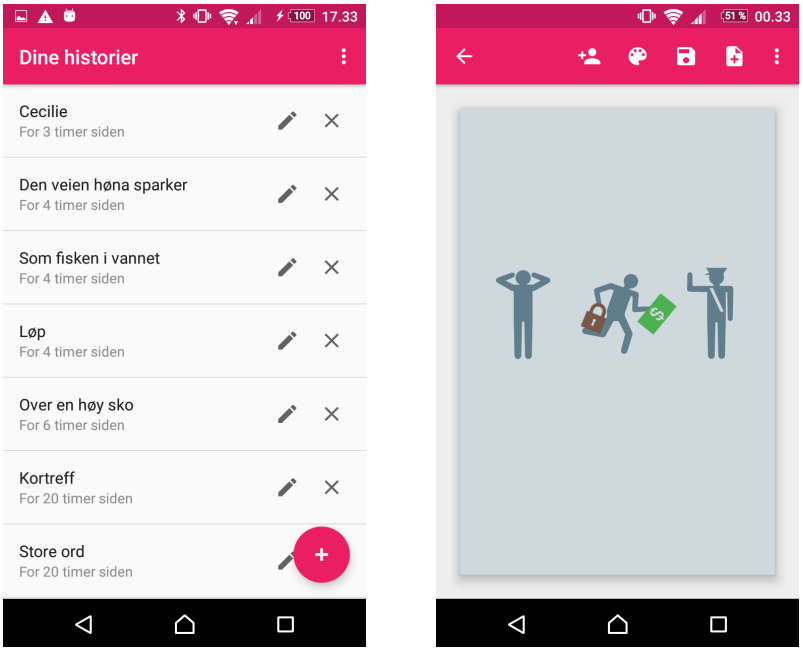


Figure 2.1: PictoTheatre, shown at the 2016 RØST conference in Bergen



(a) List of stories (b) Scene editing

Figure 2.2: Screenshots from PictogramApp

2.2 Related work

The Children and Youth Clinic has prior to this project experimented with different ways to engage their patients. Among these was an e-sport event named *E-LAN*, held in the end of October 2018. The purpose of this event was to connect gaming towards a healthy lifestyle and to let children and youth master various areas of interest. As a part of this initiative, an avatar generation system was created that let users create personal avatars which represent themselves. Each user would then carry their avatar in a name tag attached on their clothing. The software seems to run on Windows with support for a web client, and outputs two-dimensional portrait pictures.

Several applications and prototypes have been made that aim to provide information about and illustrate a child's hospital stay. A notable example is *IACTA*, short for *Inter-Active Communication Tool for Activities*. This application ()...) (Stålberg et al., 2018).

Another example is an inpatient portal application named *MyChart Bedside*, developed by Epic Systems Corporation for tablet devices. A study conducted by Kelly et al. (2017) revealed that 90 percent of children's parents were satisfied with the portal.

Bitmoji

Instruction videos used by Norwegian on their airplanes

2.3 Hospital settings and terminology

Given that the application will be used in a hospital setting, the associated terminology will be extended to the application. A *procedure* is a sequence of steps separated from each other. Each *step* contains a background, an avatar and elements related to the procedure in the form of illustrations or pictures, and may feature interactive as well as non-interactive elements.

Story - scene Comic strip - panel Procedure - step

2.4 Litterature background

A number of queries were performed on academic literature search engines in order to discover related work and gain further insight in the problem area. Each query contained a set of the following keywords:

- Hospital
- Patient
- Pediatric
- Children
- Information
- Informative
- Interactive
- Understanding
- Comprehension
- Engage
- Cartoon
- Comics
- Illustrations
- Personalised

Chapter 3

Methodology

This project functions as a pilot study in preparation for a bigger project held at the clinic. It is also an explorative study as it may discover new ways to communicate between patients and the hospital, possibly replacing the current way of informing patients. This allows the clinic to run a small-scale project and see how the application compares to the existing system at an early stage with reduced investment and costs.

The development will focus on iterating over designs and prototypes in a user-centered manner. Using this method, potential users and stakeholders will be able to try out the design throughout various phases of its development. This user testing may consist of focus groups and uncontrolled experiments, and the gained experience can be applied in the next development stage. In our case, the testing will be restricted to the internal group at first, but a designated test group will be created once the design evolves into interactive prototypes.

3.1 Evaluation

The final prototype will be evaluated by a usability test. A group of X users will be invited to test and evaluate the application. The users will be handed an interactive prototype and asked to perform certain use cases. In addition, the users will give their impressions of the system through a semi-structured interview. The project is deemed to be valuable if the users find the application to be more informative and engaging than the current system.

"informing", "ease of use", "trustability" and "fun"

3.2 Design process

Iterative

For hver iterasjon - Hva er problemstillingen? - Hvilken tilnærming til løsningen skal prototypen ha? - Hvordan er det levert? - Hvordan det er testet/testresultater

- Double Diamond approach: solve the right problem

https://www.designcouncil.org.uk/news-opinion/design-process-what-double-Diamond

Må utforske mye før man fokuserer inn på problemstilling - utforskningen er iterativ

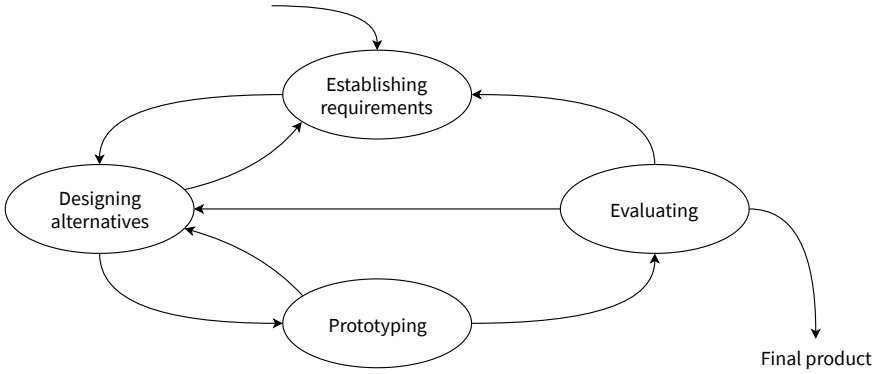


Figure 3.1: Interaction design lifecycle model

3.3 Interaction design

Preece et al. (2015) developed a lifecycle model for interaction design that could prove to be useful for this project. This model is shown in 3.1

3.4 Prototyping

3.4.1 Prototyping tools

Pen and paper

Online prototyping software

Marvel

Figma

Chapter 4

Planning the design

This chapter deals with the initial planning of the design, where the most important factors are considered.

4.1 Inspiration

The PictogramApp application, of which the master project will primarily be based on, allows users to create their own *stories* consisting of an arbitrary number of *scenes*. These concepts can be applied to the new application, though they will be named as *procedures* and *steps* respectively.

4.2 Requirements

The first step of the interaction design lifecycle is centered around establishing requirements. This involves having a dialog with the client, getting an idea of what they expect and correcting the requirements if they change. Preece et al. (2015) lists out two aims of a requirement activity:

> One aim is to understand as much as possible about the users, their activities, and the context of that activity, so the system under development can support them in achieving their goals. Building on this, our second aim is to produce a set of stable requirements that form a sound basis to start designing.

The initial requirements were formed after a meeting with Helgesen and Thorsen. These are divided into functional requirements which describe what the application should do, and non-functional requirements which tell something about constraints of the application and its development.

4.2.1 Functional requirements

SCP wishes to have an application where the user can view personally targeted procedures. These will feature the user's own personal avatar along with information about an upcoming procedure at the hospital. Afterwards, the user should be able to rate their experience, and if possible, this rating should be reflected when the procedure is shown in retrospect.

4.2.2 Non-functional requirements

The clinic expressed that they intend to use the application on larger screens akin to tablets.

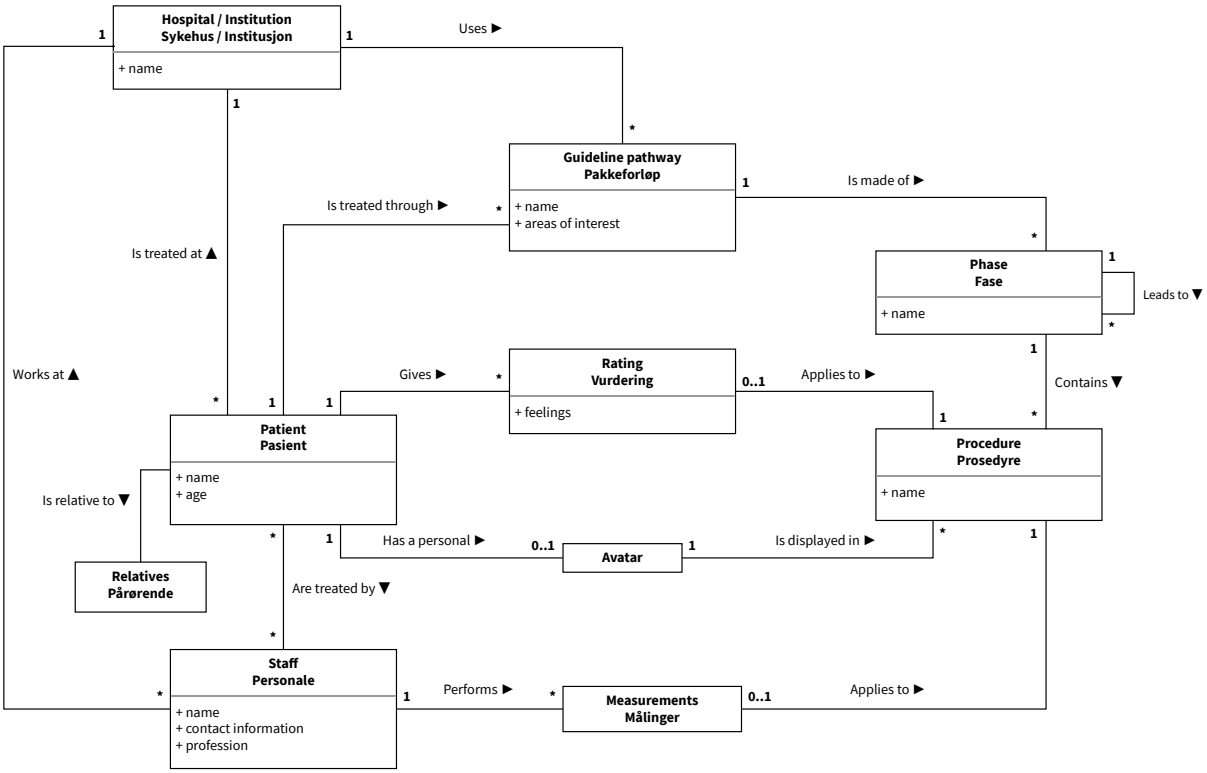


Figure 4.1: Domain model

4.3 Target groups

As the requirements reveal, the application is intended for several users. It is therefore important to know who these users may be. For this project, these users are described in form of target groups.

