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

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Chapter 1

Introduction

1.1 About the thesis

This thesis describes an application development project that was held from August 2018 to June 2019. Carsten Helgesen, the project supervisor, proposed the project as a continuation of a bachelor project from the spring of 2018. Both projects aim to facilitate non-verbal communication and to visualise information and emotions through human figures in context. The original intention was to create a communication tool aimed for people with autism, but the project has taken a new direction since then.

Throughout the second and third quarters of 2018, the project gained interest at the Children and Youth Clinic (CYC) at Haukeland University Hospital. Ideas for the project were discussed during this period with Consultant (Child and Youth Psychiatrist) Paul Joachim Thorsen.

More to come as the project endures.

1.2 Motivation

Dagens situasjon, en slags introduksjon

1.3 Problem description

Children situated at hospitals

It is a recurring problem that

> 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?

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 2.3), 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. Finally, a discussion about further work is made in Chapter 10.

Chapter 2

Background

2.1 Terminology

A *pictogram* (also called a pictograph) is a simplified figure that resembles and represents a physical object. Pictograms are a common sight in a modern everyday life and are used to warn about dangers, to inform about functionality and to hint about specific characteristics. As such, they can be seen e.g. at traffic signs, danger signs, public toilets and in computers. Naturally, pictograms vary in shapes and sizes, but they are ultimately designed in a way that make them easy to interpret and understand their symbolic meaning.

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

2.2 Preceding projects

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

2.2.1 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 (figures which represent physical objects, see 2.1). Their 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

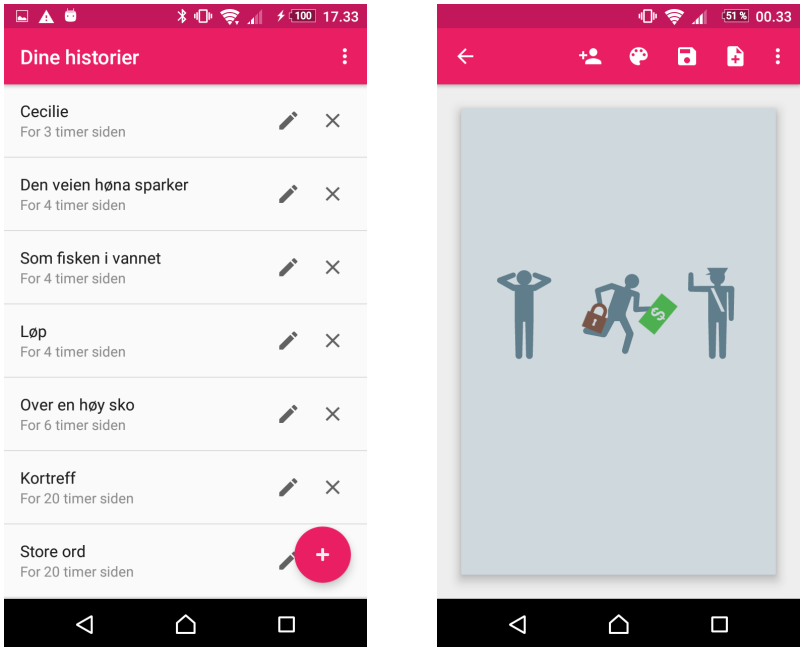
- *PictoBooth*, a photo booth that translates the body and gestures into real life pictograms,
- *PictoFont*, a symbol typeface consisting of various pictograms, and

- *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.

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

2.2.2 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.



(a) List of stories (b) Scene editing

Figure 2.2: Screenshots from PictogramApp

2.3 Related work

CYC 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

2.4 Theoretical foundation

The problem area was presented first and foremost by CYC. During meetings, Paul 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.

A number of search queries was performed on academic literature in order to confirm these statements 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

The queries yielded nine articles which form the theoretical foundation of this thesis.

