NTNU
Kunnskap for en bedre verden

Bachelor thesis in web development:

Colourlab - Logging system

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Preface

Bachelors thesis around the creation of a new system for the Colorlabs at NTNU in Gjøvik made as a part of the study program Web Development. The project was carried out during the spring semester 2018 between January and May and was made in collaboration with the university. The system is made for booking and logging activity in the Colorlabs, and was made because the current system is a book, which is outdated and was not used.

Gjøvik, 2018-05-16

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Acknowledgment

We would like to thank Marius Pedersen for all the time and help he has given us during the project; he has been a pleasure to work with. Further we would also like to thank our supervisor; Carlos Vicient-Monllaó, for continuous supervision throughout the project. Lastly we would like to thank all participants from interviews and user testing - without them the product would not have been the same.

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Abstract

Title	Colourlab - Logging system
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Description

The task at hand has been to create a new logging and booking system for the Colourlabs at NTNU in Gjøvik. Where the goal is to make a functional system, ready to be used.

By utilizing different methods the group created a complete system, that reached its goal of being better than the current solution. It is also easy to use and accessible everywhere, anytime (as long as a internet connection is established). The system allows for further development and efficiently keeps structured logs. This report goes through all work done, every result achieved and the final product.

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Chapter 1

Introduction

The Colourlab at NTNU in Gjøvik is a research group that are currently specializing in colour science, colour imaging, image processing, and video processing (Colourlab, 2018). They have several rooms on campus dedicated to research and practical lectures. These rooms contain a lot of equipment, both mobile and immobile. The rooms and equipment are used by both students and employers, but also guests such as researchers that come from other locations than NTNU Gjøvik. To keep track of who uses the rooms and equipment, and to insure privacy when working in the labs, they need a booking system.

The project is about developing a new system for the Colourlab that allows for booking of rooms and equipment in those rooms. As well as logging all these bookings so that statistics about usage can be made.

1.1 Existing solution

The Colourlab does not currently have a digital solution for logging and booking equipment. The current solution is a book that is in one of the labs where they note down what they are using and when. This solution is not something that everyone uses in the Color lab which makes it very inefficient. They cannot know without going into the labs if the equipment they need is booked or not. Also, even if the equipment is not booked, it might be used by someone who hasn't written it down in the book. This also creates a conflict when it comes to storing logs of use, seeing as not everyone uses the system so it is not a true representation of the data.

However, for booking rooms the Colourlab is currently also using an e-mail booking solution with their NTNU e-mails. Where they send a mail to the room with the times they want to book, and if its available they can book it. The drawback to this system is that everyone in the system needs to be notified of bookings. Also, it is not possible to log these bookings in an efficient way.

Because both these "systems" are in use, confusion when someone uses the book and someone uses the mail-system also occurs.

Post-it notes are used to keep rooms and equipment over extended periods of time. Also used if research is being done where if someone walked in during the research it would get ruined. The post-it notes would be placed on the doors or equipment saying that it is "in use" and "do not enter".

1.2 Problem Formulation

The Colourlab has been using a book for 17 years for booking and cataloging the use of equipment. The facilities consists of different rooms, while the book is located in only one room. This requires someone who wants to book equipment to leave their current location and go look through the book, which is both time-consuming and inefficient. Furthermore, if someone wants to book a room they need to send emails to all participants of the Colourlab to notify them that the room is occupied.

The Colourlab also needs to log hours that has been used in the lab and with equipment to know what is being used a lot and what is not being used as frequently. Specifically important when working on an EU-project where it is required to log and document all hours they have worked. The administrator can then see this log and figure out what equipment they need more of this will also help making an argument to the school administration as to why they could need more equipment.

Another issue brought up by the project owner is that equipment which is broken or missing need to be brought to their attention. Currently there is no easy way to report this, which can cause problems when the equipment is needed by the Colourlab.

To solve these issues, the Colourlab wants a new, responsive system that works on all devices and is easy and fast to use to ensure that everyone uses it. They are planning to put tablets

outside (and inside) the labs so that they can easily log usage even if users have not booked it prior. The system needs to contain different roles so that they can log what equipment or rooms different roles use the most. They want it to be flexible for administrators to add new equipment and rooms if necessary.

1.3 Goal

The goal of the project is to develop a booking system that is more user friendly and efficient than their current existing solution and replace it end of May 2018. As well as log all bookings so that administrators easily can see who has used what and how long it has been used.

1.3.1 Purpose goals

- Easier and more accessible booking solution.
- Accessible everywhere, anytime.
- Make logging of usage more efficient.
- Allow for further development of the system.

1.3.2 Result goals

- Web-based booking system
- New booking system of rooms and equipment.
- User friendly and recognizable design
- The solution should completely replace the existing system.
- Deliver a better organization/management/logging tool for administrator.
- Able to book from anywhere.

1.3.3 Learning outcome

- Get experience on working with a real client and project.
- Learn more about the planning process from start to finish.
- Learn about working in a team
- Analyze existing solutions and learn from these.
- Learn more about frameworks and how to use them.

1.4 Professional background

The group members consist of students from web development, where they have studied web languages, and have developed good knowledge of design- and development processes. Which gives them the required knowledge to develop a web based system for this project.

1.5 Restrictions

Time schedule

The projects time schedule was from January 8th up until May 16th. Time was limited as there has to be a functional product and written report by this deadline.

Budget

All the systems and tools that are to be used for the project will have to be free as the school did not provide a budget for the project.

Other subjects

All the group members also have other subjects parallel to the bachelor project. So balancing time and resources is a concern.

1.6 Target audience

The target audience in this project are users of the NTNU Color Lab. This target audience can be split into four subgroups; students, teachers, administrators and researchers. The solution is aimed at these groups, but primarily the master students who use the labs. A secondary group will be the administrator of the system, as there is a lot of back-end functionality included in the admin management system.

1.7 Similar solutions

Currently there is no direct competition for the Colourlab as this is an internal web application to be used by NTNU. However, research looking at similar booking solutions was spent to get inspiration and figure out what worked for other systems. Examples of these websites are Norwegian, Booking.com and NTNU's own internal booking system for rooms. These solutions will be expanded upon in the section 2.1 Related Work.

1.8 Document structure

The rest of this document is structured as follows.

Chapter 1 - Introduction

The introduction explains and lays the ground for the rest of the report. It also explains the project, the problem, the goals, the restrictions, the target group.

Chapter 2 - Background

Research, definition of methods and preparation before starting the development.

Chapter 3 - Methods

Expands on how methods was used for this project in more detail.

Chapter 4 - Development

Explains how the system is made and how this was made possible.

Chapter 5 - Result

Showcases the result, goes through all pages in the finished product, the goal.

Chapter 6 - Discussion

In this chapter there is a discussion about different aspects of the results and the process. This is where faults are explained and digressed, further there is an explanation on what could be improved.

Chapter 7 - Conclusion

In this chapter the project will be summarized and a conclusion is drawn on how it turned out.

Chapter 2

Background

This chapter expands on research conducted and how methods & tools has been used throughout the design and development process.

2.1 Related work

As stated in chapter 1.7, there currently is no direct competition or similar solutions for the Colourlab as this is an custom solution. However, research looking at similar booking solutions was spent to get inspiration and figure out what worked for other systems.

2.1.1 NTNU Booking

NTNU has an existing booking solution for rooms on campus. Here users can book rooms and view when rooms are booked in the different buildings. However the Colourlab rooms or equipment are not included in what users are able to book through this system.

When viewing the booking of rooms in a building, bookings are displayed in a week by week calendar, and how long they are booked each day are indicated by how long the column is vertically. This allows for a visual representation of when rooms are booked/available. (See figure 2.1)

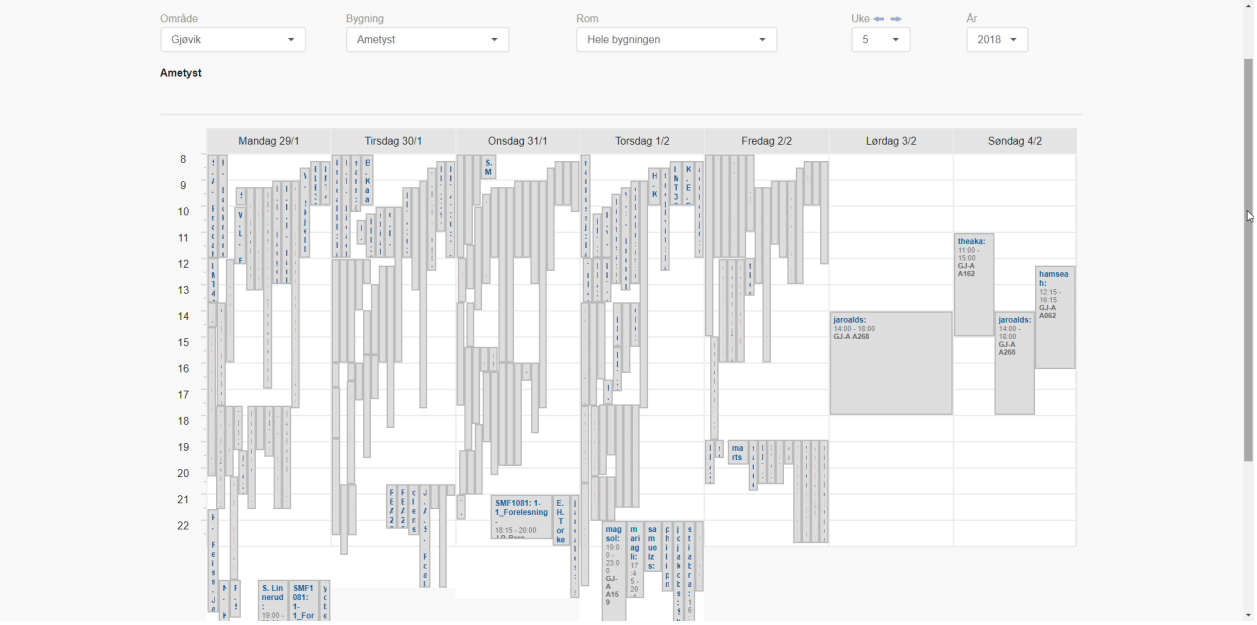


Figure 2.1: NTNU Booking visualization of bookings

When booking a room users have the option to select the time from/to and date, which area (campus), what building, what type of room (group rooms etc.), and how many people the room needs to accommodate. After selecting fields it tells how many rooms are available with the chosen criteria, as well as showing suggestions. At the bottom of the screen simple links to navigate the site is shown. At the top there is a navigation to see bookings. (See figure 2.2)