The primary target group will be children and youth at the clinic with ages raging from 5 to 12. The content of the application must therefore be adapted to the target group and be suitable for their age.

The second target group will be the staff at the clinic. This includes physicians, practicioners, consultants, medical assistants and other people working with healthcare.

A third target group is relatives and parents of patients. This group is worth considering as they do have an influence for the patient's stay. In fact, parents contribute to decision-making for most children.

An essential plan when it comes to the design of the application is to let children of the intended age group test it in various stages of its development. Their input is valuable since it can contribute to making the application age-appropriate (Stålberg et al., 2016).

4.4 Domain

The domain of the application is mostly related to healthcare.

A class diagram of the domain is shown in figure 4.1.

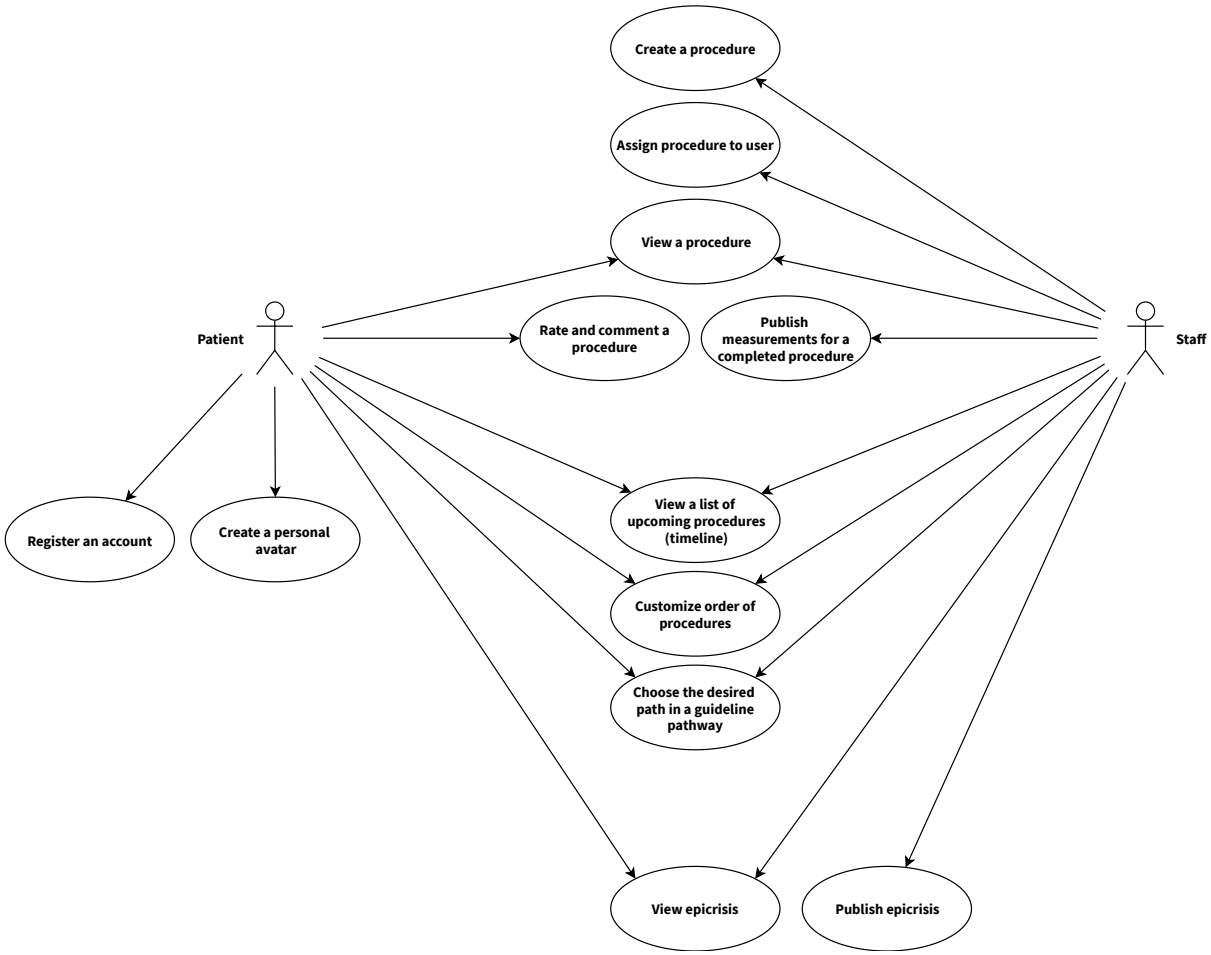


Figure 4.2: Use case diagram

4.5 Use cases

An use case diagram is shown in figure 4.2. Some use cases may be grouped together, such as Related use cases are grouped together

Chapter 5

Iterating the design

Once the requirements are established, the iterative process of the design development begins. Each iteration works as a distinct step towards the final design of the application, from bare-bone paper sketches to high fidelity prototypes.

5.1 Iteration 1: Paper sketches

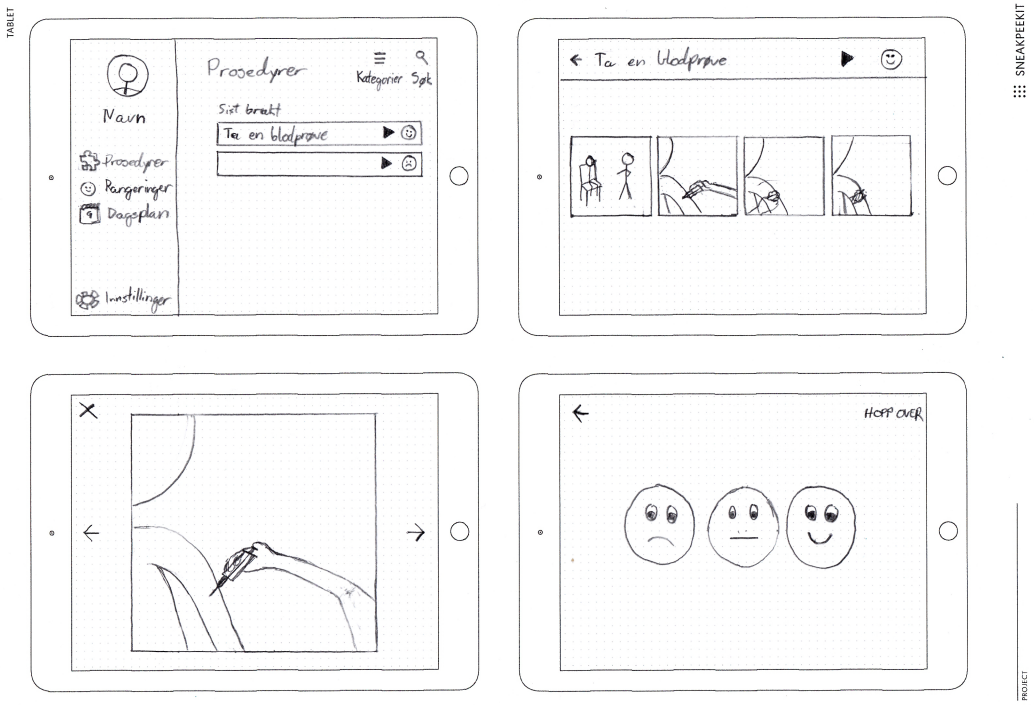
The version made in the first iteration is also the simplest, made with pencil and printed sheets of paper. It illustrates two sides of the application: in the first, the user enters a procedure and evaluates it (figure 5.1a), a common use case in this application. The procedures are shown in a *previously used* list, showing the smiley if rated. Each procedure can be viewed as a cartoon comic with a horizontal, scrollable sequence of frames. The user will be able to scroll across the whole procedure from left to right and to put each frame in focus, essentially becoming a step-to-step tutorial. This is a good way to get an overview of the procedure on its own, but it provides less interaction than if the user would, say, walk through the steps in a game-like approach. At the end of the procedure, the user is prompted to express their experience through use of smileys, a method proven to be quite successful (Stålberg et al., 2016). The rating system is very basic and simple to understand for children, containing only a sad, neutral and a happy face.

In the second side of the application, the sketches illustrate how a procedure may be edited by an authorized user (figure 5.1b). The process involves creating frames, inserting elements and modifying them. A toolbar is shown at the top with a varying amount of buttons, showing only the ones that are relevant for the current situation. Compared to PictogramApp, the interface is supposed to be more drag-and-drop oriented with possibilities to drag pages between each other. Another improvement is that elements must be clicked/tapped before they can be modified.