Chapter 3

Methodology

This project functions as a pilot study in preparation for a bigger project held at the clinic. It is also a comparative study as it may possibly replace 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. Users, both employees and children at the clinic, 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. The testing will most likely be restricted to the internal group at first, but a designated test group may be created once the design evolves into prototypes. Elements of Design Thinking might also be considered.

3.1 Evaluation (plan)

The final prototype will be evaluated by comparing it with the current system. A group of two to six users of the intended age group will be invited to test and evaluate the application while a control group of the same size will test the current system under the same conditions. The users will quantitatively rate the systems by giving scores from one to five in areas such as "fun", "understandable" and "interesting". The project is deemed to be valuable if the users find the application to be more informative and engaging than the current system.

It is yet to be decided if the test groups will consist of children situated at the clinic, i.e. the target group, or children around the same age.

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

3.3 Interaction design

3.4 Prototyping

3.4.1 Prototyping tools

Chapter 4

Planning the design

4.1 Considerations etc etc

4.2 Use cases

4.3 Domain model

Chapter 5

Iterating the design

5.1 Iteration 1: Paper prototype

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. Contrary to the original application, a single step may be animated and contain more information than a single picture can provide.

Some initial sketches were made during the first meeting with Paul Thorsen. Among others, they illustrated a list of procedures, a procedure in its entirety, rating the procedure and how the rating is reflected in the list of procedures. Selected sketches were used as a basis for the initial designing process.

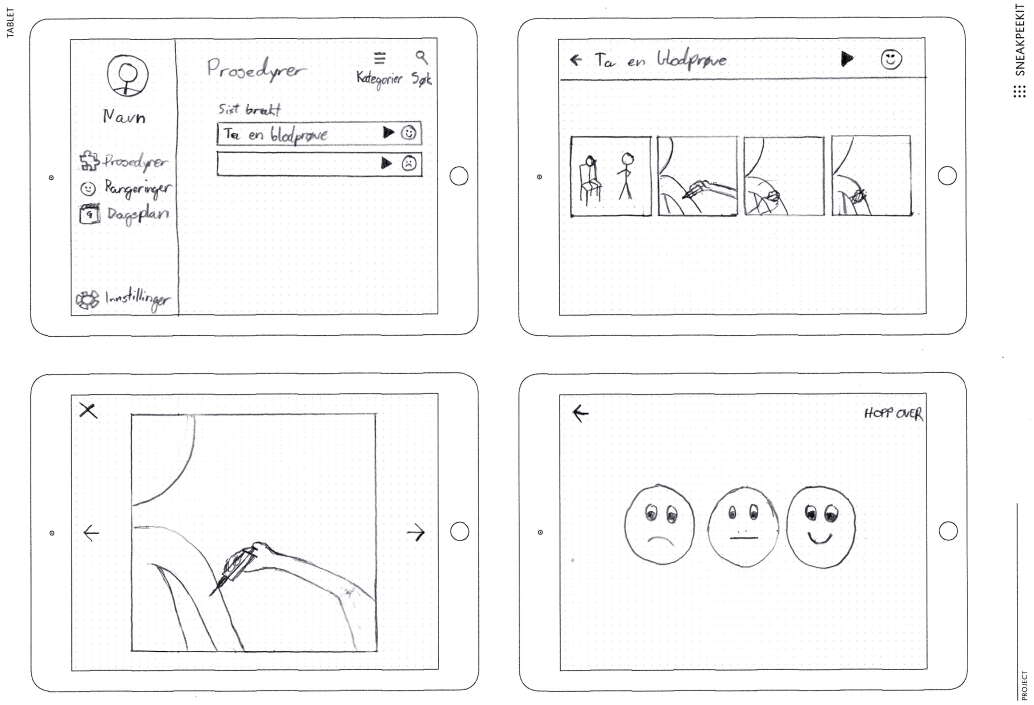
The first design shows the user entering a procedure and evaluating it (see figure 5.1a), a common use case in this application. When viewing a procedure, its steps are shown in an horizontal, scrollable sequence of pictures. The user will be able to scroll across the whole procedure from left to right and to put each picture 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). A more complicated system for rating procedures and experiences has been suggested but such a system is not within the scope of this application.

