

Preface

This task comes from an idea of real-life problem with the management of the images online. There's a problem to find what we want to see if we stored images in different online stores. It's interesting and meaningful to develop a such web application to solve this problem. After discussing the idea, I decided to make a task like that with the help of Nils.

During this project, most of the knowledges are what we have learned before, and of course something new to learn and research. It is a good experience to apply different knowledges to make a real system.

I will thank everyone helped me in my project, especially my advisor Nils Tesdal for all the help and feedback.

Signature :

Shanshan Qu

5/20/2019

Trondheim

Task Description

Title:

Personal Image Hub

The purpose of the task:

Today people have personal photographs stored in many different online stores. It is very difficult to get an overview of all the images and difficult to find the ones you would like to see.

This task is to make a web application that acts as a hub for all your images, where you can store information about all the images you have, search for images based on location, date taken and tags. The tags can be anything, for example "summer" , "holiday" etc.

Description:

The basic and required functionality is image registration and image search. An image is registered with an URL to the storage location, a date, a location and tags. Images have metadata, and most images have a date associated with it.

This should be extracted from the image with the use of a library and automatically filled into the date field. Many images also have a geo-location, and then this should also be automatically filled in. The search functionality should have a form with from-date, to-date and tags (maybe also location info like country, county and city). The results should be in the form of thumbnails, and pagination should be used.

Possible extensions to the basic functionality (highest priority first):

- a zoomable map with all the image locations, so the user can find images directly on the map.
- be able to register many images at the same time. Then the metadata found (date & location) should be automatically stored, together with possible common tags for all the images.
- The different image stores may require authentication. The first version this application only needs to support the use of unprotected images, but a possible addition is to store credentials for each user for each store used.
- to extract location info like country, county and city from the image by the use of the Google Maps API.
- to use an online (or local if possible) machine learning service to auto-tag the images. These tags should in that case be stored in a separate DB field than the tags specified by the user.

Abstract

Title	Personal Image Hub
Participants	Shanshan Qu
Supervisor	Nils Tesdal
Keywords	Web application, SPA, design, programming
Number of pages	20
Availability	Open

I was tasked with building a web application for personal management of the images stored in different online stores. With this application, it is easy to register the images with the link of the images, and then gather all the images with some detailed information that may be extracted from the images. It is possible to use tags, and then we can search in all the registered images to find what you really need. This report described everything related to the app development, such as technologies, tools, methods, results and so on. It is interesting to explore more possibilities for the application, and there are many useful suggestions for the future development in the report.

Sammendrag

Tittel	Personal Image Hub
Deltakere	Shanshan Qu
Veileder	Nils Tesdal
Stikkord	Web application, SPA, design, programming
Antall sider	20
Publiseringsavtale inngått	Ja

Jeg fikk i oppgave å bygge en webapplikasjon for personlig styring av bildene lagret i forskjellige nettsteder. Med denne applikasjonen er det enkelt å registrere bildene med linken til bildene, og deretter samle alle bildene med detaljert informasjon som kan hentes ut fra bildene. Det er mulig å bruke tagger, og så kan vi søke i alle de registrerte bildene for å finne det du virkelig trenger. Denne rapporten beskrev alt relatert til apputviklingen, som teknologier, verktøy, metoder, resultater og så videre. Det er interessant å utforske flere muligheter for appen, og det er mange nyttige forslag til fremtidig utvikling i rapporten.

Table of Contents

Preface	1
Task Description	2
Abstract	3
1. Introduction	7
1.1 Report Structure	7
1.2 Project Description	7
1.3 Goals	8
1.4 Research Question	8
1.5 Acronyms	8
2. Theory	9
2.1 Technology	9
2.1.1 Frameworks	9
2.1.2 Tools	9
2.1.3 Image metadata	10
2.2 Method	11
3. Choice of technology and method	11
3.1 Technology	11
3.2 Method	12
4. Results	13
4.1 Engineering Results	13
4.2 Scientific Results	14
4.3 Administrative Results	15
5. Discussion	16
5.1 Engineering Results	16
5.2 Scientific Results	17
5.3 Administrative Results	17
5.4 Evaluation	17
6. Conclusion and further development	18
6.1 Conclusion	18