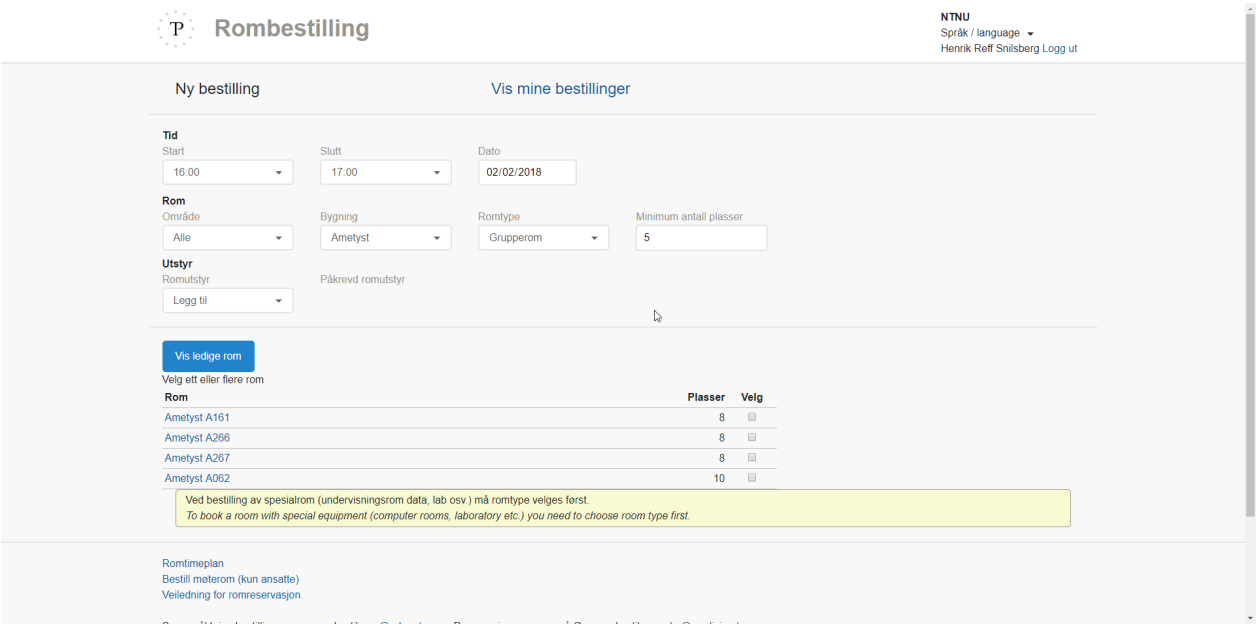


Figure 2.2: NTNU Booking suggestions

Pros

Benefits with this system is that users have a lot of options to narrow down and find rooms that fit their needs. It also limits the use of who can book by requiring users to log in through NTNU's internal portal Innsida[1] and their school connected-"Feide" account. Automatically showing rooms available with users searches is really convenient as it allows to find rooms that is available faster and easier without having to go look through the "calendar" all the time.

Cons

The calendar view can be really filled up and clunky to look at, making it difficult to actually know which rooms and available and when. Sometimes so many rooms are booked that no results will be shown in the system. Users have to go look at the calendar to see if there is a slot where they can fit in a booking. The navigation on the site is not optimal and can be confusing.

To fix these cons, the group would instead of having to go back and forth between doing a booking and the calendar, display the booked rooms within your selected time when booking, and if the time is available. As well as to have a navigation bar to make navigating and knowing which part of the system you are on obvious.

[1] https://innsida.ntnu.no/

2.1.2 Outlook

At University of Oslo (UiO) as well as NTNU (connected to the previous system) users have the ability to book collectively used rooms at the school. These rooms can be booked using Outlook[2] or OWA[3] (web mail). The following rules and pictures is taken from UiO's website. (*Reserving group rooms*, 2018)

There are some rules to reserving rooms:

- Max length for booking is 2 hours
- Rooms can only be booked 14 days before the booking
- Repeating meeting is not allowed
- There has to be at least 2 participants (students) meeting.

To do this open Outlook or OWA and log in with a user name and password. Choose Calendar in the top right corner (See figure 2.3)

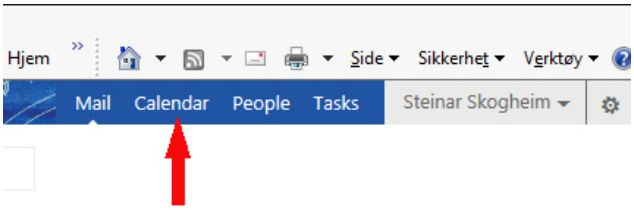


Figure 2.3: Entering calendar

Then click "New event" top left: (See figure 2.4)

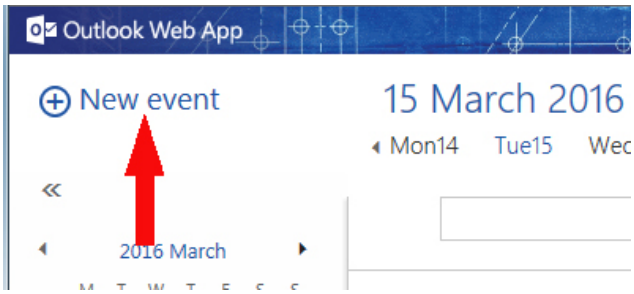


Figure 2.4: Making new event

[2]https://outlook.live.com/
[3]https://outlook.office.com/owa/

Fill in time and give the meeting a name. To choose available room click add room (See figure 2.5)

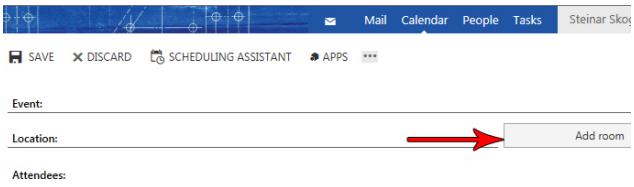


Figure 2.5: Adding room

Choose the right room list, all start with “Kollekvierom” (See figure 2.6)

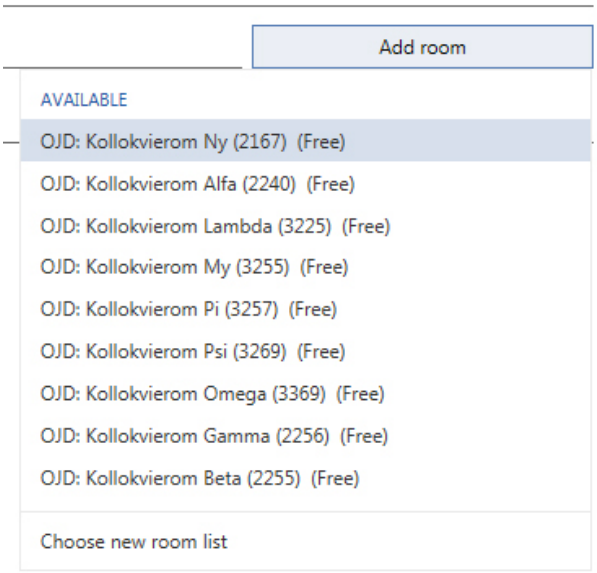


Figure 2.6: Choose a list

Then all available rooms are shown. (See figure 2.7)

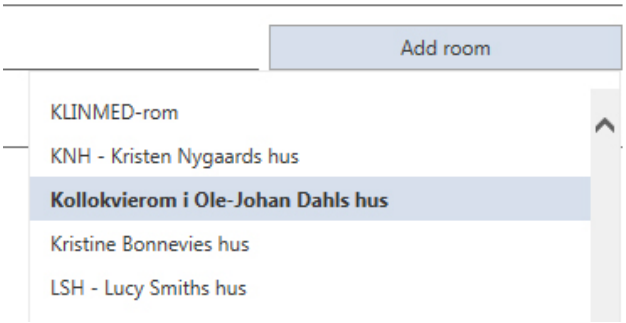


Figure 2.7: pick a room

Choose room and invite other members, then click send to send the request. If a successful booking was created users will get a confirmation e-mail.

Users can also open a rooms calendar to see when it is reserved.

Pros

It seems relatively easy to use, and can be done directly from students/employees e-mail, something that is provided by the school. By using e-mail to reserve rooms, this will automatically create an event in the users calendar when a successful reservation is created.