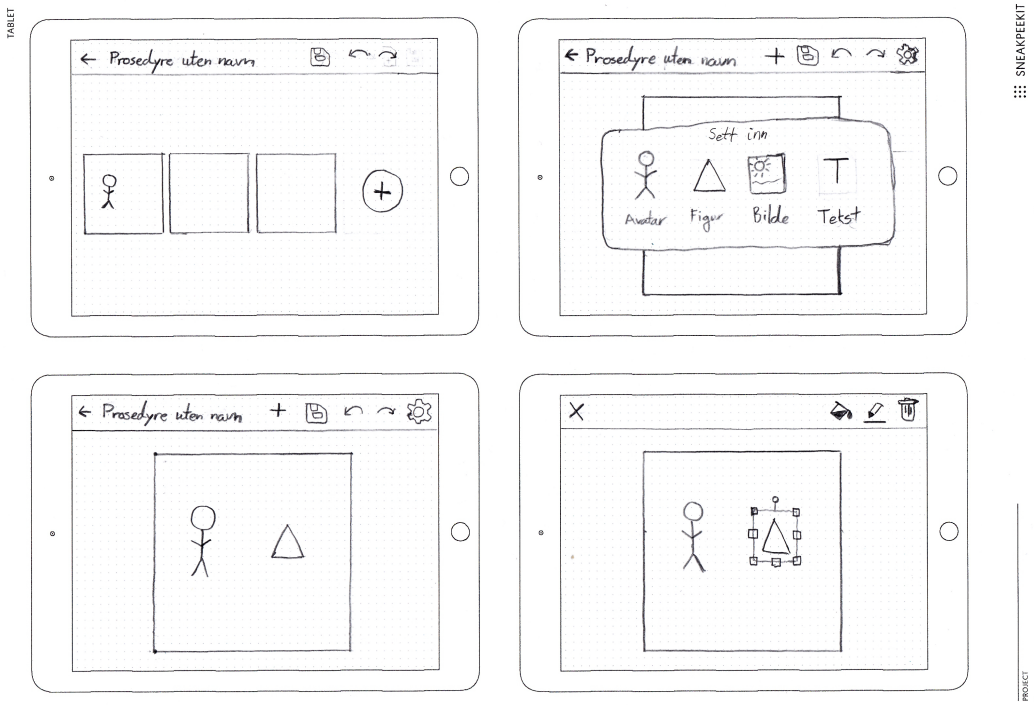
5.1.1 Considerations

The scope of the application had been partially accounted for at this stage. It was clear that the application would be used to inform patients about upcoming procedures and let patients rate them afterwards. However, it was not known whether it was intended to be used during procedures and in context with a health professional.

Children at this age have most likely been made known to tablets and interactive devices, but the youngest children of the target group may not have sufficient prior experience, either due to their age or health-related issues or a combination of both. Less experienced users should be able to learn how to use the application quickly regardless. It is therefore a good idea to consider ways to inform and possibly demonstrate the user about possible ways to interact with the application.



(a) Viewing a procedure



(b) Editing a procedure

Figure 5.1: Sketches of the first design

These initial ideas to the design will only give an indication of the final visual style of the application. Depending on the feedback of the test groups, the style should be one that the users feel more interesting. Some possible visual styles include a modern and minimal approach with focus on essential elements (similar to PictogramApp) and a more cartoonish, fun style with drawing-like pictures and an informal look. The choice of style should keep the users in mind;

5.1.2 Analysis

This design is made entirely in landscape mode, that is, with the device laying on its longest side. This felt natural when considering the application layout – especially how procedures are displayed. For future iterations it might be beneficial to primarily design for portrait mode, with the device laying on the shorter side. This will make it easier to port the application to smartphones, and it will follow the flow as the majority of current applications are based on portrait mode (with no support for landscape views).

As previously stated, the rating system shown here is very simple with three distinct options. It was pointed out that a problem here is that this system does not portray what exactly the user is feeling if things are not great. A sad face can represent a lot of feelings, but this information can not be extracted afterwards.

The editing part of the design is also imagined through a touch interface. The main question is whether the intended target group, the medical staff, is willing to use a tablet application for a key use case. Many physicians and health professionals use personal computers at their offices daily, and having to use a tablet—that they might otherwise not need—could possibly reduce their efficiency.

5.2 Iteration 2: Form study prototype

The second iteration yielded a form study prototype, a prototype with more focus on geometry and less focus on colours and detail. It shares many similarities with a wireframe. The prototype is also the first one made with a digital prototyping tool, allowing a higher fidelity despite the simplicity in the current design.

Contrary to the first prototype, this is designed for portrait mode. It keeps the two-folded design of the home page, with a collapsable hamburger menu on the left and a list of procedures on the right as shown in figure 5.2. Procedures may be filtered by their category such as *treatments* and *conversations*.

Procedures are shown frame by frame in this design. Each frame may also have a description that can provide useful information about each step and increase the sense of safety for the user. At the bottom is a small overview of the frames in the procedure, making the user aware of their process.

The prototype also features screens of a procedure containing a video. Two possibilities were considered; one where the video is fitted in a similar way to the procedures that contain images only (figure 5.4a); and another where the video is resized to fit the entire width of the screen (figure 5.4b). In the end, the latter may work as a fullscreen mode and act as a supplement to the first design.

Lastly, the rating part has been extended from three smileys to nine emojis, featuring feelings such as *delighted*, *tired* and *surprized* (figure 5.5). The new emojis are placed in a tappable grid, and tapping on an emoji turns its background green. Once the user has rated a procedure, the feelings that have been ticked will be shown on the respective procedure on the home page.

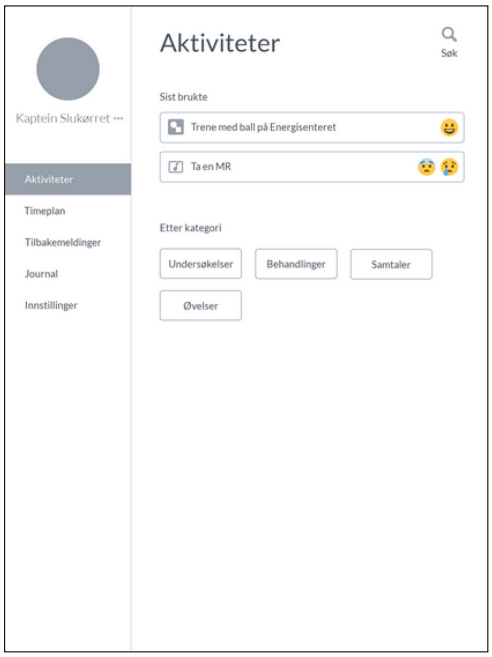


Figure 5.2: The home page

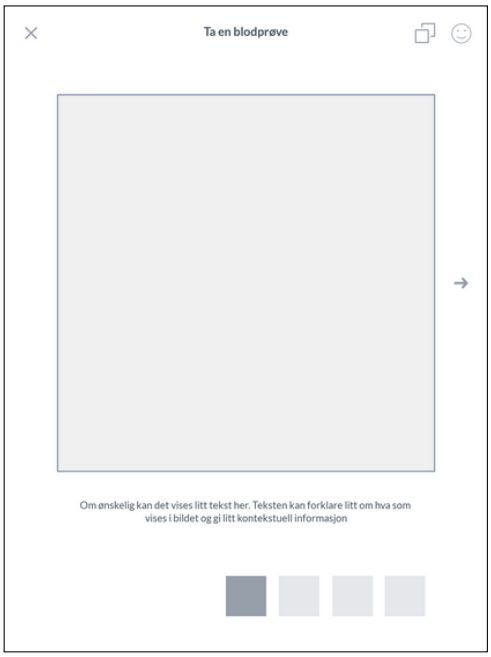
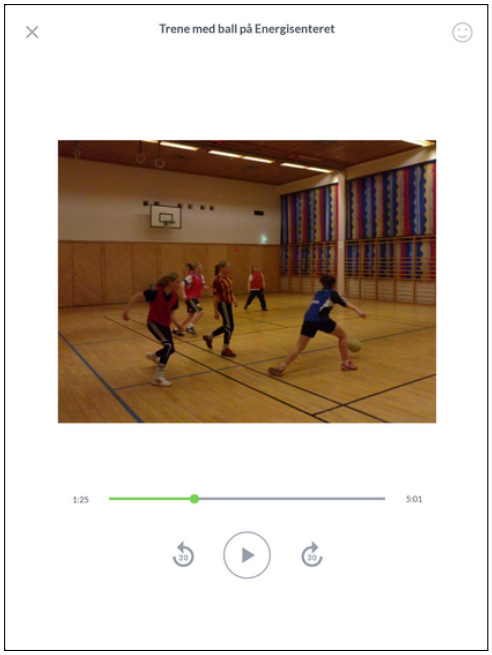
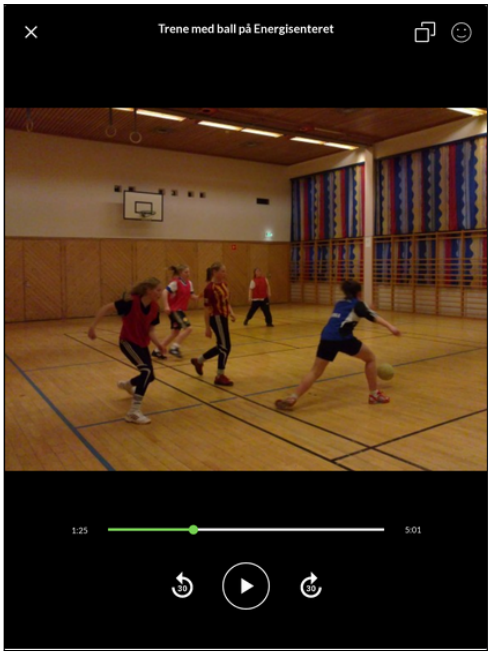