6.2	Further development	18
7.	Reference	19
8.	Attachments	20
A.	Vision Document	20
B.	Requirements Documentation	20
C.	System Documentation	20
D.	Project Handbook	20
E.	User Test Plan	20
F.	User Test Report	20

Figure List

Figure 1:	How the 8 possible EXIF values look for the letter F	10
Figure 2:	My Scrum-board made by Trello	12
Figure 3:	Design Science Research Cycles	13
Figure 4:	Diagram for the hours estimated and the actual hours used	16

Table List

Table 1:	Acronyms	8
Table 2:	Engineering Results	14
Table 3:	Table for the hours estimated and the actual hours used	15

1. Introduction

In this chapter, I will explain the project I have worked with. It contains useful information about the project and the report, and the main problem I want to research.

1.1 Report Structure

Chapter 1: Introduction

Introduce the project, give the research question and set the goals.

Chapter 2: Theory

Describe and explain the theoretical background for the work.

Chapter 3: Choice of technology and method

Show the reasons to choose these technologies and methods in chapter 2.

Chapter 4: Results

Scientific results, engineering results and administrative results.

Chapter 5: Discussion

Discuss the reasons why the results in chapter 5 were as they became, especially where there are deviations from plans and goals.

Chapter 6: Conclusion and further development

Conclude the report with a summary of the project and show how to improve the product in the future.

Chapter 7: Reference

Sources are used in the main report.

1.2 Project Description

This is a bachelor project associated with TDAT3001, Bachelor Thesis in Computer Engineering. The task started with an idea of managing images from different web stores. There are many people have similar problem to find the right image from different web stores. After discussing with my advisor, it turned out to be a specific task. It is an interesting task to handle images with URL from different online store, for example, Dropbox.

1.3 Goals

The goal of the task is to have a such system works well, and easy to use. The system should be better than the existing solution, which meets the requirements in the vision document [Attachment A].

The system is expected to be finished before the deadline May 20, 2019. Make sure the system is user-friendly through user tests.

1.4 Research Question

"How to extract metadata from an image in a web application?"

"What kind of functionality is needed in an image hub application?"

1.5 Acronyms

Word	Description
API	Acronym for Application Programming Interface. API can have multiple meanings. In connection with the web, there is often a reference to the HTTP interface that links the front end to the back end, but it can also refer to any interface that links one code base to another.
SPA	Acronym for Single Page Application. A web page that only loads once and consists of one page that is manipulated with code running in the browser.
JWT[1]	Acronym for JSON Web Token. JWT is an open standard that defines a compact and self-contained way for securely transmitting information between parties as a JSON object. This information can be verified and trusted because it is digitally signed. In the context of my web application, JWT is used for user authentication.
JSON	Acronym for JavaScript Object Notation. A format for data exchange that is based on the object definition syntax in JavaScript. JSON is widely used in web applications in connection with data exchange between the front end and the back end.
IDE	Acronym for Integrated Development Environment. It is a software application for programmers.
URL	Uniform Resource Locator, a web address.
Front end	User Interface, the client part code.
Back end	Server part code handles domain logic and data storage.

Table 1: Acronyms

2. Theory

This chapter gives an overview of important technologies, tools and methods I have used for the project.

2.1 Technology

2.1.1 Frameworks

React

React is not a framework, it's a frontend JS library created by Facebook for building user interfaces. Many developers consider it a framework and it's usually compared in that context with Angular and Vue.js.

Node

Node.js is a server-side JavaScript runtime environment that executes JavaScript server-side.

Express

Express prides itself as a minimal, fast and unopinionated framework for Node.js. It is one of the most trending backend frameworks nowadays.

Material-UI

It is one of the most popular user interface libraries for React. With the components from the Material-UI library it's very easy to make use of Material Design elements in the React web application.

2.1.2 Tools

Visual Studio Code

Visual Studio Code is a source code editor developed by Microsoft for Windows, Linux, and MacOS. It includes troubleshooting support, git functionality, "syntax highlighting", "Intelligent code completion" and refactoring of code. It is easy to customize it by change the theme or install extensions through the editor's expansion system.

npm

npm (node package manager) is a package manager for the JavaScript runtime environment Node.js.

npm can process packages that are local dependencies in a given project, as well as process globally installed JavaScript tools. When used as an addition manager for a local project, npm can install all the dependencies of a project through a package.json file with only one command.