There are also several sketches showing how the procedure may be edited by an administrator (figure 5.1b). Creating and modifying procedures on a tablet is one possibility, although not the only one, given the tablet requirement. Compared to PictogramApp, the interface is supposed to be more drag-and-drop oriented with possibilities to drag pages between each other. Another change is that elements must be clicked/tapped before they can be modified.

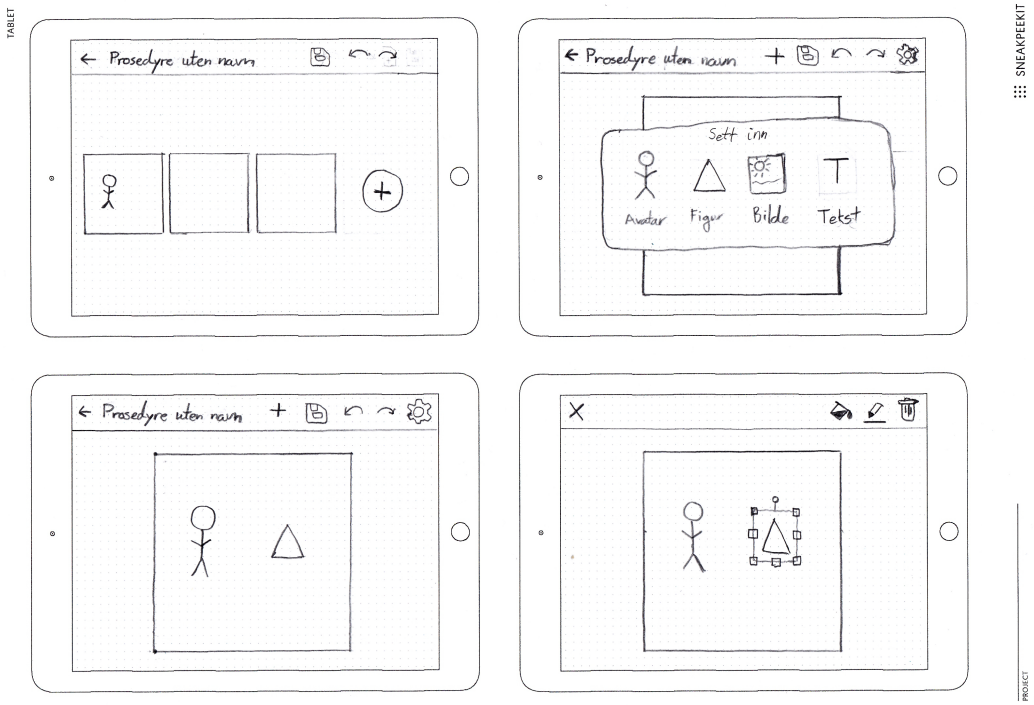
5.1.1 Considerations

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



(a) Viewing a procedure



(b) Editing a procedure

Figure 5.1: Sketches of the first design

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.

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. Regardless of what style is chosen, it should fit to the style of the avatars that are already made.

5.1.2 Analysis

5.2 Iteration 2: Form study prototype

5.2.1 Analysis

5.3 Iteration 3: Visual prototype

5.4 Iteration 4: Interactive prototype

5.5 Iteration 5: UI experiments

5.6 Iteration 6: Redesign

5.7 Iteration 7: Final prototype

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.

The design did also evolve during the prototyping process.

Chapter 6

Evaluation

Final prototype

6.1 The test group

6.2 Circumstances

6.3 Performing the evaluation

6.4 Results

Chapter 7

Tools and technology

7.1 Requirements

The Children and Youth Clinic expects 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.

The 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. 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).

The clinic expressed that they intend to use the application on larger screens and most likely on tablets.

7.2 Choice of application setup

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.