Cons

The system gives no live feedback on bookings, so users have to do everything by trial and error. It is also a little less mobile friendly.

To improve these cons the groups would implement feedback when booking. Resulting in users knowing if a booking will go through before users actually book a room.

2.1.3 Booking.com

Even though Bookings.com[4] is not a website for booking rooms, it is a big and successful booking site. Looking at how their system have accomplished a successful business with booking can be very useful to our project. They allow to select area, from/to, and how many people, right from their index-page (Figure 2.8).

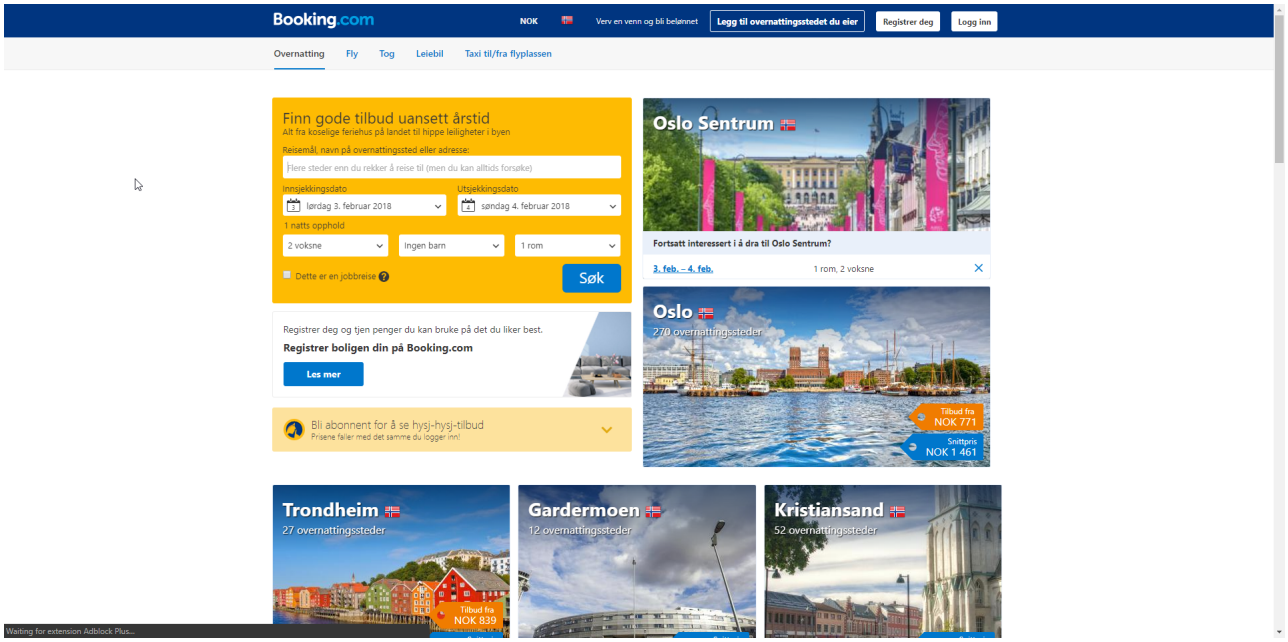


Figure 2.8: Bookings.com index page

When doing a search the web application display the available search results in a list. The web application also allow for advanced sorting on the left side, simple sorting on the top, and also changes to the original search - all easily accessible. On mobile the sorting options are grouped up in the same menu located above the search-results. (Figure 2.9)

[4]https://www.booking.com/index.no.html

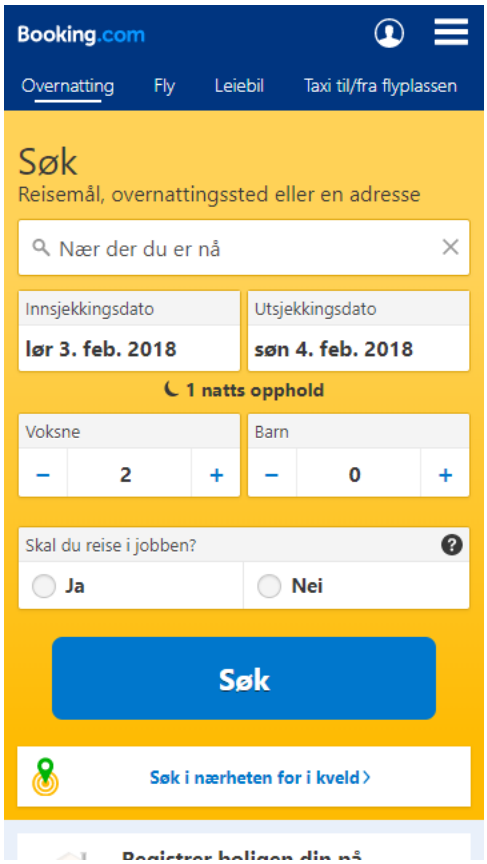


Figure 2.9: Bookings.com index page mobile

Pros

The form to search for hotels is displayed to the user on the front page, with eye-catching yellow background to guide eyes towards the main element of the page. They also allow for more advanced sorting for narrowing down to users preferences after displaying the original search result. It does not beat around the bush and lets the user do exactly what they came to the site for right away. Mobile front page show's the form to sign in right away, and advertisements/recommendations further down on the page. Mobile-version has grouped the sorting options into the same menu under buttons, making users unable to not notice all their options while also tucking them away when not needed.

Cons

The first page on the Desktop version is filled with quite a few displays of hotel advertisements, right next to, and around the booking form. Making the homepage feel less eye pleasing and cluttered. After searching, the display of the hotels on the desktop-version take up a lot of space vertically, and does not allow users to easily see more results at once without scrolling (on mobile however this works well). On the desktop-version having sorting on two different places could be confusing to the user, and the simple sorting on the top could be overlooked if the user is too fast.

The groups solution to these cons would be to have a simple main page where booking takes place, and to have a unified and recognizable filtering solution for the whole system.

2.1.4 Norwegian.com

Norwegian[5] is not a room-booking site either, but a big company that deals with booking. When entering the site users are greeted with a simple and modern form for booking right away (See figure 2.10). It also displays last searched flights so that users can quickly jump back into the booking users were last intending to do.

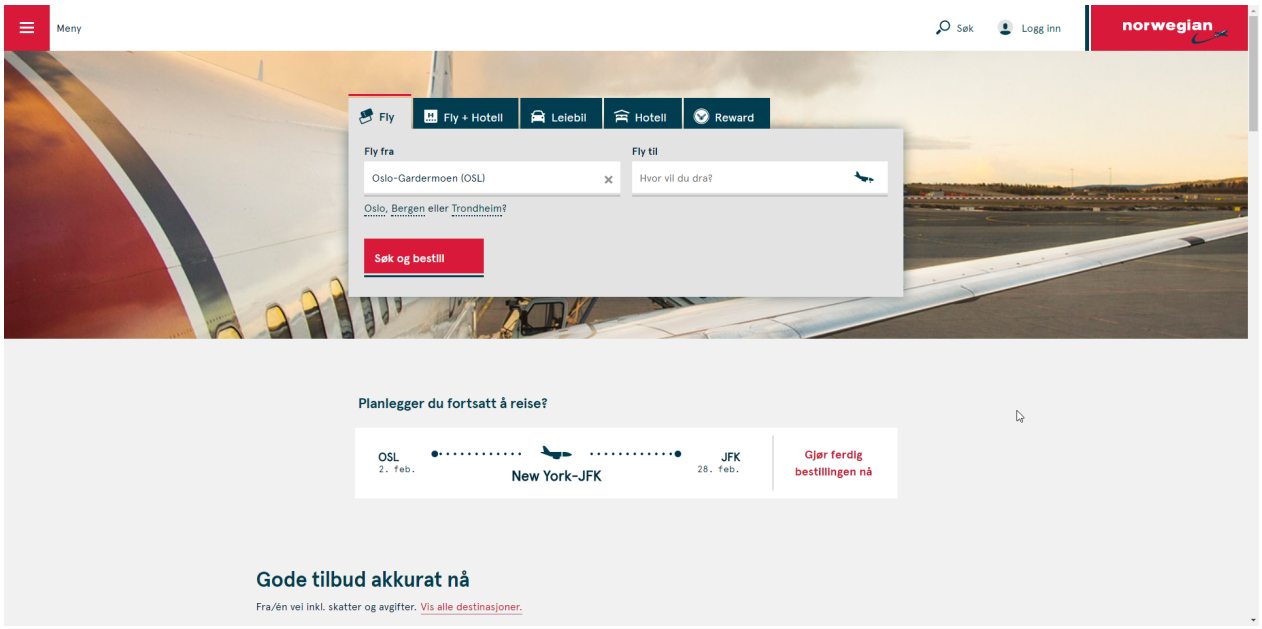


Figure 2.10: Norwegian index page

[5] https://www.norwegian.no/

After filling in the two first input fields, the rest of the form opens up and users can fill in the rest of the required information (See figure 2.11).

