Østfold University College

BACHELOR'S THESIS

Development of Makerspace Management System
Group BO17-G14

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21/03/2017

Computer Science / Digital Media Production / Information Systems
Faculty of Computer Sciences

HØGSKOLEN I ØSTFOLD

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BACHELOROPPGAVE

Prosjektkategori: Bacheloroppgave	X	Fritt tilgjengelig
Omfgang i studiepoeng: 20	(30/12 2029)	Fritt tilgjengelig etter
Fagområde: Informasjonsteknologi	(X)	Tilgjengelig etter avtale med oppdragsgiver

Tittel: Utvikling av MakerSpace Management System	Dato: March 21, 2017
Forfatterere: Nicolai Naglestad, Thomas Bergby, Espen Ottar Skjeggestad, Simon Chen Dybvik	Veileder: Børre Stenseth
Avdeling / Program: Avdeling for Informasjonsteknologi (alle programmer)	Gruppenummer: BO17-G14
Oppdragsgiver: HiØ/IT (MakerSpace)	Kontaktperson hos oppdragsgiver: Espen Teigen

Ekstrakt:
Det har vært en økende vektlegging på dokumentasjonen i bacheloroppgavene ved HiØ, slik at hoveddokumentet nå er grunnlaget for karaktersettingen. Formålet med dette prosjektet er å gjøre det enklere for studentene å produsere dokumentasjon med hensiktsmessig innhold, tradisjonell struktur, og profesjonell utforming. Rapporten starter med å redegjøre for generelle krav til vitenskapelige og tekniske rapporter. Det blir lagt spesielt vekt på kravene som stilles ved HiØ. Det gies en kort oversikt over hvordan man produserer og vedlikeholder dokumenter, både analoge og digitale. Deretter blir det utformet en mal som angir struktur og innhold i hoveddokumentet. Etter en ha utviklet en sett med minimumskrav til programvarene som skal brukes, blir det klart at kun to verktøy er aktuelle: LaTeX og *OpenOffice Writer*. En selvforklarende mal blir implementert i dokumentverktøyet LaTeX (en mer eller mindre identisk mal for OpenOffice er beskrevet i prosjektet *OpenOffice mal for bacheloroppgaven*).

3 emneord:

REST API / NOSQL
Inventar
Maker Movement

Abstract

Coming soon. . . !

Acknowledgements

We would like to thank the following people. . .

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Chapter 1

Introduction

1.1 The Group

The group consist of 4 third year students. 1 informatics 2 digital media production and 1 information-systems. Most of the group have worked with each other on multiple occasions. Be it in student organisation or school projects. 3 member of the group also share apartment. All member have a high interest in the project where they themselves have spent much time.

1.1.1 Thomas Magelssen Bergby

A student who has been interested in everything regarding IT and technology since he was a kid. Thomas has been a leader for “Lær Kidsa Koding” (A group of students who teach coding for kids) and a leader for student assistants in web-development and JavaScript courses.

Thomas studies Informatics, and has gained skills within JavaScript, Java, PHP, CSS, Linux and Python. During his studies, he has taken courses like

- Algorithms and data-structures
- Software Engineering
- Object Oriented Programming
- Android Programming

He also enjoys traveling, and hopes to eventually get a job in the United Kingdom or USA.

1.1.2 Nicolai Naglestad

Studied International Baccalaureate at Skagerak International School in Sandefjord. Nicolai has an above average interest in technology and is always looking for something new to learn. Beside his studies he works as a student assistant in the subjects introduction to programming, web development, object-oriented programming and lastly he works at the schools MakerSpace where the latter is a position where he helps students get started on projects and with the use of the 3D printers. Nicolai has great interest with most aspects the are to be found inside the MakerSpace and you will find him there mosty of the time.

Nicolai studies digital media production at Østfold University College, but has taken subjects such as OOP, Software Engineering and .NET. He also enjoys learning new systems and languages.