Trello

Trello is a task management app that gives you a visual overview of what is being worked on and who is working on it. I just use it to make SCRUM board for my project.

Version Control

It is a system that keeps track of the version of the code. It makes it possible to get a full overview of how the project has changed over time, making it easier for more developers to work on the same project at the same time. I used version control system git in this project.

Gitlab

It is a web-based tool that provides a Git-repository manager providing wiki, issue-tracking and CI/CD pipeline features.

2.1.3 Image metadata

EXIF orientation values

[2]There are 8 possible EXIF orientation values, numbered 1 to 8.

1. 0 degrees – the correct orientation, no adjustment is required.
2. 0 degrees, mirrored – image has been flipped back-to-front.
3. 180 degrees – image is upside down.
4. 180 degrees, mirrored – image is upside down and flipped back-to-front.
5. 90 degrees – image is on its side.
6. 90 degrees, mirrored – image is on its side and flipped back-to-front.
7. 270 degrees – image is on its far side.
8. 270 degrees, mirrored – image is on its far side and flipped back-to-front.

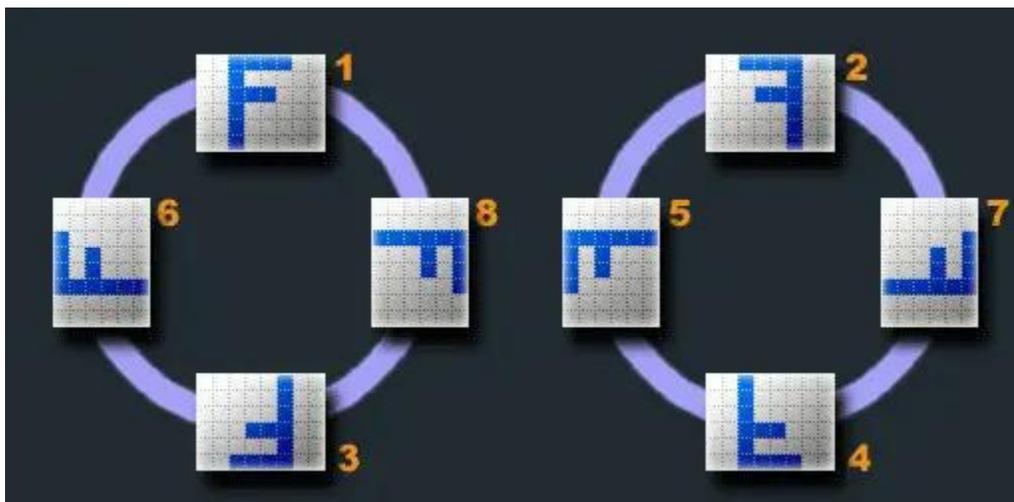


Figure 1: How the 8 possible EXIF values look for the letter F

node-exif

With node-exif[3] you can extract Exif metadata from images (JPEG). Exif is a format used, for example, by digital cameras (including smartphones) and scanners to save additional information about an image in the image file. This information can be the camera model, resolution, where the image was taken (GPS) or when it was taken.

2.2 Method

Agile

Agile is a development methodology based on iterative and incremental approach.[4]

It is a process that helps teams provide quick responses to the feedback they receive on their project. It creates opportunities to assess a project's direction during the development cycle. Teams assess the project in regular meetings called sprints.

It's also important to mention the agile manifesto. *The agile manifesto* has four important values:

- Focus should be more on individuals and interactions instead of processes and tools
- Working software is more important than comprehensive documentation
- Customer collaboration is more vital than contract negotiation
- The process should respond to change rather than follow a plan

Scrum framework is an agile process that allows us to focus on delivering the business value in the shortest time. It rapidly and repeatedly inspects actual working software.

3. Choice of technology and method

In this chapter, I will list the reasons why I choose to use the technologies and methods in the last chapter.