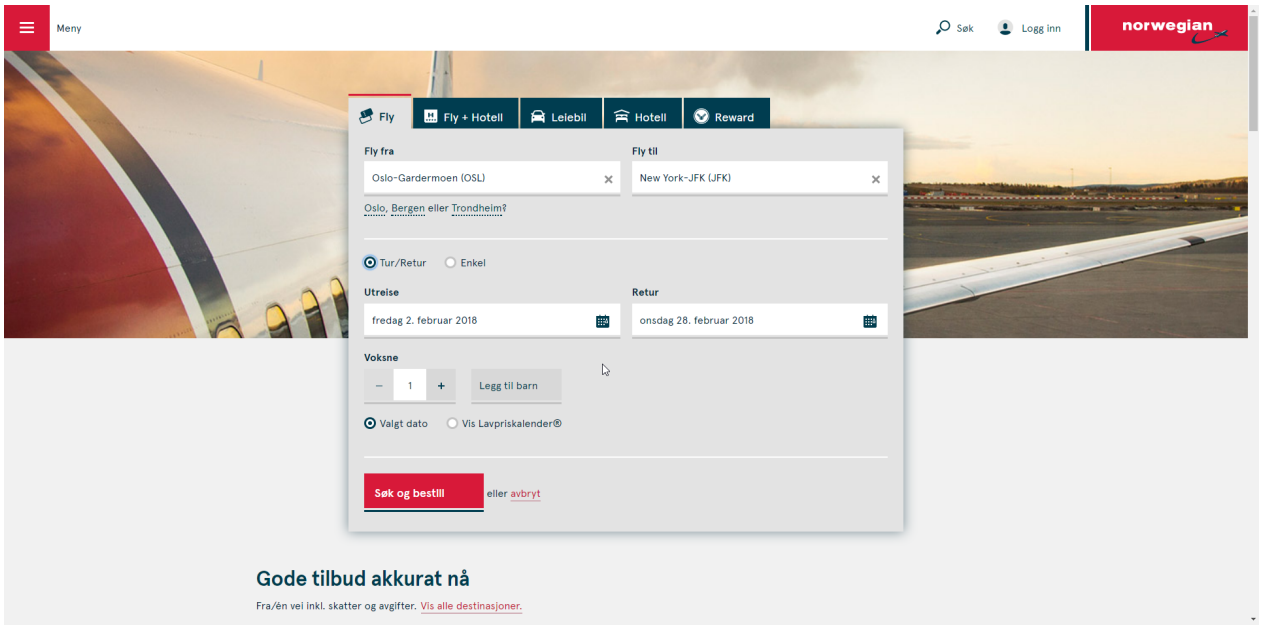


Figure 2.11: Norwegian index expanded options

However on phone it is already open, as it is simply the form on the main page. (See figure 2.12)

When displaying the available flights users can also click to see the low-price calendar to see if there are other dates, and what the prices are on those days. After the search users can also change the search again on the desktop version.

Figure 2.12: Mobile version Norwegian booking

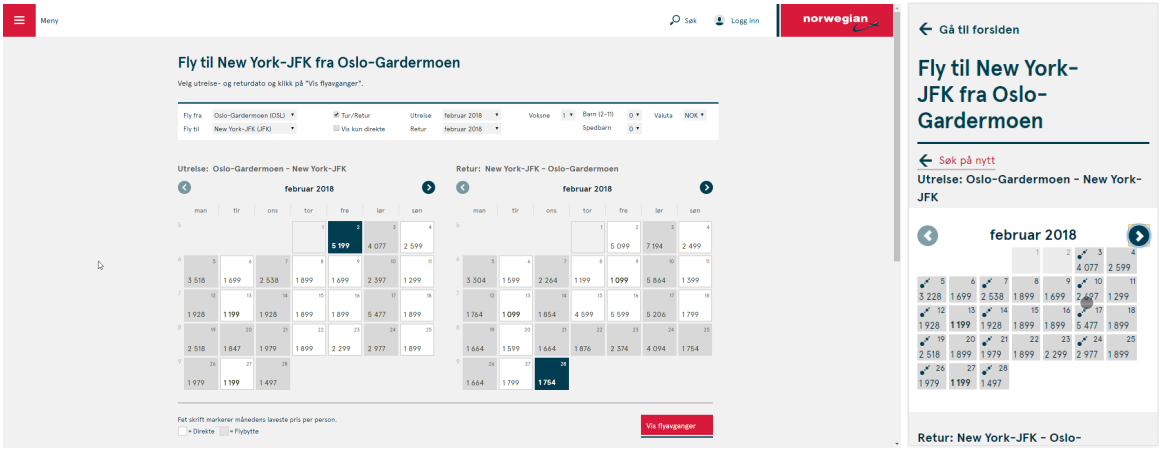


Figure 2.13: Norwegian lowest price calendar (Desktop and mobile)

Pros

A very modern and clean look. Feels professional. Guides users right to what they want, without overwhelming them with fields to fill in. Gets the most important parts filled first. Allowing users to change their search easily makes it more user friendly for users. Users can see the prices for each day.

Cons

A nice addition would be to have the possibility to change the search on phone as well without having to go back to the front-page. The calendar view of cheapest prices is very nice, but a more direct and visual way of seeing the cheaper flights like a graph or bar chart to quickly see the price differences visually would be a good addition, like Bookinghouse[6] does (See figure 2.14).

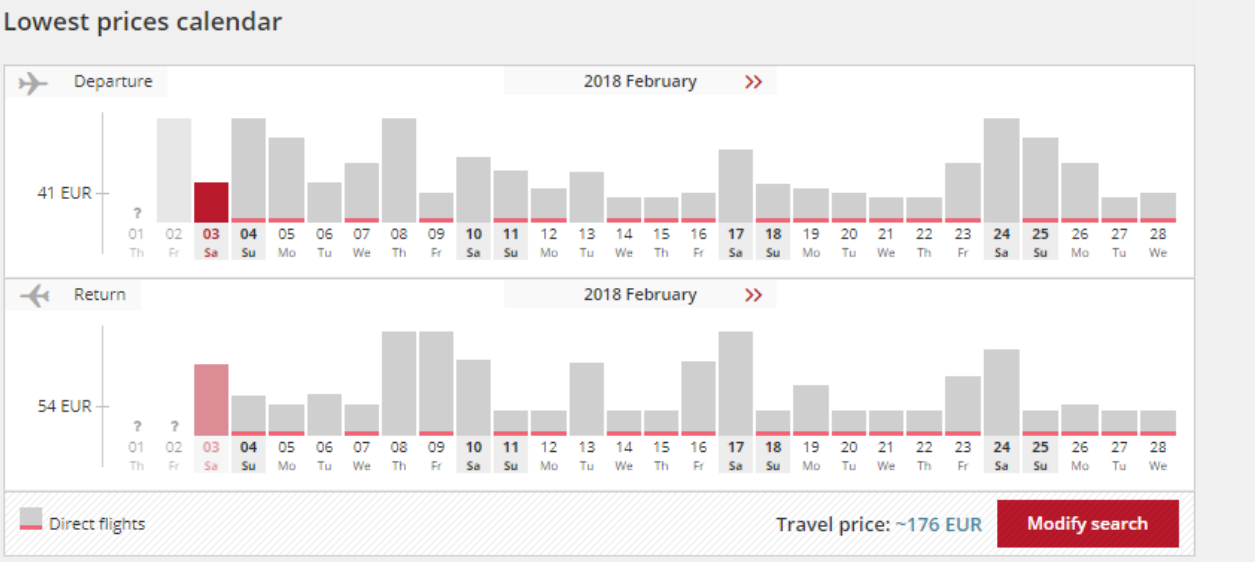


Figure 2.14: Bookinghouse.ee lowest price calendar

[6]https://www.bookinghouse.ee/en/

2.1.5 Research results

After gathering information from the research it was decided that something clean and simple would be best. The main focus should be booking as soon as users log in. The better and simpler solutions had the booking in focus, and made it easy for the user to quickly book something at the main page. Further these sites had some simple information that can easily be displayed underneath the booking.

Although the labs have their own email that could be connected to the current NTNU Outlook Booking System, the Colourlab does not use this because they need more than a simple booking system. They did not simply want a way to book rooms, but they wanted a application that would also allow for booking of equipment and the logging of all activity. This way the Colourlab could use the information gathered to know what is used most and what might be improved in the future.

Additionally the Colourlab could not use NTNU's own booking system (as depicted in 2.1.1) because the lab rooms are not included in that system, neither are the equipment. The Colourlab needs a system tailored specifically for their needs. A system that allows different roles/permissions for the users, logging the usage of rooms/equipment and other features.

2.2 SCRUM

Scrum is an agile method typically used in software development. Scrum is an iterative and flexible framework used as a project management tool (Schwaber and Sutherland, 2018). The advantages of using Scrum is as mentioned that one will work in a flexible and iterative process. Going through an iterative work process allows changes and continuous improvement. In Scrum one will do user testing at the end of every sprint, which will make developers aware of issues while they're fresh. The project owner will also be updated regarding the development process from the beginning to the end, which will result in higher customer satisfaction (Layton, n.d.).

Scrum functions by dividing work into actions that are completed within something called *sprints*. By dividing the work into sprints the tasks will be easier to manage and deploy.

In Scrum different roles are assigned to people involved in the development process. There

is a Scrum-master, product owner and team members. The role of the Scrum-master is to ensure everyone on the team follows and understands the Scrum methodology, the scrum master also serves the product owner.

In the start of each sprint the whole development team and the scrum master conducts a meeting to discuss what to implement and do throughout the sprint, the team has to estimate how much time is expected to be used on each task. At the end of sprints evaluation of what has been completed, what could have been done differently and what challenges occurred are conducted.

2.3 GANTT-diagram

A GANTT-diagram is a tool that is used for project planning. It is a graphical representation of a projects milestones and schedule. This helps highlight issues and tasks and create predictability throughout the project.