1.1.3 Espen Ottar Skjeggestad

He has a broad field of interest, but the main one is IT and Biology. He is an active person that likes jogging, training, diving and trips. He is also politically active in the student politics and has roles as elected representative for the class, member of the student counsel and member of the executive committee for the student-democracy. He is currently a student vara-member of the University College Board. In work roles he was a student assistant for GRIT and is now working at the school library.

Espen studies Information Systems with focus on IT and code, but also includes business leadership and classes about economy.

1.1.4 Simon Chen Dybvik

Simon has been interested in technology his whole life. As a curious child, he often disassembled products to see what's inside and how it worked. He is over average interested in Apple and their products.

During his studies at Østfold University College he has exchanged a semester abroad to California State University, Monterey Bay, where he focused on web development using CMS, JavaScript, jQuery, HTML and CSS, and graphic design. He is former vice-president of NITO Studentene Halden. NITO is a union for engineers and technologists.

Simon studies Information Systems with emphasis in web development. He has taken courses like project management, marketing, business economics and graphic design.

1.2 Employer

The employer for this project is MakerSpace (MS) which is a room located in Østfold University College (HiØ). The MakerSpace is a playroom for creating all types of technology, everything from electronics and robotics, to programming and 3D-printing. The room is currently funded and managed by the IT department.

Here, students and lecturers can use the rooms equipment to experiment with technology to further educate themselves within topics that they find interesting, and that are not necessarily related to any ongoing subject at the university college. MakerSpace is open for all students and staff of the university college, but is mainly used by the IT department.

The employers for this project are Staff Engineer Espen Teigen and University College Teacher Michael Andersen Lundsveen.

1.3 Task

The task of this project is to develop an inventory- and loan-system for Østfold University College's MakerSpace. The purpose of this is to make it easier for employees at MakerSpace to keep track of inventory at all times. A full inventory-system will help both students and staff to find equipment when a student assistant or department Engineer is not available. The system should preferably be able to know where equipment is in MakerSpace at any time. Simultaneously the employers

of this project want to have a system for users of the MakerSpace to be able to loan out the equipment in the MakerSpace.

1.3.1 Purpose

The purpose of this system is to make maintaining the MakerSpace easier for all parties, but mainly for the employees of MakerSpace. This means less time is used for maintaining inventory and helping to find different equipment. This benefits the school in saving money, as the student assistants do not need to be consulted as often. They currently help with mundane tasks like finding equipment and counting inventory, and decide what needs to be ordered to fill up stocks.

1.3.2 Project delivery / Prototype

This group aims to supply the employer a website (front-end) and server (back-end) that is both user tested, and to the employers and users specification.

The website will support the following features:

- View all items (Name, Location, Description, Amount in stock)
- Create/Update/Delete items (CRUD)
- Register/Modify/Delete/View users
- User registration either via custom system or via OAuth 2.0
- The ability to loan set items defined by admins (list editable)
- See currently loaned items (all items or based on user)

Additionally to this there will be a REST API based on Node.js and MongoDB to provide a system for storing the information for the website and possible future applications or other systems.

Documentation

Each separate prototype/system will also include full documentation on how the system is to be used and in the case of the REST API, how it can be used in other systems. This documentation will be hosted on

the same location as where the code is stored (GitHub). As with our main project page the document will be a web page generated by Jekyll hosted by GitHub Pages.

1.3.3 Method

The group will be using the incremental method for development of the system. This method focuses on development piece by piece, and works well for modular systems. It also works for quantitative and qualitative testing of the parts that are done. These parts can also be used, and delivered to the employer.

Incremental method is that you work on one piece of the system at a time. E.g you make the database-system first, and finish it. You can then move on to the next part.

This method has a lower risk of total failure and no delivery, because of the fact that is made up by working pieces.

1.4 Report structure

The report will be structured in the following way

1. Introduction
2. Analysis
3. Design
4. Evaluation
5. Discussion
6. Conclusion

Analysis

This chapter is about what the employer wants, and how they define the task. This is also where the group will address the fact that the project started out big and difficult, to the smaller and more practical project it is today. The project tools and descriptions of these will be discussed here as well.