Figure 5.3: A single frame of a procedure



(a) Viewing a video



(b) Viewing a video in fullscreen

Figure 5.4: Two ways to view a video

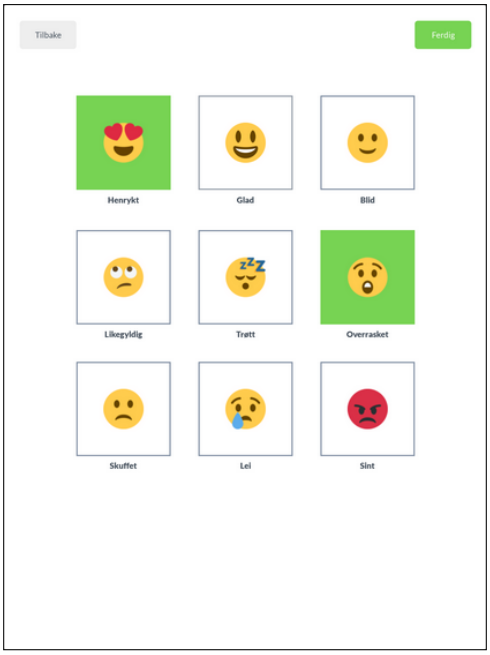


Figure 5.5: An emoji grid

5.2.1 Analysis

Both video procedures feature media controls to administer the video playback. Whether these buttons are neccessary ultimately depends on the video format. If the video is a local file, then dedicated buttons are indeed necessary. However, if it is determined to use YouTube embeds for videos, then such buttons may not be needed as the embed includes them.

Questions were raised if whether it was necessary to include emojis that closely resembled each other, such as both *glad* and *blid* which both translate to 'happy'. There was also skepticism if whether *indifferent* qualifies as a feeling. If need be, it would be possible to express indifference by not tapping any emojis. Basically, the current rating system seems to be a bit unnecessarily complicated.

5.2.2 Considerations

After showing this prototype, Thorsen presented their way of rating feelings at the Children and Youth Clinic. This method involves the five feelings *happy*, *sad*, *anger*, *fear* and *disgust*, each with a scale that measured the amount for each feeling. In addition, there is a scale for *sense of achievement*, i.e. to which degree the patient feels they have mastered the activity and achieved something of it.

5.3 Iteration 3: Small extension

The third iteration, albeit a less extensive one, builds directly upon the previous iteration with a few enhancements. It focuses mostly on the home page and the rating page.

The home page shown in figure 5.6 is similar, but the elements are bigger and also in a grid layout. The bigger elements make space for a preview of the prototype, letting the user see how it looks like before opening it. The idea behind this is to make each procedure easier to recognize, as well as making it a bit prettier for the eye.

The rating system has again been reworked, and this time it uses five feelings (figure 5.7). Each feeling has a slider that measures the intensity of each feeling, and the more intense, the bigger the emoji

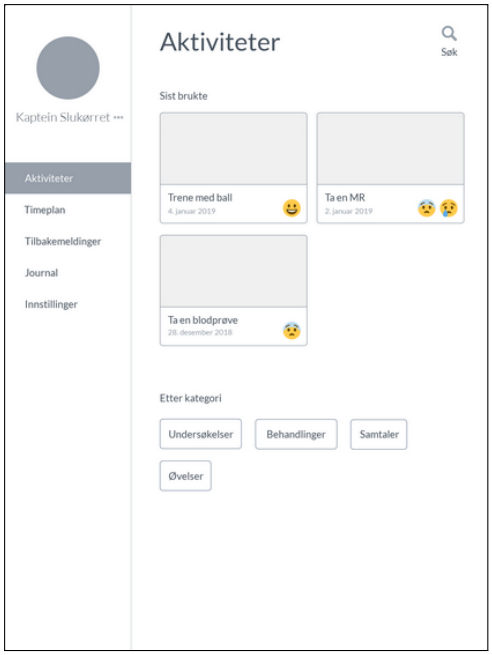


Figure 5.6: The home page with bigger elements

Figure 5.7: Five feelings with bars

grows. The new design also allows space for text that can help describing what each feeling represents. The feelings that are measured to be greater than 50 % will be displayed on the respective procedure – and that may be more than one feeling.

5.3.1 Analysis

The main issue here is that there is currently no concept of *timeline* in the design yet. There is an entry in the menu named *timeplan* which has not been considered so far. As it stands, the list of procedures here is quite loosely structured considering the use case *View a list of upcoming procedures (timeline)*. They are currently put in a last used list which can quickly change its order, whereas a timeline is a more rigid structure that does not change that easily.

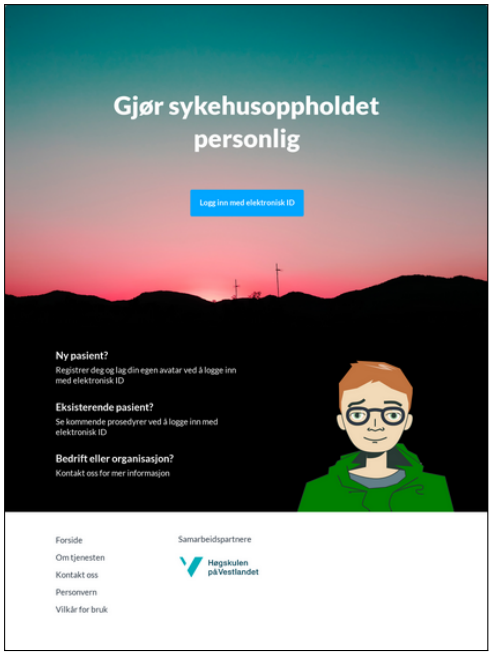
A procedure may also consist of several procedures. This has not been accounted for in this design, but a wish for *procedure groups* is present.

Although the new rating system is now more similar to the existing system used at the clinic, there are still things that can be improved. Among others, there is no initial indication of where you want to drag the sliders. There is also a tad too much whitespace and little context; what are these feelings for? What is the intention here? What happens when the user taps the *back* button?

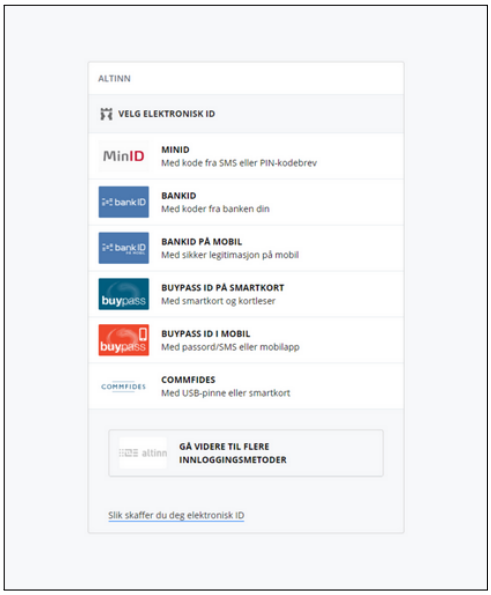
5.4 Iteration 4: Interactive prototype

The first interactive prototype is brought to life in the fourth iteration, with a focus on the user experience in its entirety. Although the layouts are mostly the same, the new design brings in a new look for many elements.

The experience starts at the doorstep, which in this case is the home page. The idea behind this is to have an informative, public page that any Internet user can view (figure 5.8a), along with an image of an avatar which is one of the main points in this iteration. A login step is required in order to view the user's sensitive data such as profile, timeline and procedures (figure 5.8b), and one of the sugges-



(a) A public home page



(b) Signing in using secure Norwegian authentication systems

Figure 5.8: The application before accessing sensitive data

tions since iteration 3 was to use secure Norwegian authentication systems such as BankID. These are systems in use by banks and official entities in Norway, providing an electronic ID for Norwegian inhabitants.

The design and look of the application has been improved; instead of the hamburger menu, there is now a navigation bar. The titles are tappable, and the title of the current page is emphasized through a bigger font size.

The application itself is now divided in three; the first and primary page being the timeline (figure 5.9). The line itself is shown to the left, with each dot representing a procedure or a group of procedures. To make it clear where the user is, there is a headline *next procedure* which acts like a 'you are here' mark. Past procedures are greyed out to avoid confusion.

The previous home page, listing the last used procedures, is now in a page named *Procedures*. Other than that, there are few changes apart from the visuals. Emojis are now placed over the preview area, making more room for the text below.

There is now a dedicated page for feelings (figure 5.11) where the user can view information gathered by rating each procedure. The last given rating is shown at the top, with the respective emoji and scale for each feeling. Swiping up, there is a filter for each feeling that show only the procedures that made the user feel happy, procedures that were sad, fearful procedures et cetera, combined with a strong background color for each feeling.

Pages such as *my profile*, *my avatar*, *settings* can be found by tapping the profile icon at the upper right corner.

When tapping on a procedure, the screen in figure 5.12 slides up into view. For this prototype, one standard graphical procedure and one video-based procedure were made. The layout remains mostly the same as in 5.2, but now with complete illustrations for the interactiveness of the prototype.