2.4 Tools

Choosing the right tools for the job is crucial for the project, work on trying to limit the amount of tools was done, as having too many tools could easily clutter and disorganize the group. Many of the tools chosen proved to be very useful for reaching the goal.

2.4.1 Writing tools

LaTeX

LaTeX is a document preparation/typesetting system. This means that when writing, plain text is used, rather then formatted text as found in WYSIWYG (What You See Is What You Get) systems such as Microsoft Word, Google Docs. LaTeX encourages the writer not to think about appearance of their document, but rather on getting the right content.

LaTeX writing in plain text means that instead of writing in the document as it is, and having to worry about design and layout. The writer simply has to write the content, and use markup

tagging in a logical structure (using familiar concepts as chapter, section, table, figure etc.). (TheLaTeXProject, 2018)

Brackets and Sublime Text

Choosing a efficient and user-friendly text editor helps a tremendous amount when coding and developing. These text editors were personal choices, which all allowed extensions and customization for further efficiency. For the project Brackets[7] and Sublime Text[8] were used.

2.4.2 Collaboration tools

Google Drive

Google Drive[9] is a cloud file storage service. Google Drive lets users use several free web-applications, such as Google Docs and Google Sheets to allow collaboration between users and systems in an easy seamless way. Google Drive also allows users to create folders to share multiple files between people. This also functioned as the primary tool for keeping and storing documentation.

Google Docs

Google Docs[10] is an online, in the cloud text document. It allows for several people to write and collaborate together in the same file, and access it from any device.

Google Sheets

Google Sheets[11] is an online, in the cloud spreadsheet document. It allows for several people to work together in the same file, and access it from any device.

[7] http://brackets.io/
[8] https://www.sublimetext.com/
[9] https://www.google.com/drive/
[10] https://docs.google.com
[11] https://www.google.com/sheets/about/

Share Latex

Share Latex[12] is a web based text editor and interface that allows multiple people to write and modify the same document in real time, sort of like Google Docs just for Latex. Which makes collaboration and knowing what to write about much easier. As the document is in the cloud one does not have to worry about losing or corrupting the file.

GitHub/Git

GitHub[13] is a version control system which allows users to commit code to a repository, which allows the group to collaborate on code. It also documents every change with updates on the website, which makes it easier for group members to see what has been done on sections they are not currently working at. When creating new functionality to the application using branches ensures that code will not get overridden if the new functionality does not properly work. If mistakes were made, one could always roll back to previous versions which made the whole process more efficient.

ZenHub

To organize sprints and work in progress, a plugin for GitHub which is called ZenHub[14] was used. ZenHub is a Agile Project Management System. Originally it was intended to use Trello [15] which is a similar solution, but to limit the amount of tools used for the project, ZenHub as recommended which reduced the number of tools by at least one. ZenHub also worked better for the project with the integration to GitHub.

2.4.3 Communication tools

Facebook Messenger

For everyday communication a group chat on Facebook Messenger was the go-to solution. This were very crucial for spontaneous work sessions and day to day communication.

[12] https://www.sharelatex.com/project
[13] https://github.com/
[14] https://www.zenhub.com/
[15] https://trello.com/

Discord

When working from home or online the group used Discord[16] for talking to each other and collaborate. Discord is a free VOIP (Voice over IP) software. Discord easily allows users to share code, files and send text messages on a private server. Users can also share their screen, which can be very useful when working remotely. On Discord the group also have a third-party bot which notifies everyone each time there is a commit(new update) to our GitHub repository. This way the group can easily know when there has been an update to the code.

2.4.4 Other tools

Balsamiq

Balsamiq[17] is a program for creating digital wireframes (Read about wireframes in section 2.7.4). The advantages of this program is that users can quickly create mock ups and modify them. The wireframes are not very detailed so designers do not really think much about design but rather functionality. Wireframes can also be made clickable which are a lot more presentable for user testing.

XAMPP

XAMPP[18] is a web-server-program, it is used to locally run a Apache server for interacting with a database using a programming language like PHP. This is used so that one does not have to upload the entire project to a running web-server every time a change is made. Instead changes are seen right after they're made.

Adobe Photoshop

Adobe Photoshop[19] is a picture and graphical editing program, used for making a moodboard in this project.

[16] https://discordapp.com/
[17] https://balsamiq.com/
[18] https://www.apachefriends.org/index.html
[19] https://www.adobe.com/no/products/photoshop.html

Relational model

The relational database model is one of the most popular database models. It was proposed/developed by E. F. Codd in 1970 (*Relational Database*, 2018). A relational model works by storing data into the tables (also called relations) which consists of rows (also called tuples or records) and columns (also called attributes). Each row has an unique key which is used to identify that specific row. A table usually represents one "entity type" such as Bookings or Users. Where rows represent a instance of that entity such as a specific booking or the user Carlos, and columns represents other values for that instance, for example booking time or user address. (Hernandez, 2013)

A relational database is a collection of tables and the relations between them. When a set of tuples have the same attributes there is a relation. In that way one can connect the tuples by using the unique key and retrieve information.

Site-map

A site map is a hierarchical systemic view of the web page, used during the planning phase. It is a tool to help users gain a true understanding of how the web page looks like (Nielsen, 2008).

Use-case

A use-case diagram aims to describe a systems requirements based on different target groups. By creating a use-case diagram one can define what kind of users will be using an system, including the requirements the system need to fulfill the functionality associated with these.

EER-diagram

EER-diagram, or Enhanced Entity Relationship diagram, is often used in conceptual design of database models. It is a structured graphic representation of the database, and displays the relations between the tables and the whole database information structure (Elmazri, 2010, p. 245-284).

2.5 Web solution

Benefits of developing a web solution is that it can be accessed from anywhere, anytime and on all modern devices as long as the user is connected to the internet. When developing a website, developers have many different choices as to what technologies to use. However the base languages such as HTML, CSS and JavaScript are usually always used. The Colourlab did not have an existing system already, which allowed any technologies to be used. For frameworks and guidelines that were used see section 2.6.

2.5.1 Markup languages

HTML5

Markup language for structuring and formatting content for web.

CSS3

Style sheet language used to modify and apply styling to the HTML structure and elements.

2.5.2 Programming languages

JavaScript

JavaScript is a client side scripting language used for editing and interaction with HTML structure. The language allows for interactions and moving parts that HTML or CSS are unable to perform alone.

jQuery

jQuery[20] is a JavaScript library that allows the user to take shortcuts when making JavaScript implementations. It also improves efficiency as jQuery does not require as much code compared to JavaScript. jQuery also implements a few extra functions to use to improve work flow.

[20] https://jquery.com/

AJAX

AJAX uses a combination of browser built-in XMLHttpRequest objects (to request data from a web server) and JavaScript and HTML (to display or use the data). Using AJAX allows the system to update a web page without reloading the page, and send data to the web server in the background.

PHP

PHP is a programming language which allows the user to interact with a server side database. This language makes it possible to send and store information on a outside server where it can fetch it later at any time.

SQL

SQL is a domain-specific language used to manage data from databases. SQL is designed for and works especially well with relational databases.

2.5.3 Other languages

JSON

JSON is text written in JavaScript Object Notation, and is a syntax for storing and exchanging data. JSON is used to display data between a server and the browser, as the data can only be text. JSON is often converted into JavaScript or JavaScript objects.

2.6 Frameworks and guidelines

2.6.1 Laravel

Laravel[21] is a framework based on Symfony[22] which is a PHP framework that implements finished classes and structures for easier implementation of content. Laravel uses its own file type

[21] https://laravel.com/
[22] https://symfony.com/

called ".blade.php" which it compiles to HTML. Laravel is made in a way that makes creating SQL queries to the database faster and easier to understand, as it utilizes eloquent methods.

.blade.php

Blade files are structured like normal HTML. However it allows the user to utilize a lot of new features included in Laravel. Such as including files, extending files (this way files can be in another file as a template), more efficient ways to print information from the database, and more. Blade makes displaying and working with PHP more efficient.

Eloquent ORM

Eloquent ORM is Laravels built-in ORM implementation. Eloquent allows the user to work with the database as objects using an easy to use expressive syntax method.

"The Eloquent ORM included with Laravel provides a beautiful, simple ActiveRecord implementation for working with your database. Each database table has a corresponding "Model" which is used to interact with that table. Models allow you to query for data in your tables, as well as insert new records into the table." (*Laravel Eloquent*, 2018)

ORM

ORM stands for Object-relational mapping and allows users to create files using object-oriented programming language that converts the database, so that no matter which database-solution that is being used the database will stay the same. Which basically means it creates a virtual object database that can be used when writing the programming language. ORM also allows for the use of Eloquent methods through models.

2.6.2 Material Design

Google created Material Design as a guideline for design back in 2014. Google has used these guidelines when developing its applications such as Google Drive, Google Docs and YouTube. It is design that is clear and consistent across all platforms, material should have physical surfaces, shadows and edges, interactive elements should have clear visuals to signify that they can

be interacted with.

"The foundational elements of print-based design – typography, grids, space, scale, color, and use of imagery – guide visual treatments. These elements do far more than please the eye. They create hierarchy, meaning, and focus. Deliberate color choices, edge-to-edge imagery, large-scale typography, and intentional white space create a bold and graphic interface that immerse the user in the experience An emphasis on user actions makes core functionality immediately apparent and provides way-points for the user." (*Material Design Introduction*, 2018)

2.6.3 Material Design Lite (MDL)

Material Design Lite[23] is a front-end template that integrates Google's design guidelines easily and quickly when making web applications. By using a template like this, the development process becomes a lot quicker because developers do not have to customize the design as much compared to CSS or JavaScript. Material Design Lite uses Google's guidelines to help make consistent, attractive and functional web content. It successfully does this by letting the user implement pre-created and designed components to their page, with copy paste. The components can be manually edited with pre-created CSS-classes to enhance or change their appearance, while still staying true to the Material design guidelines.