Design

This is where the design of the project is discussed. The design process, implementations and decisions during the project is addressed here.

Evaluation

TBA

Discussion

TBA

Conclusion

TBA

Chapter 2

Analysis (Vuerdering om dette er mer begrepsforklaring enn analyse)

2.1 The task

The task is from a need to get a control over the items that exists in MakerSpace. What they are and an approximately how many there are. It is also a need to get a control on the items student loan. The system will need the student assistants that work on MakerSpace to add and remove items. The boss of MakerSpace will need to have the same right and the possibility to add and remove student assistants. There will not be a need to get an exact cont on items like small leds and screws. But for bigger and more expensive equpment like raspberry pi or drones will need a count.

2.2 MakerSpace

MakerSpace is manly manned with by student assistants Around 3 people. It has a large room with usually many visiting through the day. Many of the student visiting make do by them self but occasionally need student assistants to find something or get advice on how to do a project. Manly the student assistants work with making sure the MakerSpace room is in order. They also have courses in relevant discipline for MakerSpace like 3D printing and drones.

2.3 Program tools

2.3.1 MongoDB

We chose to use MongoDB as a database system because we mainly wanted to learn to use a NOSQL database system. MongoDB type databases, have some strengths that make it easier for us to use when developing a system. MongoDB themselves have a good overview showing the differences of SQL and NOSQL **nosqldatabasesexplained_2017** where we can see that this can both help us build the database easier and we should learn and gain experience with this type of system as this might become very relevant for business in the future.

2.3.2 Node.js

Like with our database system it is mostly chosen due to our want to learn and experiment with technologies that we have not used yet in subjects we have had previously. We also looked around at what other had been using to make a REST API and why they used that specific architecture.

We quickly found that most recommended to use Node.js. This was because that it is well documented and is very easy to setup and test (requiring only the server itself and a database server to connect to) other architectures require specific software from the server to run. (As an example a REST API based on Spring/Java require a Gradle or Apache Maven server to run)

2.3.3 Git and GitHub

The group uses Git and GitHub for version control, both for the report and development.

The repositories on GitHub are public for everyone to see and contribute to, since this is a MakerSpace project. All the development is open source, and GitHub is a good platform for this exact purpose.

2.3.4 Latex

The group chose to use LaTeXfor writing the report, and the documentation. The Minutes are also written in LaTeX.

The group chose to use LaTeXover other text editors, because of the usability. When it comes to large projects and reports, LaTeXis superior to other editors.

It is proven **blanco_2015** that LaTeXis easier to use and more manageable on larger reports and projects, over e.g. Word. When a document becomes complex, it is a lot easier to use LaTeX. See graph (figure 2.1).