3.1 Technology

Frameworks and tools

Started with the framework and some tools I have used in this project. At first, I think I am not a developer with so much experience. It is always not easy for me to learn and experience a totally new framework although they may be very similar. I would like to use more familiar framework, then I choose basic React+Node.js to complete the application. Material Design elements looks clean and beautiful, and therefore I choose Material-UI for UI design. For styling, I just use CSS modules in JS for components.

VS code is a powerful Editor as IDE with that I was used to before. It is natural to use these tools that I have known before. For writing part of the documentation, I choose to use Google Docs, which is easy to use and share online.

In addition, I don't need more collaboration tools to communicate with team members because I am working alone, just use email to contact with my supervisor.

Metadata

For the application, I use a library described in last chapter to extract important information for images. It's normal to have additional EXIF data if the photos are taken by digital camera or smart phone. It is important to note that the orientation value should be extracted as well because the web browser like Chrome can not automatically rotate the images to the right orientation by the values.

3.2 Method

The method for the development I has chosen is the agile method even if the team is so small. I don't think this is very formal because in most cases it needs more people in the project team. Therefore, I just pick up some ideas from the agile method and use it. The agile method is suitable because it is a common method for software development, and it breaks a larger project into some smaller parts that can be finished in increments and iterations.

For example, I was using Scrum board for getting an overview of the user stories, small tasks and the progress. The following picture is the Scrum board during the project. Every day I will check the progress, find out what I am going to do next from the board and update the status if tasks are done.

Some parts of the scrum framework are missing. The total working time is broken into several sprints for about two or three weeks. The meeting was held regularly with help and feedback.

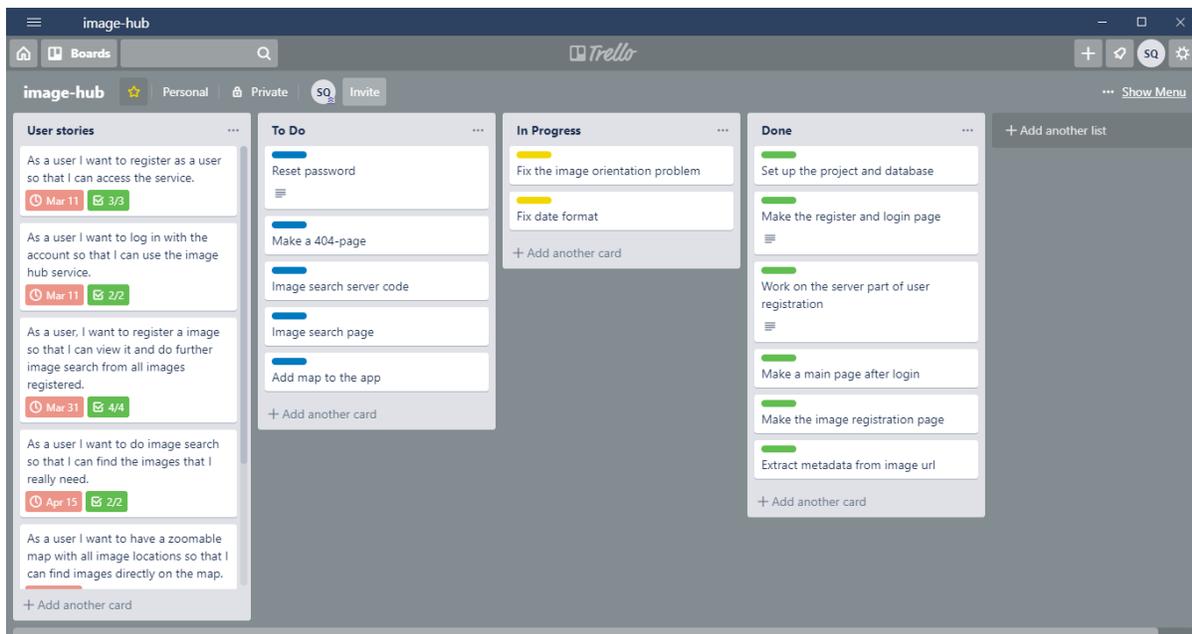


Figure 2: My Scrum-board made by Trello

Research methods are the strategies used in the collection of data for analysis in order to uncover new information or create better understanding of a topic.