Flutter is a relatively new framework

Dersom en Windows-løsning er ønskelig vil dette muligens kreve kunnskap om .NET, noe som ikke er blitt lært hittil. Det er flere måter å utvikle Windows 10-eksklusive applikasjoner på, men jeg har ikke gått i detalj gjennom disse ennå.

Dersom vi lander på å utvikle for mobile operativsystemer vil det være naturlig å lage en multiplatform-applikasjon. Dersom ønskelig kan man etterpå se på en web-applikasjon eller en Windows desktop app.

- Xamarin (Microsoft) - C og F - Stabilt og robust rammeverk - Kan utvikle for Windows 10 samtidig som for Android og iOS - Dårligere ytelse - Tidkrevende - Flutter (Google) - Dart (C-lignende syntaks, kompilerer til JavaScript) - God ytelse - Hot reload - Ganske nytt; mangler erfaring som andre rammeverk har - React Native (Facebook) - HTML/CSS/JavaScript - Bruker native UI-elementer - Hot reload - Kan gjenbruke kode for eventuell nettside - Dårligere ytelse - Relativt vanskelig å teste - PhoneGap (Adobe) / Cordova (Apache) - HTML/CSS/JavaScript - Tradisjonelle web-rammeverk - Delvis manglende støtte for native funksjonalitet - Titanium - JavaScript -

Flutter har stort potensiale for utvikling av mobilapplikasjoner og ser ut til å passe oppgavebeskrivelsen på en god måte. Dersom man ønsker å utvikle en og samme app både for Windows 10 og for Android/iOS vil Xamarin være et lovende alternativ.

Angående 3D-rotering av 2D-bilder kan dette oppnås enten ved å bruke en rekke bilder som er ferdig rotert, eller å faktisk rotere 2D-bilder i 3D. Xamarin har støtte for sistnevnte via SkiaSharp. Flutter støtter 3D-rotering også. Det ser ut til at React Native ikke har native støtte for dette, men det finnes trolig JavaScript-plugins som kan tilføye slik funksjonalitet.

7.3 Aiming for an approach

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 basically two types of applications left to choose from.

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.

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 7.1 shows a few frameworks and what functionalities they offer.

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 7.1: Web developer friendly frameworks for mobile application development

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

Supported functionalities What functionality do the frameworks facilitate?

7.4 Database system

SQL vs NoSQL

7.5 Technologies used

7.5.1 Framework

CSS-in-JS - makes it easier to utilize visual themes

7.5.2 JSON

Lagringsmessig vil historier være serialiserte og kunne lagres i databaser. For å overføre historier kan de sendes i form av JSON-strenger som vil beskrive informasjon som

- Paneler - Antall paneler, evt. navn på disse - Størrelse på panel(er) - Piktogram/avatar - Plassering - Rotasjon - Størrelse - Om piktogrammet/avataren er speilvendt - Farge - Bakgrunn - Farge eller bilde

JSON kan også benyttes til å overføre kontoinformasjon, innstillinger og lignende. Bilder og piktogrammer overføres som filer.

Chapter 8

Application outline

8.1 Application model

Figure

8.2 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.

8.2.1 Projecting the avatar on the screen

Given that the avatar generation system only outputs images seen from the front view angle only, it will require additional work to make these look natural in a three-dimensional space. This has also been taken into consideration when deciding which tool to use for developing the application.

The avatar generation system created for E-LAN (from 2.3) can be used together with the application. This enables the user to view their avatar in procedures like they were participating themselves. The system does, however, only output portrait pictures in 2D and concerns were raised about whether these 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. There are in fact multiple approaches to this as seen in table 8.1.

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).

8.3 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.

	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 8.1: Different ways to project an avatar on a screen

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.

With this in mind, there were 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.

Chapter 9

Conclusion

9.1 Results

9.2 Discussion

9.3 Validity

9.4 Concerns

Chapter 10

Further work

$x = y + 1$

$x = y + 1$

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