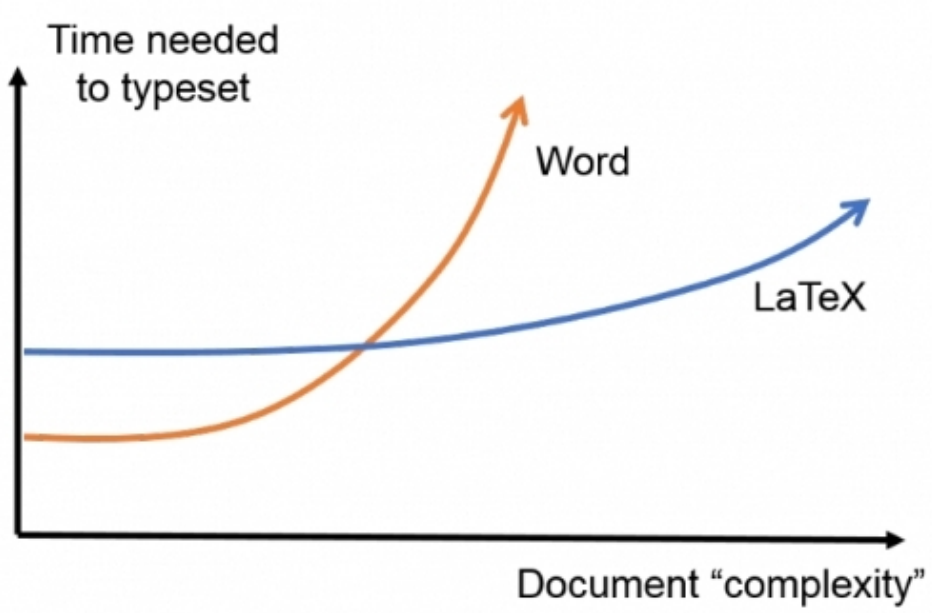


Figure 2.1: Graph about document complexity.

Chapter 3

Design (Vurdere om dette passer bedre under analyse)

3.1 Site layout

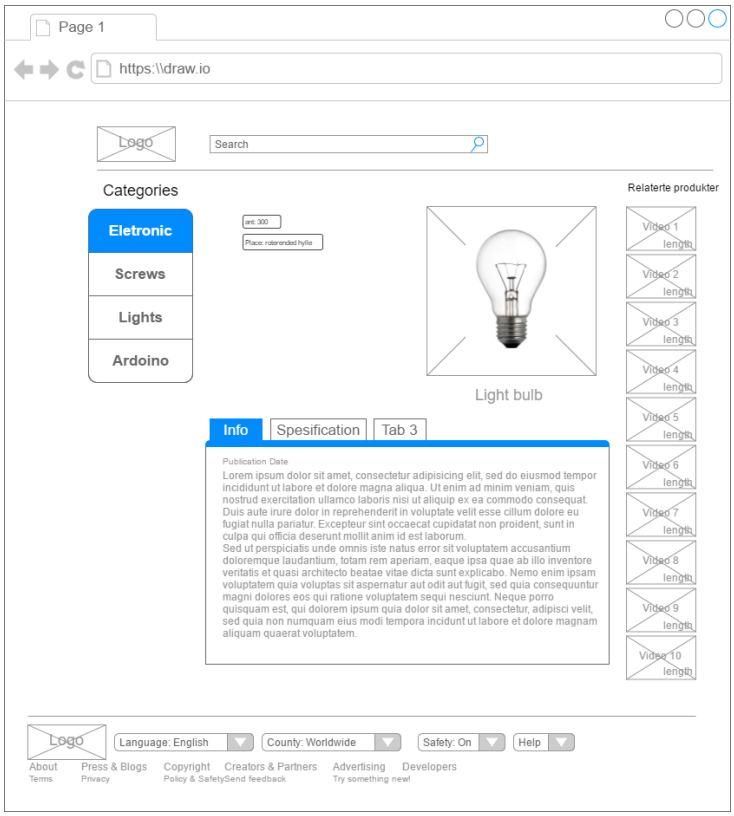
The site layout is based on the business model from sites like komplett.no, Kjell&Company and Thingiverse. This is because the model is well tested and easy to recognize for the user. The first wireframes looked like this

Originally the group wanted to have a site that had pictures for each item and a lot of information about the items. But after discussion with supervisor about how the workforce of MakerSpace is limited.

The design is based on these wireframes.

3.2 MongoDB

As stated in chap analyse(begreper) As our database is a NOSQL type database there is no proper way to properly represent the database models. We therefore choose to display them in two ways; the model.js file in the NodeJS server and a output from the REST API in it's default JSON format.