For the research method part, I choose Design Science Research (DSR). It is a well-accepted framework to solve problem within Information Systems (IS). Some ideas can be implemented in my project.

I think it is important to focus on the design cycle, start with building the design and functionalities and then evaluate with the requirements. Repeat several times until I am satisfied with the results.

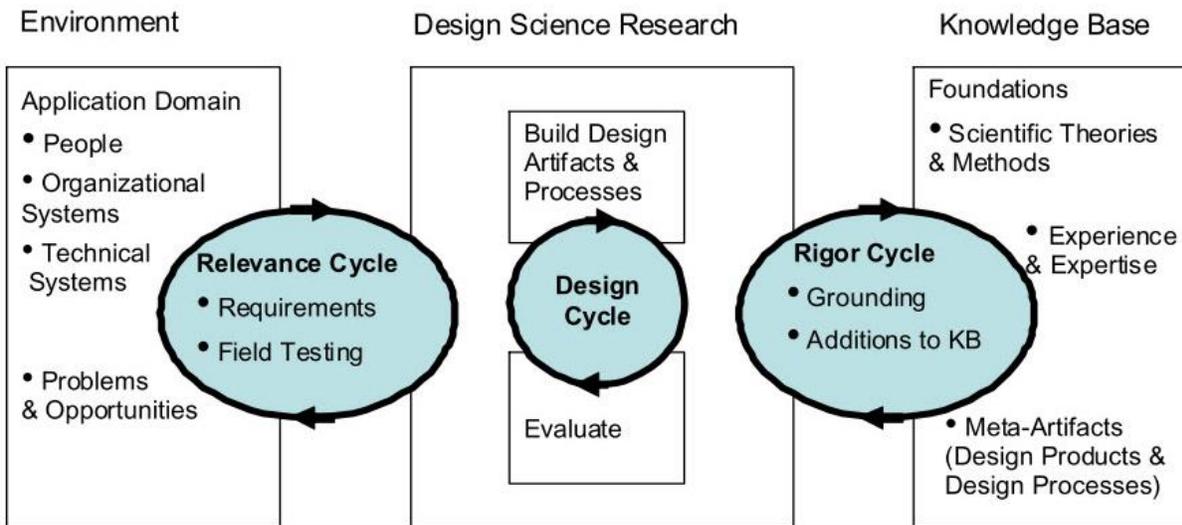


Figure 3: Design Science Research Cycles[5]

4. Results

This chapter will present the all the results from what I have produced from the project. The results are divided into three parts- scientific results, engineering results and administrative results.

4.1 Engineering Results

We have planned the goals in the vision document[Attachment A]and requirements documentation[Attachment B] when I started the project. In the following table, I will describe the status for each functionality.

	Functionalities	Status
1	Register user	Completed. An email will be sent after user registration.
2	Log in	Completed. You can log in with the account you have registered.
3	Change password	Not fully completed. Have no time to finish it.
4	Register new images	Completed. Basic functionality.
5	Auto-fill date and geo-location into their fields	Completed. I added a button for that. If there's metadata connected with this image, the date and geo-location will be filled in when you click on the button.
6	Auto-tag the images	Completed. I added a button for getting three auto-generated tags with highest confidence.
7	Search for images and show the results	Completed. Basic functionality.
8	Have a zoomable map with all image locations	Not fully completed. Have no time to finish it.

Table 2: Engineering Results

The application can be used with different web browsers. I have tried to optimize the layout for mobile phone, but it still has some shortcomings

System Documentation[Attachment C] is in the attachments.

4.2 Scientific Results

An extremely important part of the report to answer the research questions.

“What kind of functionality is needed in an image hub application?”

To answer the question above, the User Test Report[Attachment F] is an important basis.

4.2.1 Findings from the user test

The first thing is to get the real image source. The images are only registered with the URL, and it is difficult to know where the images are stored. To solve this problem, more information about the images should be added. It’s possible to have a link or button to go to that site with the images stored.

It will be better that we have different source choices when we register an image, then link to the online store to pick up the URLs.

Another functionality I would like to have is to share only the images that you want to share, for example, the search result.