The rating screen has turned into an overlay which, instead of appearing as a new page and covering the whole screen, appears over part of the procedure screen. Tapping on the greyed area has the same

Figure 5.9: The timeline page

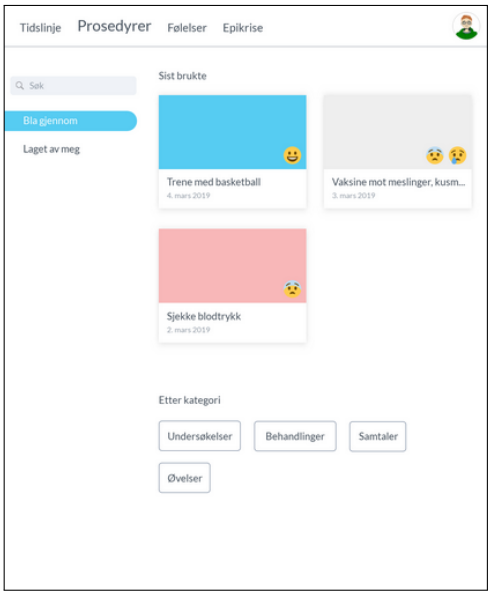


Figure 5.10: The procedures page (previous home page)

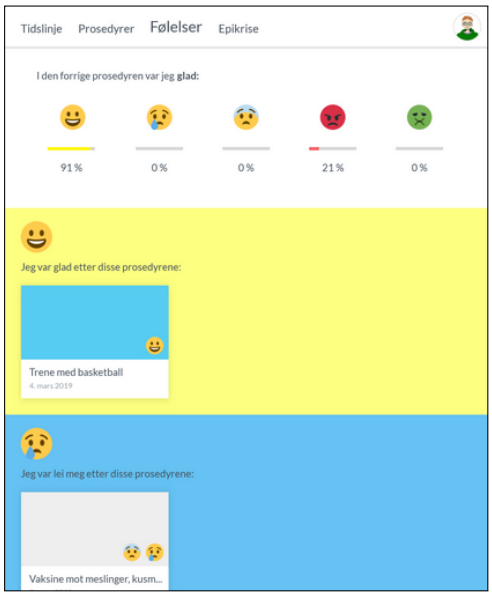


Figure 5.11: The feelings page

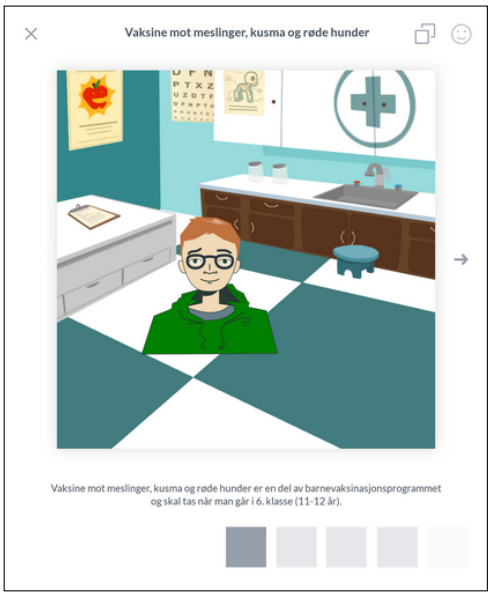


Figure 5.12: Interactive procedure page

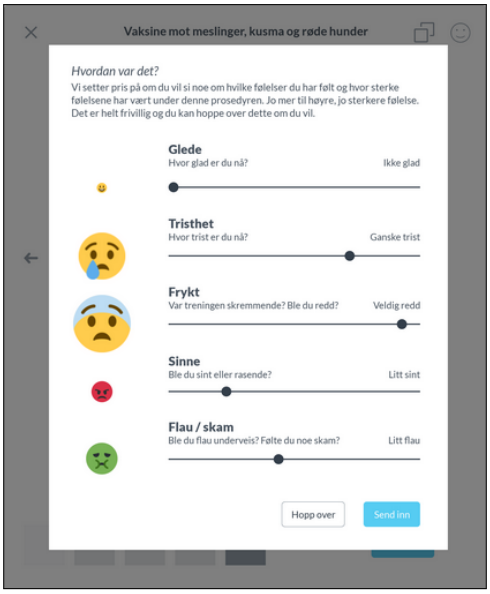


Figure 5.13: The new rating overlay

effect as tapping on *back*; taking the user back to the previous screen. A new feature for the sliders is a label on the right-hand side. For the happy feeling it displays *ikke glad* (not happy), *lite glad* (little happy), *ganske glad* (pretty happy) and *veldig glad* (very happy) depending on the intensity of the feeling.

Once completing all procedures, a new entry *epicrisis* appears on the nagivation bar. The epicrisis page itself has not been designed in this iteration.

5.4.1 Analysis

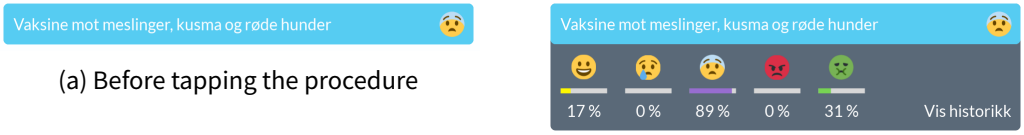
This prototype has been primariy been designed for use with a second generation iPad that could be borrowed. The testing could therefore be done with the intended shape and form, using swiping and tapping with fingers instead of clicking and dragging with a mouse. The prototype was, however, presented on a projector for bigger groups who were pressured on time.

The results of the user testing deemed that the Norwegian authentication systems as shown in the login sequence (figure 5.8b), is unnecessary. It is not given that those systems will be used in the final application, although useful for authentication matters. A simple, local login system will suffice during this design phase.

The rating overlay shown in figure 5.13 is better, but not good enough. The labels provide more information about the feeling, but at the initial state, there is still no indication of where you need to drag the sliders. They remain a bit unintuitive.

Through heuristic evaluation, another issue was revealed. The rating shown at the top of figure 5.11 is associated with a procedure, but that procedure is not shown. The context is missing, making the user have to navigate to another page in order to find said procedure.

Two features were requested after the user testing. The first is to view a history of ratings. The vision is for the user (and the staff) to see their feelings progress. This way, the patient can see if they have become less fearful, sad or angry of a particular procedure. The second requested feature is to view a textual version of a procedure.



(a) Before tapping the procedure

(b) After tapping the procedure

Figure 5.14: Dropdown element

5.4.2 Considerations

Although this prototype was also made with a digital prototyping tool, issues emerged that made it difficult to simulate an actual application. The most notable example is the sliders in figure 5.13. These should in theory be adjusted individually, with the respective emoji scaling up or down depending on the slider value. This could not be solved with the prototyping tool being in use, and the workaround is to create five separate screens—each with a different state for each slider—in order to achieve a sense of progression. This requires the user to tap on each slider consecutively, each slider can be set to one value only, and the user cannot swipe the slider to see the scaling effect of the respective emoji. These issues together made it more difficult to perform user testing with the users navigating the prototype.

5.5 Iteration 5: Further UI experiments

The next iteration is more of an experimental kind, working more as an alternative to the design in iteration 4. It tries to discover different ways to display and interact with elements in the application.

Among the things experimented with, there are coloured procedure elements, a dropdown panel and a syncrhonization bar. The reason behind colouring the procedures is to visualize whether they have been read or not. Procedures shown in blue are yet to be read. The dropdown element appears when the user taps on the emoji. The headings in the navigation bar have been put to the center, where they seem to be more decorative than being left-aligned.

The aforementioned requested feature, to show a history of ratings, was put in focus for this iteration. Two alternatives were designed for this purpose as illustrated in figure 5.15.

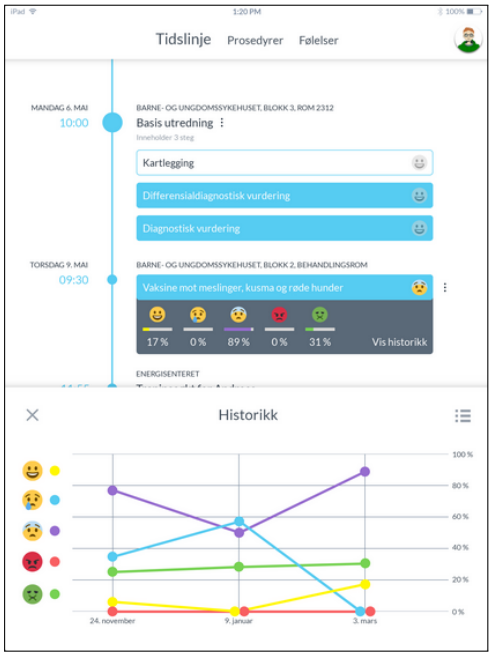
The rather standard layout for the procedures page has in this iteration been swapped out with a more complementary layout. The search bar, previously put aside, is now the main focus. The procedure elements have also changed; instead of laying at the bottom, the titles are hovering above the rectangular preview areas. The page for feelings still contains the last given rating, but now with the associated procedure.

New to the application is a page named *Summary*, which is based on showing the average feelings expressed in the last week, month and year. The epicrisis has also been put here as it technically is a summary of a hospital stay.

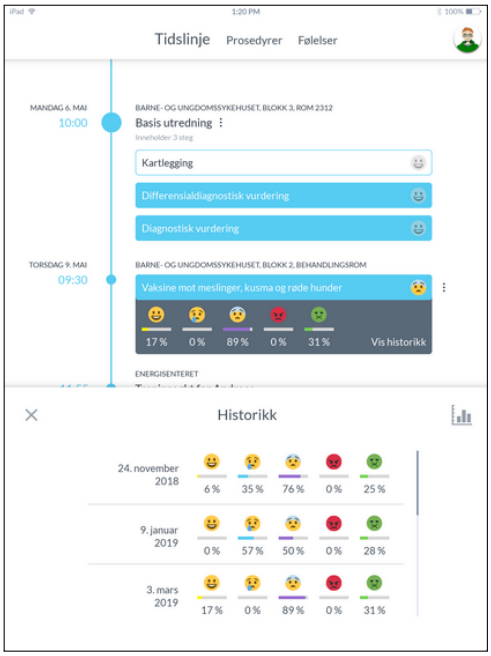
A new part of the procedure page is now the addition of thumbnails that show the current and nearby pages. The rating overlay has also been updated, now with colored sliders. Now that the sliders are colored on one side only, the initial state is intuitive for the user. The labels have been placed below the dots and move together with them.