Page 1
https:\\draw.io
Logo
Search
Categories
Eletronic
Screws
Lights
Ardoino
Light bulb
Relaterte produkter
Video 1 length
Video 2 length
Video 3 length
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Video 5 length
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Video 8 length
Video 9 length
Video 10 length
Info
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Logo
Language: English
County: Worldwide
Safety: On
Help
About
Terms
Press & Blogs
Privacy
Copyright
Policy & Safety
Creators & Partners
Send feedback
Advertising
Try something new!
Developers

Figure 3.1:

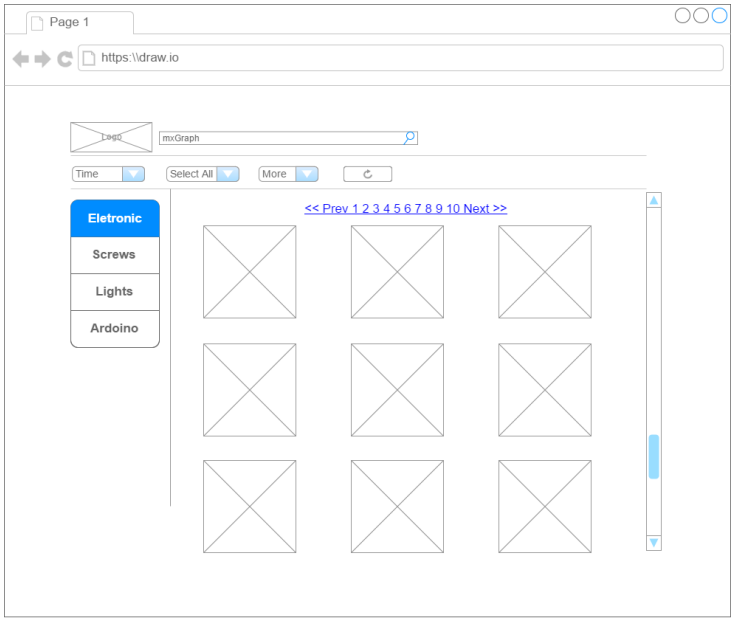

Figure 3.2:

3.2.1 Items

Node.js Model

```
var ItemSchema = new mongoose.Schema(
  {
    item_name: {
      type: String,
      unique: true,
      required: true
    },
    description: {
      en: String,
      no: String
    },
    short_description: {
      en: String,
      no: String
    },
    categories: [
      {
```

```
        type: mongoose.Schema.ObjectId,
        ref: 'Category'
      }
    ],
    tags: [
      {
        type: mongoose.Schema.ObjectId,
        ref: 'Tag'
      }
    ],
    locale: {
      type: mongoose.Schema.ObjectId,
      ref: 'Location'
    },
    image_url: String,
    quantity: Number
  }
);
```

JSON Model

```
{
  "_id": "58de638c5edb8f418b9c22d5",
  "quantity": 5,
  "image_url": "http://website.com/image.jpg",
  "item_name": "A Item",
  "__v": 0,
  "tags": [
    {
      "_id": "58b445ecbdc857062a247226",
      "__v": 0,
      "tag": {
        "en": "arduino",
        "no": "arduino"
      }
    }
  ],
  "categories": [
    {
      "_id": "58ac2d03bdc857062a24721a",
      "__v": 0,
      "category": {
        "en": "Arduino",
        "no": "Arduino"
      }
    }
  ],
  "description": {
    "en": "A item.",
    "no": "En ting."
  }
}
```

3.2.2 Category

Node.js Model

```
var CategorySchema = new mongoose.Schema(
  {
    category: {
      en: {type: String, required: true},
      no: String
    }
  }
);
```

JSON Model

```
{
  "_id": "58a3309f170b430a6a835012",
  "__v": 0,
  "category": {
    "en": "Test Category 1",
    "no": "Test Kategori 1"
  }
}
```

3.2.3 Tag

Node.js Model

```
var TagSchema = new mongoose.Schema(
  {
    tag: {
      en: {type: String, required: true},
      no: String
    }
  }
);
```

JSON Model

```
{
  "_id": "58b445ecbdc857062a247226",
  "__v": 0,
  "tag": {
    "en": "arduino",
    "no": "arduino"
  }
}
```

Chapter 4

Implementasjon

4.1 First itiration

4.2 Utredning

4.3 Mediaproduksjon

Chapter 5

Testing

5.1 Test goal)

Test the site's usability. This include finding item

To ensure the system do what it is supposed to do, we need to verify this through a usability test. The group need to ensure that the new functions work as intended after implementation. As already existing functions can get affected after rolling out the new implementation.