The image detail page is not powerful enough without functions to add and remove tags.

4.2.2 Findings from other places

A functionality to create a photo album will be good. The album can be various formats, for example a pdf file or just a link to the application. It should be shared conveniently. To make a pdf we might need some automatic layout. This could be achieved by using a library if that exists, or it could be whole new project.

I haven’t considered that the links have some security or authentication limitations. If these situations appear, the registration may be not worked as normal. It is also important to make sure that we can register different kinds of links even if the websites require authentication.

A possible addition can be some improvements with the image detail page with more metadata which are useful for photographers. For examples, the following data:

- Exposure time
- Aperture
- ISO film

4.3 Administrative Results

I will use the data from Project Handbook[Attachment D] to explain the administrative result, which means the comparison between the hours estimation in the progress plan and the hours used in fact.

Activities	Estimation (Hours)	Actual hours used	Deviation
Code	250	304	+54

Research	60	51	-9
Testing	15	9	-6
Vision Document	30	19	-11
Requirements Documentation	25	29	+4
System Documentation	15	10	-5
Main Report	90	71	-19
Meetings and notes	15	12	-3
Total	500	505	+5

Table 3 : Table for the hours estimated and the actual hours used

I made a diagram for getting a deeper understanding of the results.

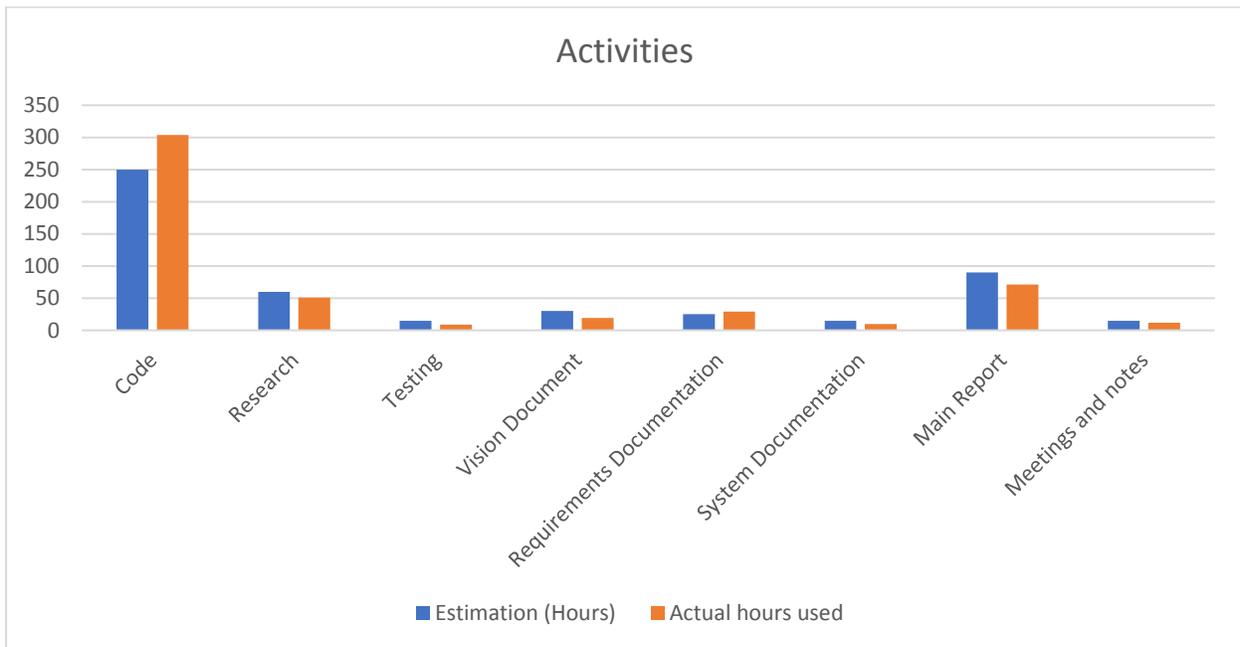


Figure 4: Diagram for the hours estimated and the actual hours used

5. Discussion

This chapter gives discussion of the results from last chapter.