5.5.1 Analysis

The reception for these changes were mixed, some changes were seen as positive while others were negative. The blue coloured procedures in figure 5.15 were confusing and did not provide the intended



(a) History as graph



(b) History as list

Figure 5.15: Timeline with two alternatives for showing rating history

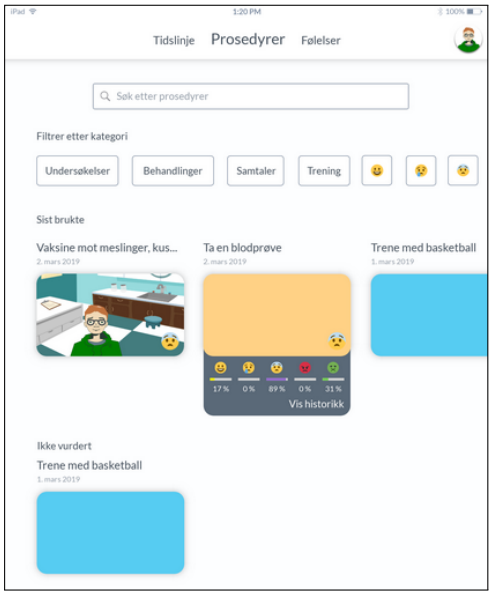


Figure 5.16: Procedures page with new layout

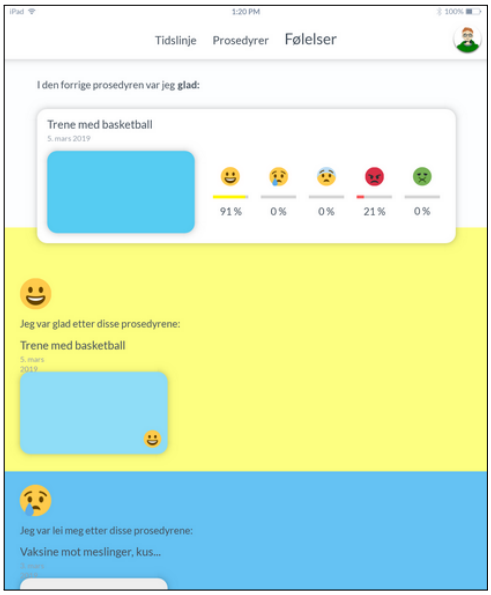


Figure 5.17: Updated feelings page

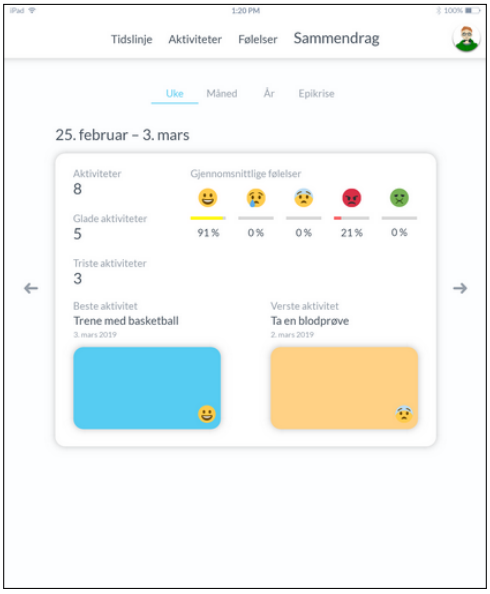


Figure 5.18: Summary page

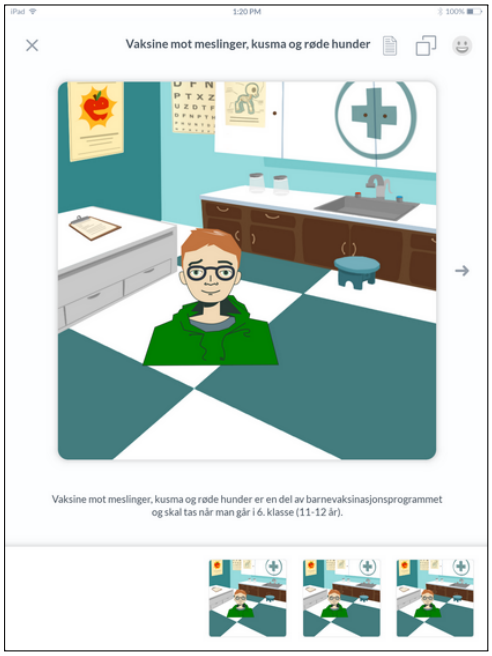


Figure 5.19: Procedure page with thumbnails

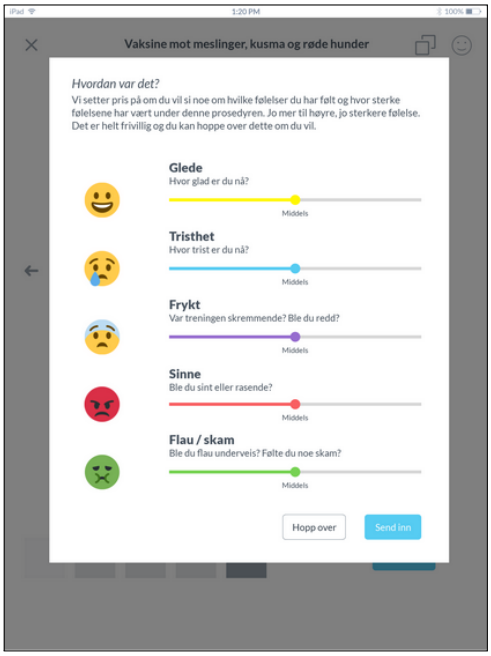


Figure 5.20: Ratings with colored sliders

meaning for the supervisor.

The new layout for the procedure page was not really clear either. It was pointed out that this functionality would suit better for the staff and not for the patient. In fact, there is no particular use case for this and it has fallen short in terms of functionality ever since replacing the page with the new home page.

There seemed to be little gain for the procedure thumbnails as shown in figure 5.16. They were often too small, making it difficult to depict what is happening in each thumbnail, not to mention the thumbnail looks very similar. The focus has been put on something that is hardly visible and takes away from the main purpose of this element; to visualize the user's progress.

As the design has evolved, there are some differences in the designs across the various pages. Some procedures are shown as narrow buttons (figure 5.15) while others have a preview window (figure 5.16). The design should aim for consistency across all pages, but this case in particular lacks consistency. It would be preferrable to stick to one way of representing procedures.

5.6 Iteration 6: Redesign

(...)

This design has been made using a different digital prototyping tool. As the previous tool is pretty restrictive when it comes to exporting, the screens had to be made from scratch. Following this change, it made sense to rebuild the design as well, aiming for a more modern and uniform look. It is worth noting that some of the design of iteration 5, while perfectly suitable, have not been ported over to the new platform yet.

(...)

5.6.1 Analysis

Comment field for ratings, and measurements

Need a welcome sequence, introducing the user to the application and letting them select an avatar

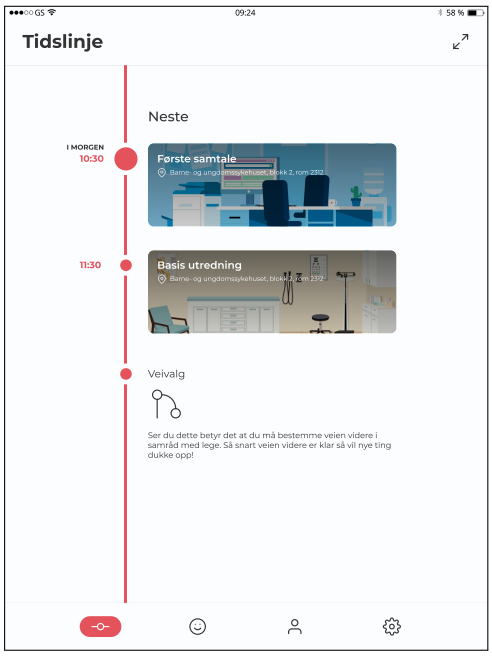
5.7 Iteration 7: Final prototype

To be written

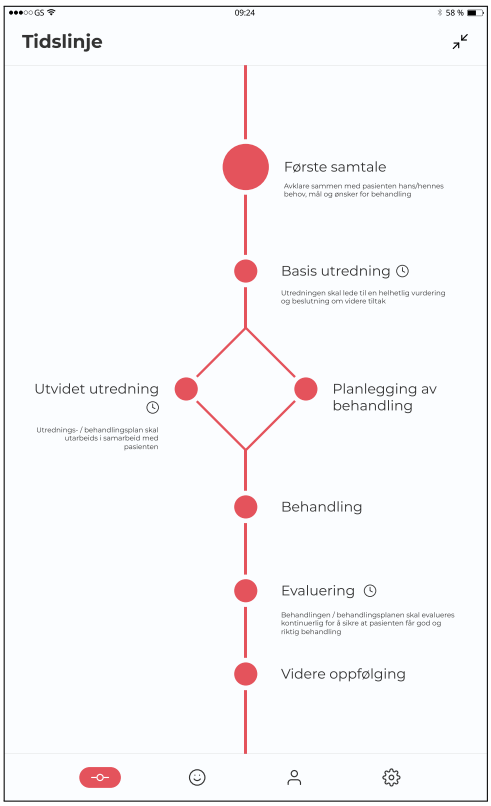
5.7.1 Analysis

When working on the final prototype, it was discovered that the design process did not consider every single case. One example is considering which emoji to display on a procedure after rating it.