Testing verifies that the system meets requirements and verifications to ensure that the system is built right. Testing helps to validate that the system is being developed for what the user need and expect.

Test the site's usability. This include finding item's, Using categories and adding items.

5.2 Methods

5.2.1 Five Second Test

The Five Second Test is to measure the clarity of the site. By showing the test subject the design for only five seconds, and then asking what they recall after viewing it.

5.2.2 Usability Testing

An qualitative method for testing the usability of an product. This be given a user a set of task to do on the product and evaluating the re-

sults. It's important not note that it's not the user that is tested, but the product.

5.3 Target Audience

The target audience will be students and employees that do not have as much knowledge about MakerSpace and it's items. This is to make sure the system is optimal to understand too new users.

The target audience will be students and employees at HIOF, that do not have as much knowledge about MakerSpace and it's items. This is to make sure the system is optimal to understand too new users.

The test group will consist of 4 students, where 2 male and 2 female. And 2 employees, 1 representative from each sex.

5.4 Test Execution

5.4.1 Roles

User

The user will go through different instructions given by the test leader for the site. The reactions and problems the user will encounter will be valuable test data to improve the site.

Test Leader

The test leader will give instructions to the user and note all activity.

5.4.2 Setup

User will in setup be in the same room as the test leader. This is because there are no good test environment available to have the user and the test leader in separate rooms a normal for a normal usertest.

The user will sit at the desk in a environment with as few distraction as possible. The test leader will sit behind the user to not distract and "guide" the user by body language or other non verbal way.

5.4.3 Tasks

1. Find any kind of a led light that a red color.

   The goal of this question is to se if the user will prefer to find the light by using category og use the searcher

2. Find Cosmo and tell us what it can be used for.

   The goal of this question is to se how the user will find an item they don't know how is spelled and if the searchbar will help the user.

3. Change language of the site from English to Norwegian.

   The goal here is to se if the user can with ease find where they change the language of the site, or if this should be emphasised more.

4. Add this item to the site "random little thing".

   The goal is to se if its easy and understandable for the user to add an item to the site.

5. Find Arduino Uno without using search box.

   The goal for this test is to check what the user will use. Category list or the inventory list.

5.4.4 After interview?

Did you get a overview over what kind of items there are in MakerSpace?

Chapter 6

Evaluation

Chapter 7

Discussion

Chapter 8

Conclusion

Appendix A

Meeting notes

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A.1 Meeting 24-1-17

BO17-G14 Guidance meeting

Minutes for January 24, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas

Absent:

Reports

The pre-report is delivered and approved

Last meeting points

1. Create pre-report
2. Create project contract
   The minutes of the previous meeting were approved.

New Business

1. Define tools we are going to use
2. Have perimeter meeting with employer.

Next Meeting: Thursday, January 31, at 10:30

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A.2 Meeting 31-1-17

BO17-G14 Guidance meeting

Minutes for February 31, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas

Absent: B. Thomas *(Travelling)*

Reports

Nothing notably to report.

Last meeting points

1. Create high fidelity wireframes

   The minutes of the previous meeting were approved.

New Business

1. Create wireframes
2. Define work roles
3. Meeting with employer to discuss wireframes

Next Meeting: Thursday, February 07, at 10:30

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A.3 Meeting 7-2-17

BO17-G14 Guidance meeting

Minutes for February 07, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas

Absent:

Reports

Wireframes

Landingpage and Itempage — We have created wireframes of landingpages and itempages. These pages have also been discussed with employer.

Last meeting points

1. Create wireframes
2. Have meeting with employer on what the system should contain.

   The minutes of the previous meeting were approved.

New Business

1. Create web page usable for user testing
2. Define therms

Next Meeting: Thursday, February 14, at 10:30

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A.4 Meeting 14-2-17

BO17-G14 Guidance meeting

Minutes for February 14, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas

Absent:

Reports

Webpage

Database — We now have a server. MongoDB is no created and with some dummy-data. It used Json files.