5.1 Engineering Results

Engineering results are related to the functional requirements. I will say most of the requirements are fulfilled. The web application works well for the basic functionality, image registration and image search.

It takes long time to fetch metadata from the URL of the image. Take Dropbox as an example, the URL should be a direct download link rather than the normal link. That means the image we have downloaded should be intact with EXIF data. [6]

For example, this kind of URLs can be use in the Dropbox case:

https://dl.dropboxusercontent.com/s/35y4mjwggmadfmt/20171110_121130.jpg?dl=0

https://dl.dropboxusercontent.com/s/dd5ydfefgneh3/20171021_103858.jpg?dl=0

https://dl.dropboxusercontent.com/s/6pjlqrch85ipm5i/20181124_090801.jpg?dl=0

https://dl.dropboxusercontent.com/s/okp88ogipzeab5o/20180707_113422.jpg?dl=0

https://dl.dropboxusercontent.com/s/hgn01diapltk5g3/20180803_093611.jpg?dl=0

https://dl.dropboxusercontent.com/s/5bf2xj5j11pdh26/20180710_162432.jpg?dl=0

5.2 Scientific Results

I have planned a user test by myself in the end of the project, the Test plan[Attachment E] and the Test Report[Attachment F] are in the attachments. There are so many findings from the user test, but some of the data are not enough. For example, I think the question like “Where do you store your images/photos online?” is important. If the time is enough, I may do some research and survey on more test users to get the information about that to know the need of the users well. Then I can use more links to test the results.

5.3 Administrative Results

Based on the administrative results described in chapter 4, I find that there are many differences between ideal and reality. Fortunately, the requirement of the work time (501.5 hours[7]) for the whole project is fulfilled.

I have spent much more time on coding for both front-end and back-end. Because of that, the time left for different kinds of documentation is so short. The time on progress plan is not so reasonable either. Good thing is the basic functionalities works as I have expected. If I had better scheduling of the time, better preparation of knowledges, the product would be much better.

5.4 Evaluation

I worked alone for this project. The project is started late from week 5, and I had other courses with assignments during the project process. I am sorry that I did not arrange the time perfectly.

In the end of the project, I always had the feeling with pressing time every day. The product should be finished earlier, and I should do the user tests, start to write more documentation earlier.

Sometimes I worked inefficiently because my ability to solve problems by myself is not strong enough. It was always a time-consuming work to try various possible solutions for a problem. I think it was a rewarding process to find the problem and solve it by myself. As a result, I learned a lot from the process. I was becoming more familiar with the technologies, methods, frameworks and so on.

I think my biggest shortcoming is that the research part is not so substantial. It's better to decide the research questions earlier and do more research about it.

All in all, this was a very good experience to manage everything by myself.

6. Conclusion and further development

6.1 Conclusion

In this project, I finished building the web application that meet most of the requirements, and then did some research and analyses based on the web app and the user tests.

6.2 Further development

This version of the application is just a little simple, without so many additional functionalities I have expected before. In the result chapter, I have mentioned some of the functionalities that we can add in the future based on the user test. Some of them are not easy to achieve. For my version of the application, the map functionalities can be improved a lot in the future.

7. Reference

- [1] Introduction to JSON Web Tokens
<https://jwt.io/introduction/>
- [2] EXIF Orientation values with a picture
<https://sirv.com/help/resources/rotate-photos-to-be-upright/>
- [3] Node-exif
<https://www.npmjs.com/package/exif>
- [4] What is Agile Methodology?
<https://luis-goncalves.com/what-is-agile-methodology/>
- [5] Design Science Research
<https://www.uio.no/studier/emner/jus/afin/FINF4002/v13/hefner-design.pdf>
- [6] MATTHEW GUAY: How do you Generate a Direct Download Link to Share a Dropbox File?
<https://zapier.com/learn/how-to/generate-direct-dropbox-link/>
- [7] Bacheloroppgave våren 2019
http://iie.ntnu.no/fag/hpr/FellesVeiledning2019.html#_Innlevering_av_presentasjon

8. Attachments

- A. Vision Document
- B. Requirements Documentation
- C. System Documentation
- D. Project Handbook
- E. User Test Plan
- F. User Test Report