"Material Design Lite lets you add a Material Design look and feel to your websites. It does not rely on any JavaScript frameworks and aims to optimize for cross-device use, gracefully degrade in older browsers, and offer an experience that is immediately accessible." (*Material Design Lite*, 2018)

2.7 Design Process

The design process is an iterative process where design decision and structure is challenged through sketching, prototyping and user testing. It is in this process design is reiterated and faults with existing solutions is discovered.

[23] https://getmdl.io/

The importance of being thorough in this part of the project is critical. A bad design decision early on in the process will be harder to change later in the project when development has started.

2.7.1 Affinity diagramming

Affinity diagramming is a technique to fetch the essence from interviews. One way to do this is to write down hallmarks, opinions, hobbies and experiences on post-it notes, then group up the notes. Grouping the notes is a way to organize then so it is easier to make good personas. This way, when you make the personas (expanded on in section 3.2.2), it will be easier to make a more realistic persona with real depth. Which makes taking the position of a user easier, and the end product will be better suited for the user. (Also called concept sorting (Kumar, 2013, p. 240))

2.7.2 Personas and scenarios

Personas are fictional users made up by analyzing the different target groups. The data gathered by analyzing the target groups will be used to create these fictional personas, as it is much more effective to represent this data as a real user instead of raw data.

The personas should be believable and realistic, as these are created and treated as real people in the development process. Personas are made to help broaden the mindset, build empathy, inspire ideation and define direction according to (Kumar, 2013)

Scenarios are stories featuring users and context. It is a short story that will describe a users journey when interacting with a system.

Personas and scenarios will ensure that the team will develop an application with these people and stories in mind. It will allow constant user testing in the development process without actually having to contact real-case users every time.

This method combined with real-case user testing will help keep the user experience in mind of the team throughout the process.

Storyboard

A storyboard is a sketch/drawing representing a use case or scenario that needs to be completed. This can be the whole story of a how a persona fulfills their scenario. Using storyboards it is possible to see how many steps or actions a persona needs to complete in order to do what they intended on doing.

2.7.3 Sketches

Making sketches on paper is fast and easy to do. The process does not need to be very detailed, it is more about visualizing ideas and thoughts out on paper. (Benyon, 2010) Using this method multiple solutions to a problem can be presented in a short period of time. This way bad design decisions can be eliminated early on, - and it allows figuring out what elements and decisions seem logical and functional in what places.

2.7.4 Wireframes / Lo-fi prototype

Wireframes or lo-fi prototype are created before the development process to help establish a basic structure and layout of a system. Wireframes are not as raw like basic sketches, but serve a very similar purpose. It is not supposed to incorporate detailed design elements, but rather present the main elements. Identifying the key requirements and functionality is required to create wireframes/lo-fi prototype.

2.7.5 Moodboard

A moodboard is a composition consisting of images, text and elements that are there to help illustrate a style to pursue. This can be helpful to distribute and give the designers a similar feeling of how the application should look in the final iteration.

2.7.6 Design template

Design template is used to show and test all elements and colors to be used in the application. This is where the design of the site is discovered, and should be what the final design is based

on.

2.7.7 WCAG 2.0

WCAG 2.0 (Web Content Accessibility Guidelines) is a guideline for making web content more accessible for all users (*WCAG 2.0-standarden*, n.d.). The web is used by a wide range of people, and making it accessible for everyone is important. Following these guidelines should help make the web page usable for everyone.

2.7.8 User testing

At the end of each sprint user testing was performed to get feedback. To reach a user friendly system it is essential to do user testing throughout the whole development process. When testing users observers can easily see what design decisions might not be so user friendly, what parts of the system users struggle with and what their thoughts about the system are. Major design flaws can be found through user testing, but also smaller adjustments such as color choices, text size and information structure. (Krug, 2014) & (Rubin and Chisnell, 2008)

2.7.9 Interview

Interviews are conversations conducted with potential users of the system. The purpose is to analyze the conversation and body language to discover faults and other information regarding the solution.

Chapter 3

Methodology

This chapter expands on how methods and tools previously mentioned in Chapter 2 were used, during start-up phase, organization phase and the design and development process.

3.1 Organization and planning

To achieve the goal mentioned in chapter 1, section 1.3, web technologies to create a web system will be used.

3.1.1 Workflow

From the start of the project the group created routines and rules that would be followed throughout the process. The first week the project plan (Appendix A.3) was created. Despite the fact that Agile methodologies such as SCRUM claim that you do not need to prepare, as that would make it into a Waterfall method. The group felt that at the beginning of the project certain planning is needed. Therefore some time was spent preparing and organizing the project from the very start to ensure that the focus would be entirely on the development process when it came to that point.

The group designated 3 days a week for working on the project. Meetings with the project owner and supervisor was also scheduled weekly.

Early in the process there was designated roles for each group member to ensure responsibility areas and efficient work flow.

3.1.2 Project roles

- Ole Martin Ibsen: Front-end and Documentation
- Henrik Reff Snilsberg: Project lead, Front-end and Back-end
- Fredrik Paulsen: Front-end and Back-end
- Carlos Vicient-Monllaó: Supervisor
- Marius Pedersen: Product owner

3.1.3 Routines and rules

Each week the group will have meetings with the product owner and supervisor. If a meeting is not required certain weeks these can be cancelled.

Three fulls days each week will be the dedicated days for working on the project, however if needed more can be set up.

A minimum of 15 hours of work each week is required, but all members plan to be flexible with our time, meaning that some weeks the group will spend more than the required amount depending on the workload in other subjects.

Logging time spent on each activity and task is to be done after each workday (See Appendix:A.14).

Group rules

- Obligatory to attend all meetings with client and supervisor.
- Notify members if you can't attend planned activities.
- All group members have to be responsible for their task.
- Be available online when working from home.
- All major decisions and changes must be discussed with all members.
- When there is disagreement, the majority vote decides.
- The group leader has to make sure goals are met.

3.1.4 Work environment

A work environment where one can concentrate fully without interruptions is essential when working with intensive tasks. In the start of the project members met up at school to work together, this was because being at school enforced us to be efficient and present at all times.

However, when developing and coding group members collaborated from home over Discord. This way of working from a desktop computer when coding was way more productive.

3.1.5 GANTT-diagram

As seen below in figure 3.1 the project was split into 4 sprints. In the start of the project there was planned a 3 week period to work on the project plan and research. Shortly after this the SCRUM-sprints were laid from the start of February up until the end of April where development on the solution would be done. Simultaneously with the SCRUM-sprints there would be some report writing up until the deadline in May.

Using a GANTT-diagram was proven useful to us because it helped organize the project in a visual way.

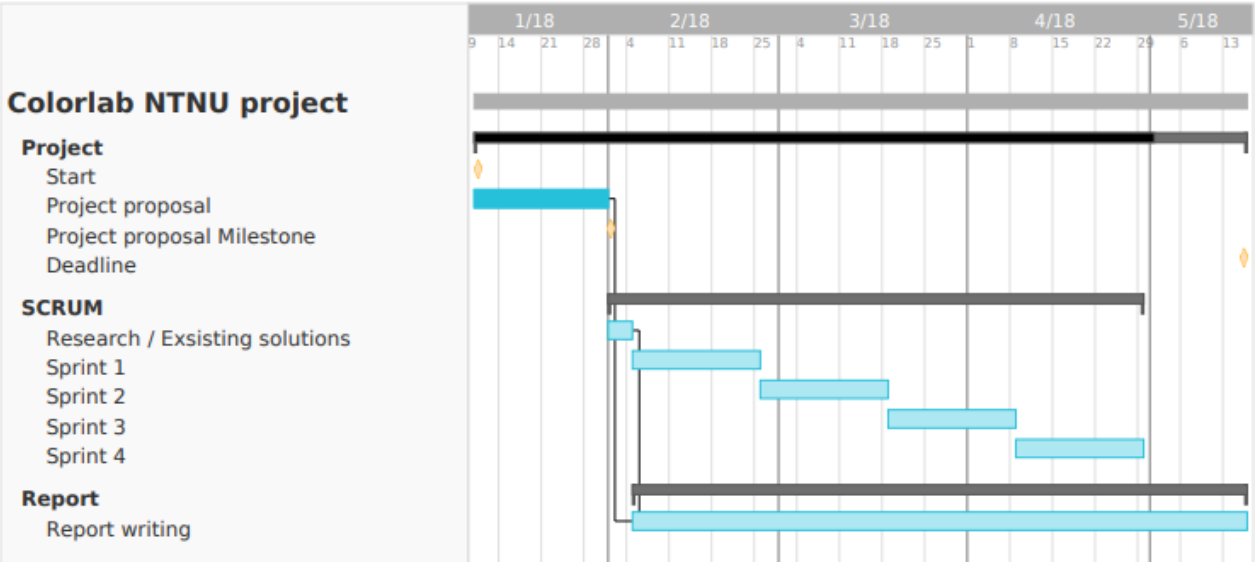


Figure 3.1: GANTT-diagram

3.1.6 SCRUM

Henrik Reff Snilsberg was assigned the role as Scrum-master, and the two remaining members were assigned team member roles. At the start of each sprint the group had a meeting to discuss what to do this sprint, how hard of a task things would be and how to do it.