HTML page — The HTML landing page is now created and show dummy data and has a standard navigation menu that follow on all pages.

Last meeting points

1. Check the webpage
2. Defining therms

New Business

1. Start to fill out main report.
2. continue a prototype webpage so we can start user-testing.
3. Start to create a user-test.

Next Meeting: Thursday, February 21, at 10:30

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A.5 Meeting 21-2-17

BO17-G14 Guidance meeting

Minutes for February 14, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas

Absent:

Reports

Site

HTML page —

- The page now speaks with the API
- Created item page and admin page

Database — Continud working on the API

- Fix database form by empty items.
- Fix models
- tarted working on authentication for API

Main report

Added some parts form pre-report to main-report. Gone through the main structure for the template. Checked existing hall of fame reports to se best practise for the main-report.

Last meeting points

1. Start to fill out main report.
2. continue a prototype webpage so we can start user-testing.
3. Start to create a user-test.

New Business

1. Make a design on the webpage to make it ready for user testing.
2. Create the structure and fill out what we can on the main report. Add discussion of why we chose to focus on a easy to update site rather then a heavy administrated site.

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Next Meeting: Thursday, February 28, at 10:30

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A.6 Meeting 28-2-17

BO17-G14 Guidance meeting

Minutes for October 5, 2011

Present: S. Børre (Chair), N. Nicolai, B. Thomas

Absent: S. Espen *(Travelling)*

Reports

Website

- We now have a detailed item view (not all info included)
- Search implemented (still testing)

Meeting discussions

New group member

We have been asked by a member of another bachelor group if he can join our group. We discuss this matter during the meeting, where our supervisor states that this decision is up to us te members of the group. Between now and next meeting we will make a decision if he will join our group or not.

Website / System

We discussed different aspects of the website, what it still needs and how we will solve different issues.

We discussed the following points that we need to implement on the website:

- Items
  - View (done)
  - Item out of stock / messaging system
  - New items (semi done) / Edit items
  - Tags on item page and in search
- Messaging system
  - Item out of stock
  - Loaned item
  - General messages
  - Need assistance
- Box location

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A.7 Meeting 28-2-17

- Users
  - Unauthenticated
    - View items
    - Send messages
  - Authenticated
    - Same as Unauthenticated
    - CRUD items
  - Admin
    - Same as Authenticated
    - CRUD news
    - CRUD users
- Login System
  Here it was discussed if we need a complicated login system as the majority of users on the system are unauthenticated users.

Report

The deadline for the report is March 9, but our supervisor states that this date is not that important as we can review the report every meeting.

Until next meeting

1. Continue work on website, to prepare it for user testing
2. Continued work on the report.

Next Meeting: Tuesday, March 7, 10:30

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A.8 Meeting 14-3-17

BO17-G14 Guidance meeting

Minutes for March 14, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas D. Simon

Reports

New member is now in the group and active in all the tools we are using.

Last meeting points

1. Continue work on website, to prepare it for user testing
2. Continued work on the report. The minutes of the previous meeting were approved.

New Business

1. Work more on report. Especially Analysis and implementation
2. Remove most of template fill that is not needed in the main report.
3. Add part about why we changed the direction of the system from high bureaucracy to low bureaucracy.

Next Meeting: Thursday, Marsh 21, at 10:30

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A.9 Meeting 21-3-17

BO17-G14 Guidance meeting

Minutes for March 21, 2017

Present: S. Børre (Chair), S. Espen, N. Nicolai B. Thomas D. Simon

Reports

Low productivity. Nothing note worthy to report.

Last meeting points

1. Work more on report. Especially Analysis and implementation
2. Remove most of template fill that is not needed in the main report.
3. Add part about why we changed the direction of the system from high bureaucracy to low bureaucracy.

New Business

1. Work more on report. Especially Analysis and implementation
2. Make sure that the new report always is ready for Mondays.
3. Make sure that all task has defined owner and time limit.

Next Meeting: Thursday, Marsh 28, at 10:30