The idea is to show emojis that have a higher score than 50 %, and hide the others. If there is no rating, then a semi-transparent emoji is shown instead. Something that was not thought about was the fact that the user could rate every feeling below 50 %, resulting in no emojis being shown. It was therefore decided to reflect this situation with a neutral emoji. In that way, it symbolizes the fact that a rating has been given.



(a) Zoomed in



(b) Zoomed out

Figure 5.21: Redesigned timeline

Chapter 6

Evaluation

To verify that the design works as intended, a more extensive evaluation of the final prototype has been made.

6.1 The test group

While it would be beneficial to let the patients—the primary target group—use the final prototype for evaluation purposes, there are several factors to why this is not a good idea. First, patients of this kind are very vulnerable and interaction is better left off for professionals and people with experience or education. Second, the prototype is not fully functional and some actions and gestures are not supported, which could lead to awkward or even harmful moments. Third, the low age of the patients induce a high risk of misunderstandings when it comes to the testing; the prototype can easily mistaken for a final product and a patient may not necessarily understand that the situation is a general case and not tailored to their current situation, possibly leading to further misunderstandings.

At the Children and Youth Clinic, a youth council has been set up to represent the younger patients at the hospital. One person from this council will, together with Thorsen, form the test group for this evaluation.

6.2 Performing the evaluation

The evaluation took place in a meeting room at the Children and Youth Clinic. (...)

6.3 Results

To come

Chapter 7

Application outline

7.1 Implementation details

An extended use case diagram is shown in figure 7.1.

A revised and more detailed domain model is shown in figure 7.2.

7.2 Architecture

7.2.1 Backend

7.2.2 Frontend

7.3 Integration with existing systems

Green figure

7.4 Anticipated challenges and feasibility

The development tools chosen for an application should support the functionality of the application. The following subsections illustrate a few scenarios which the chosen development tools should support.

7.4.1 Personalised avatars

The avatar generation system created for E-LAN (from 2.2) can be used together with the application. This enables the user to view their avatar in procedures like they were participating themselves. A challenge lies in associating an avatar to each user while making it easy to modify it when needed. The system is based on a graphical user interfacedoes not present an API; it is very much a black box where the result is an exported PNG file.

7.4.2 Realistic avatar projections

The system outputs two-dimensional portrait images only, with the face and chest facing forward. The images are also limited to the top part of the body, leaving the lower body out. Concerns were raised about whether these images would look realistic in certain settings. For example, using a single 2D image, a person laying in the bed would look awkward unless viewed from above the bed. To deal with this, there are several approaches as seen in table 7.1.

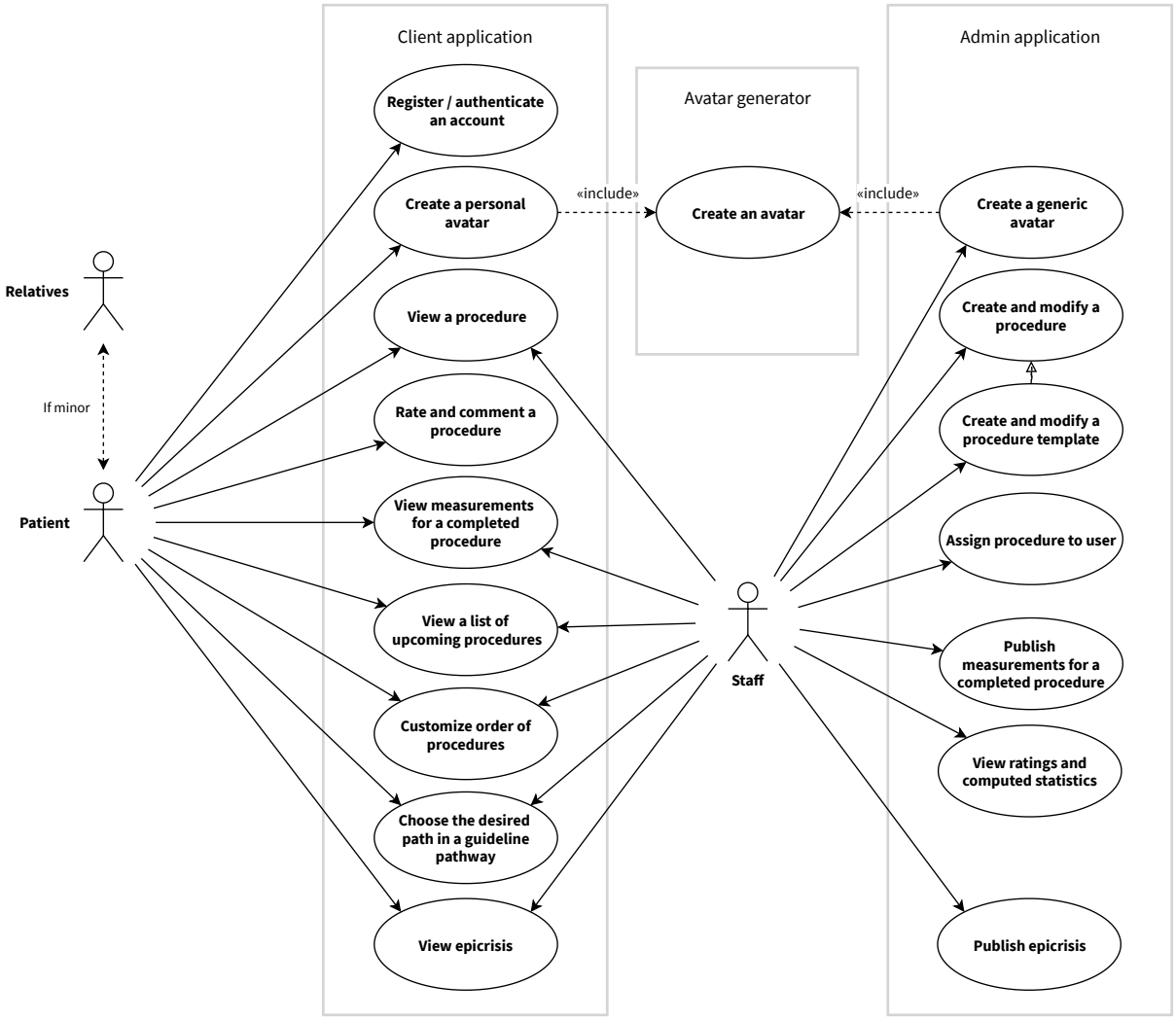


Figure 7.1: Extended use case diagram

	Realism	**Processing power**	**Ease of use**	**Additional requirements**
2D images	Lowest	Lowest	Highest	None
2D image sets with various poses	High	Low	High	Extra image sets
2D images rotated in 3D	Low	High	Low	Software framework which supports 3D rotations
3D models	Highest	Highest	Lowest	New 3D models; a 3D rendering engine; software framework which supports 3D rotations