At every point when the group met, a short period of time was set aside to discuss and evaluate what had been done since the last meeting. ZenHub was used together with SCRUM to organize the tasks and objectives for the sprints. At the end of every sprint user testing with the project owner or other users was done.

An agile project management system like ZenHub allows the group to create cards and place them into columns according to their progress (in progress, done, review/Q&A, backlog etc). This makes it easy to know what is being worked on, what needs work and what is completed. Issues were assigned labels with colors which represented different levels of urgency, importance and type of issue. See figure 3.2 for an example of how ZenHub was used during sprint 3. One can easily see in the backlog column what is still left to do, and in the "In Progress" column what is currently being worked on, when something is completed it gets moved to done.

At the end of a sprint cards gets moved to "Review Q/A" column. After reviewing through to check for bugs at the end of the sprint it gets moved to the "Closed" column all the way to the right. After doing user testing of what has been done new issues gets created and gets put into the "Backlog" column for further development in the next sprint or future.

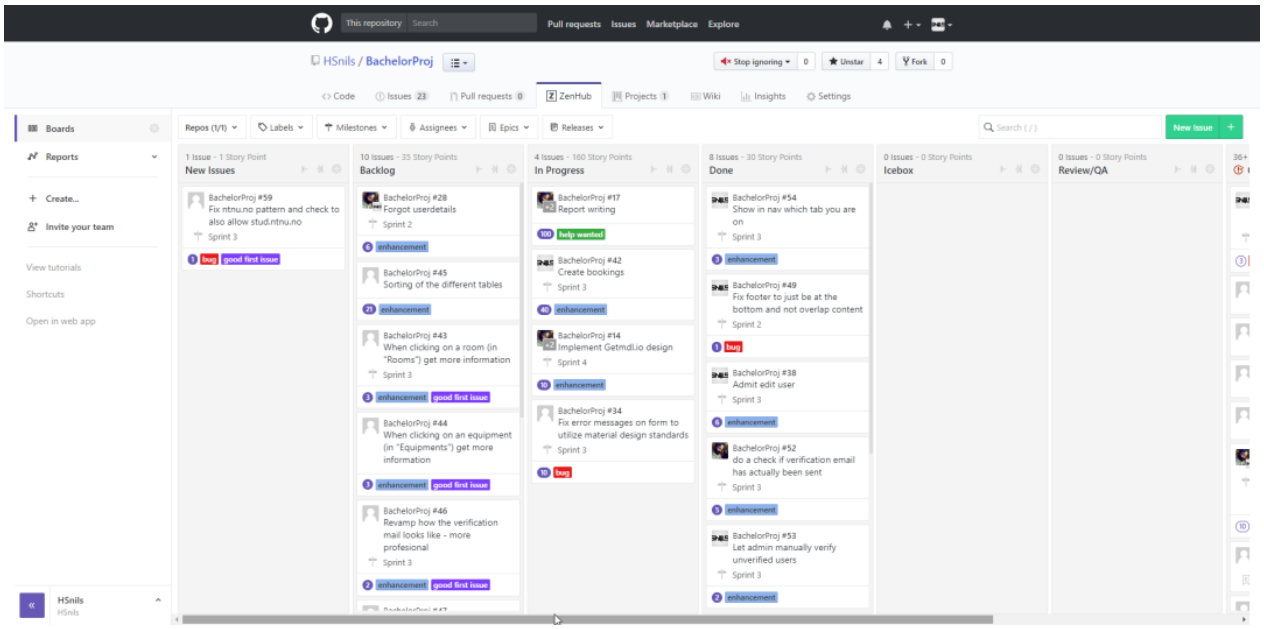


Figure 3.2: Screenshot of ZenHub during sprint 3

3.1.7 Project Plan

As previously stated, the group spent a good amount of time in the start of the project on the project plan. (Appendix A.3)

The project plan helped communicate clearly the plan with the project client, to make sure everyone was on the same page. By examining the project description made by the project

owner and trying to dissect the most important parts and making sure everyone were understanding each other correctly helped tremendously. This way the development process of the system could easily be more focused on important and essential parts. The result of this was that the group had a guideline to help focus on the most important functionality to reach the project goal.

It also helped put the time-limitation into perspective. The group knew all the things that would have to be done by the end of the project. What the challenges were and how to solve these issues. If any issues halted progress, one could refer to the project plan to help know how much work were left and if the issue was worth spending more time on at that moment.

3.2 Design Process

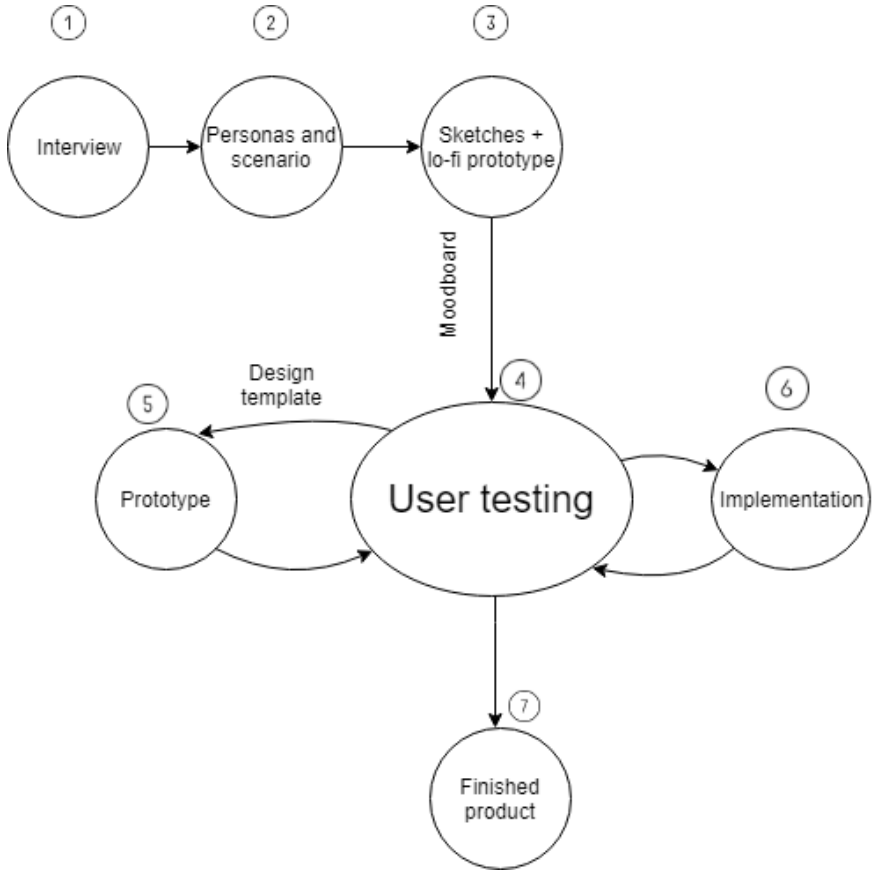


Figure 3.3: Design process

In figure 3.3 the design process for the project can be seen. The first step (see 1) in the design process was doing user interviews and gathering critical information needed for the system. From these interviews personas and scenarios (2) were created to help make sketches/lo-fi prototype (3). A moodboard was created at this point before starting with user testing (4). This is where the iterative process starts. A design template was applied to the prototype (5) and the prototype is user tested (4). Based on the user testing changes are made to the prototype and implemented (6). This process is repeated until the product is finished (7).

3.2.1 Interviews

In the start of the project interviews were done with the user group to get an idea of what was their needs and use cases. The project owner had extensive knowledge about this, seeing as he is head of the department and user of the Colour lab himself - so the majority of the time spent interviewing was with the project owner himself.

For this project qualitative user testing and interviews were the most applicable (Kvale and Brinkmann, 2009). Qualitative user interviews are more like conversations and go further in depth than quantitative interviews that are typically more shallow. Since the group needed a lot of information and research to expand on, conversations were more useful than raw data in larger quantities (Appendix: A.10)-.

User interviews were also done with other members of the Colour Lab. Early on in the project we interviewed a teacher, who confirmed much of the same things as the project owner. (Appendix: A.10 first interview)

Throughout the whole project the group continued to have weekly or biweekly meetings with the project owner. It was mostly through these interviews we learned about the user needs and what we needed in our solution.

The user group for the Colour lab was quite broad, we learned from interviews that there was master students, teachers, researchers and guests using the Colour Lab on a regular basis. From time to time there was year and bachelor students using the Color lab but this was more periodically. This meant that we needed a universal solution that is user friendly for all age groups.

We also learned what did not work regarding the existing solution. There was no efficient

way to book rooms/equipment and check availability. It was a time-consuming solution and what made it even worse was that not everyone in the Colour lab used it.

From interviews with Marius we learned that the core functions he wanted for the system was the booking and logging. He wanted a user friendly system that was efficient and quick to use. (Appendix: A.10 second interview)

Further we learned about how the different target groups uses the Colour lab, what they book, when they book it, how they use it, preferable platform to book with etc.

Master and Bachelor student bookings were more periodical tied to deadlines and what semester they were in. Students mostly used equipment in rooms but never really booked rooms themselves. They used mostly the same type of equipment tied to the subjects they were enrolled in.

Researchers and teachers were consistently booking rooms all the time. Researchers however could sometimes book equipment in rooms over a longer time period, for even up to months at the time.

What was common for all target groups was that the same type of equipment was often used, so a way to quickly book or re-book was proven to be needed.