Table 7.1: Different ways to project an avatar on a screen

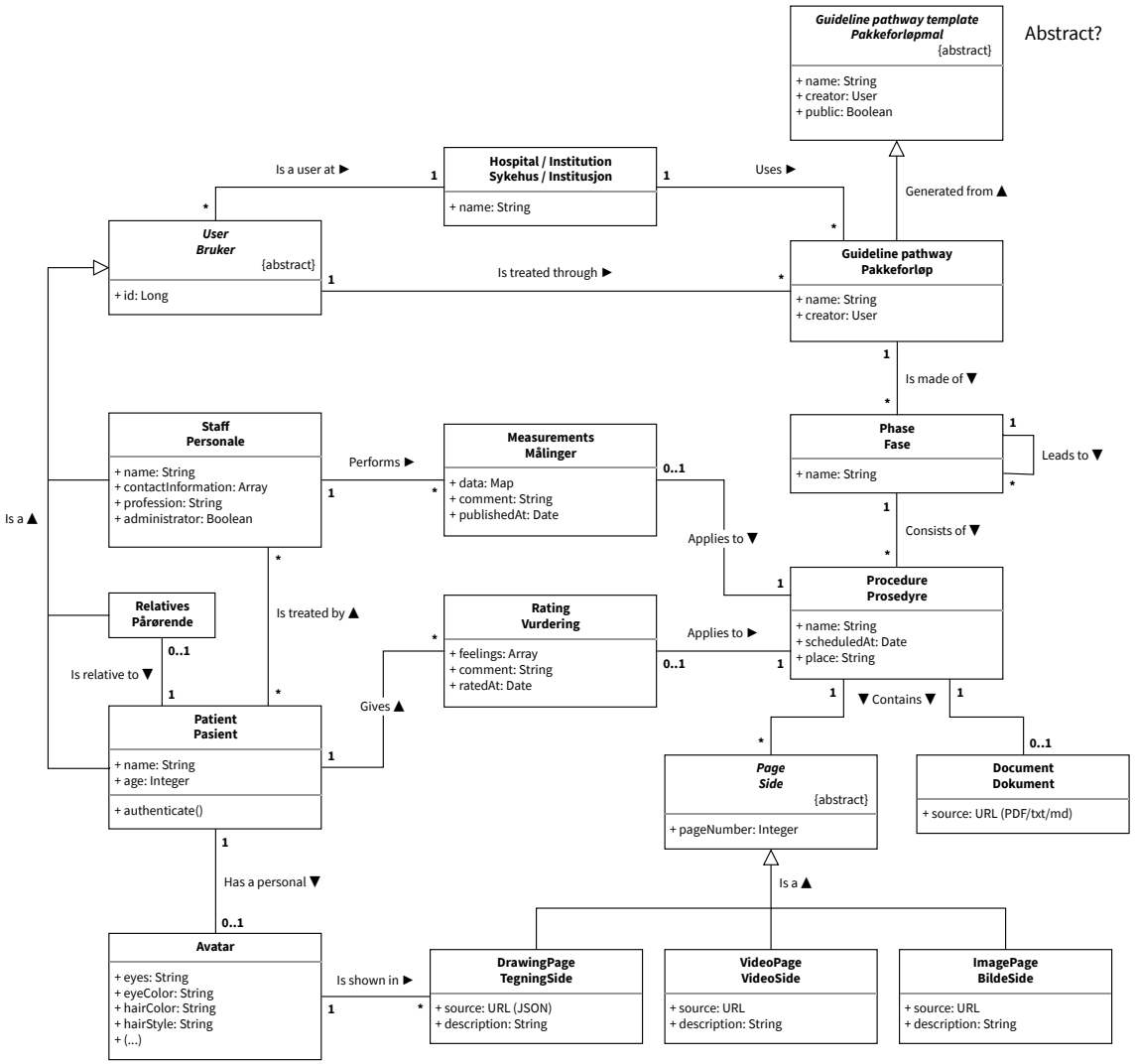


Figure 7.2: Extended domain model

It is shown that 2D images can be rotated in 3D pretty realistically. Rivers et al. (2010) carried out a project which showed that it is possible to view a figure from any angle when given three 2D projections of it.

Though, an alternative is to simply use such avatars in 2D-space.

The IACTA application shows that this can be used with similar effect as a 3D-application (Stålberg et al., 2018).

7.4.3 Visual art and template designs

This brings us (?) to the next challenge. (...)

7.4.4 Connections between client and admin applications

To be written

7.4.5 Integrations towards current healthcare systems

To be written

7.4.6 Security concerns

To be written

7.4.7 Service workers and offline content

Experimental technology Not-so-easy with web projects

7.4.8 Scaling

To be written

7.4.9 Costs

To be written

7.5 Handoff

The scope of this project involves minimal integration with existing healthcare and journal systems at Barneklinikken and Haukeland. Given that Helse Vest IKT monitors most of said systems, it would be sensible to develop an application that can be adapted, or even be developed further on, by them. It was pointed out that the developers of the avatar generation system used well-established web technologies such as HTML, CSS and JavaScript to develop it, and that similar technologies were preferred for the new application. This led to a new direction in choosing the most suitable software tools.

Attached to this thesis are Figma project files and source code for an incomplete software prototype using React and create-react-app.

(...)

Chapter 8

Tools and technology

8.1 Choice of application setup

Refer to 4.2

Requirements were not really present for this project; instead, there are various interests in how the application should be made and what it should result in.

To begin with, the Children and Youth Clinic indicated that this was intended for tablets with medium to large screens. Such tablets usually run a full-fledged operating system (OS) such as Windows or a mobile OS such as Android and iOS. There are no requirements regarding which operating systems the software should run on, but it seems that most of their tablets run Windows and Android operating systems.

As with most mobile applications, there is a choice between the following approaches:

- A *native application* is written in each operating system's native languages. For Android this is Java, and Swift and Objective-C for iOS. Native applications can access all features which each OS may offer.
- Another native approach is to write the application in a different language and compile it to native code. The resulting app is then very alike a native one and has similar performance.
- A *hybrid application* encapsulates a web page into an app. Such apps use a browser instance to render elements, although without the search bar and tools of the browser. This approach offers functionality that you don't get with web applications, but has usually worse performance compared to a native solution.
- A mobile *web application* is a responsive web page shown in the user's web browser. These do not appear in app stores but function just like an ordinary web page. Lately there have been increasing interest in Progressive Web Apps (PWAs) which aim to provide mobile web pages with app-like behaviour and functionality such as push-notifications.

Due to the uncertainty in which operating systems that are in use (and will be used in the future), going for a cross-platform application is the most preferred.

Determining which approach to use requires paying attention to several factors: requirements, anticipated challenges and stakeholder interests among others. The requirements suggest using a cross-platform application primarily aimed for tablet devices, while Helse Vest IKT suggest using web technologies when developing the application. General factors such as cost, ease of use, responsiveness, support for older devices and debugging also play a role.

When taking Helse Vest IKT's opinion into account, there are two main approaches remaining:

The first approach involves a mobile app and can be achieved in two ways; one way is to compile an application into native code. There are a number of frameworks which are able to transpile JavaScript into native applications, although the syntaxes may vary. Another way is to use *hybrid applications*, using HTML, CSS and JacaScript. These are typically built upon using a WebView, a browser instance that can be used by the application. Some frameworks offer their own JS-like language, providing additional methods and native functionality, which are compiled into traditional JavaScript.

The remaining approach is through web applications which run in web browsers. Lately there have been increasing interest in *Progressive Web Apps* (PWAs), which aim to make websites more app-like on mobile devices with offline access and push notifications. They do, however, require a website which is capable of serving HTTPS. PWAs is a relatively new kind of technology with increasing support in both Android and iOS. Some browsers also support adding an app icon to the user's app launcher, circumventing app stores in the process.

Although only 2D images are currently supported, it seems reasonable to pick an approach that allow more extensive functionality if desired.

Given that both hybrid applications and Progressive Web Applications use web browsers (WebViews) to show content on the screen, their performances are assumed to be pretty comparable. The main difference is how a hybrid application is dependent on an app store whereas a PWA is dependent on a website. In this case, a self-running application will require less server resources

Based on the reflections above, a Progressive Web Application is considered to be less suitable for this project.

8.2 Frameworks

Next to consider is frameworks. Frameworks allow developers to develop an application more efficiently by facilitating APIs, UI components, navigation, MVC patterns, utility methods or a combination of these. Some frameworks can also help deploying the application to app stores.

Table 8.1 shows a few frameworks and what functionalities they offer.

The most common way to make a hybrid app is to use a Cordova-application. Apache Cordova is the original concept Adobe PhoneGap is an extension to Cordova and acts much the same with some additional features.

It is unknown which frameworks the web developers of Helse Vest IKT have used previously, if any. A starting point is to assume that web developers have no or poor prior experience with frameworks. Any framework used for the project should therefore be easy to learn for any person skilled in HTML, CSS and JavaScript.

A framework worth explaining is React React Native is a mobile version of React, able to transpile code to both Android and iOS.

Is it too difficult for a web developer to learn React and its adjacent technologies? Learning React most likely requires learning JSX, Redux and Flux as well. Although (...)

8.3 Database system

SQL vs NoSQL

Framework	Functionality	Description
Meteor	Native compiler	JavaScript
NativeScript	Native compiler	JavaScript
React Native	Native compiler	Mobile version of React. Supports hot reloading. Focuses on Single Page Applications (SPAs)
Apache Cordova	App wrapper	
Adobe PhoneGap	App wrapper	
Ionic Capacitor	App wrapper	
Angular	Navigation	
Framework7	Navigation & UI	
Ionic	Navigation & UI	
React (+ Flux)	Navigation & UI	JavaScript and JSX (HTML-like syntax represented as JavaScript objects). Supports hot reloading
Vue.js	Navigation & UI	
Bootstrap	UI	
Onsen	UI	
Polymer	UI	
Semantic UI	UI	

Table 8.1: Web developer friendly frameworks for mobile application development

8.4 Storage

JSON

Chapter 9

Conclusion

Conclusion goes here

9.1 Discussion

Arguments for why the conclusion is as such, what went right and what went wrong

9.2 Validity

Arguments for the validity of this conclusion, that is, to which extent is it true and 'scientific'

9.3 Concerns

Things to consider

9.4 Further work

9.4.1 Design and planning

9.4.2 Development

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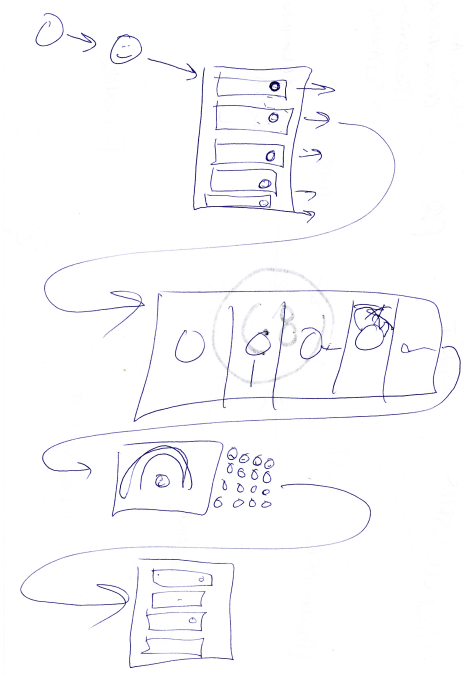
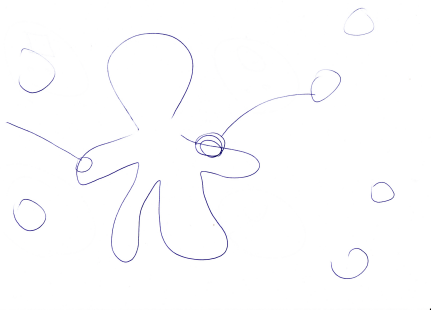
Appendix A

Brainstorming sketches



(a) A rundown of the application



(b) Age-appropriate interaction with the human body

Figure A.1: Sketches from the first meeting