3.2.2 Personas and scenarios

In this project affinity diagramming was used to make personas and scenarios. This way it is easier to make personas that are more realistic and believable, something that also makes taking the position as a user easier to do. After a few interviews, different attributes or experiences where written down on post it notes and organized in groups of different characteristics. When this was done all that was left was to “go shopping”, where one picks different attributes form the different groups and make a persona (important to make sure they can be somewhat connected)(See figure 3.4).

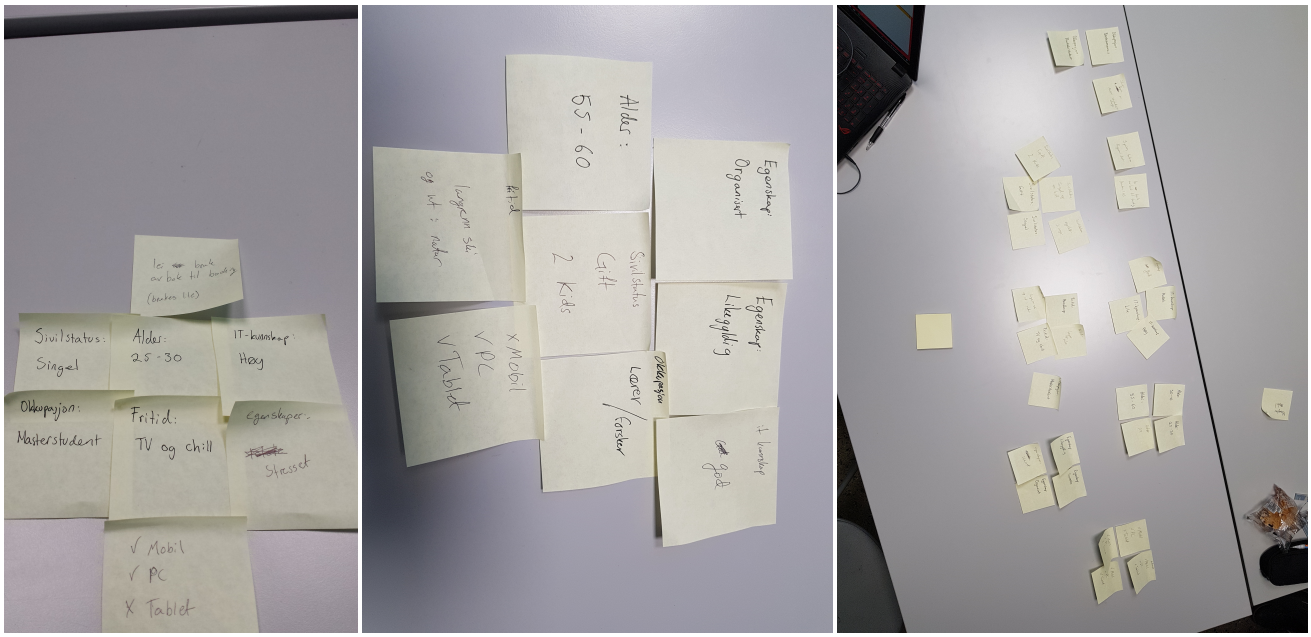


Figure 3.4: Affinity diagram

Out from these attributes a persona can be written, and scenarios can be created. Scenarios will be a task that the persona is trying to "accomplish". The prototypes will then take from these scenarios when being made.

Persona and scenarios 1

Mikkel Strand

- Age: 54 years old
- Occupation: Teacher/researcher
- Relationship status: Married with 2 kids.
- Residence: Toten

Mikkel is an organized and tidy man. He has wife and two children in their late teens. Mikkel is an outdoor man who spends a lot of free time skiing and being out in nature, often with his family. His days are busy with a lot of work and he wants to spend more time on leisure activities and family. Mikkel uses the Color lab up to several times a week, often for teaching-related material. Today he uses the analog system that already exists in the lab. He thinks this is a bit difficult, but is indifferent to the solution. He is interested in technology, but feels he has slightly above average knowledge for IT. Mikkel often uses his PC in the workplace and a tablet in his spare time. He has a slightly reduced vision, therefore, he does not use his personal cell phone often.

Scenario 1:

Mikkel is preparing for his next lecture in Color Science, he wants to book room A012 on next Monday between 8.00 AM and 16.00 PM. He is currently sitting on his PC and wants to finish this quickly as he is about to go home for the day.

Scenario 2:

Mikkel needs to book a Spectrometer for his research next week. He does not like to be spontaneous so he wants to check availability early and see when it is available.

Storyboard of scenario 1

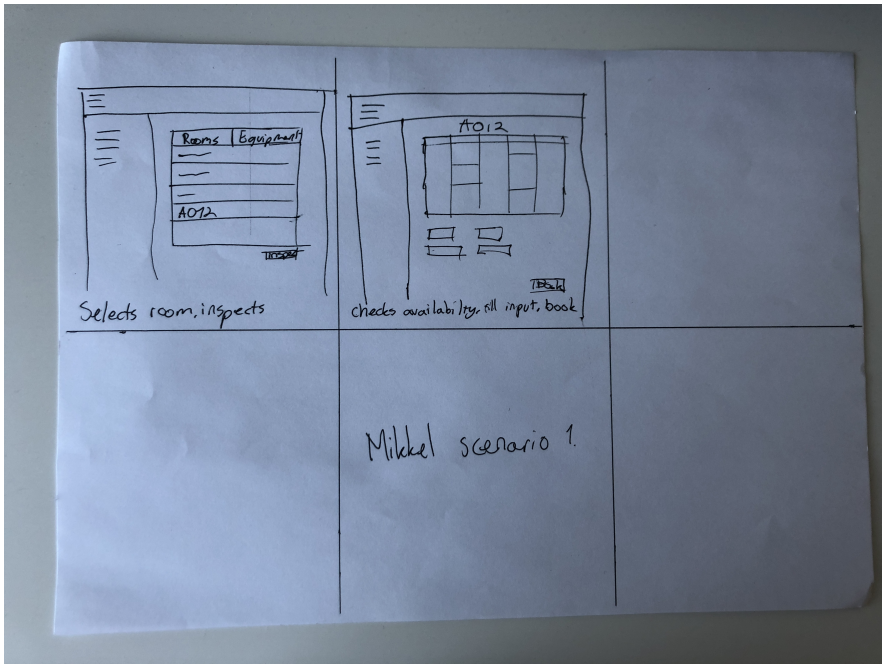


Figure 3.5: Mikkel storyboard of scenario 1

As figure 3.5 depicts: Mikkel selects A012 while booking, checks availability, and creates a booking.

Functionality that this storyboard requires is a booking system where the user can select date and time and feedback while booking to see if the room is available.

Storyboard of scenario 2

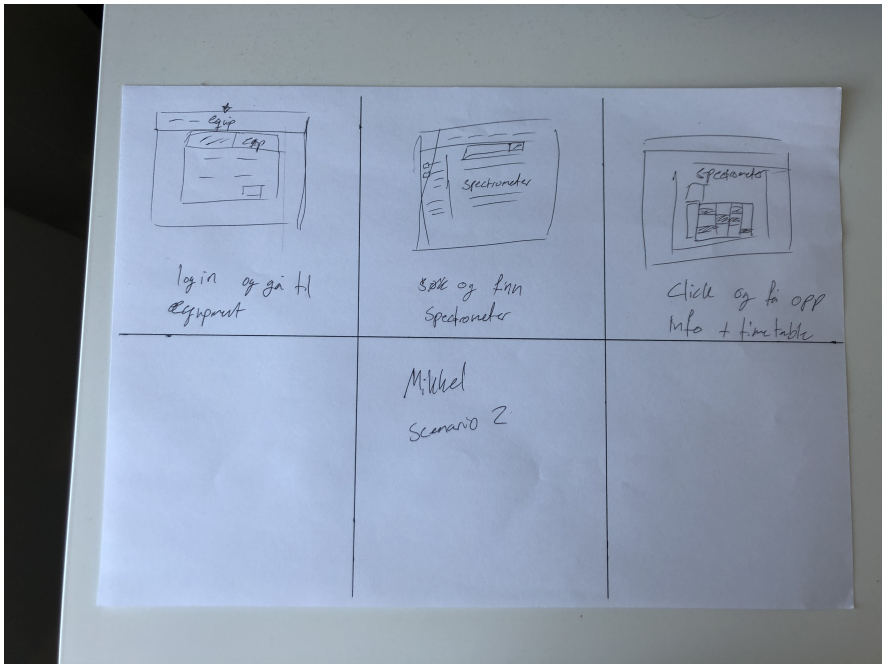


Figure 3.6: Mikkel storyboard of scenario 2

Text from storyboard (Figure 3.6): Mikkel signs in and navigates to equipment-page, filters to find "Spectometer", clicks Spectometer to gets information and date/time when the equipment is booked/available.

Functionality that this storyboard requires is a page to filter and see all equipment, a page to get more information and bookings/availability about the equipment.

Persona and scenarios 2

Pernille Bakken

- Age: 26 years old
- Occupation: Master student in Interaction Design
- Relationship status: Single
- Residence: Gjøvik

Pernille is a master student at NTNU in Gjøvik and is studying interaction design. Because she has a lot to do, she is quite stressed in everyday life. On her free-time Pernille likes to swipe on tinder and find new friends, she also likes to relax and watch TV/series. Pernille uses her phone a lot in her everyday life, but when she is at school she usually use her laptop. Her technological knowledge is at the middle of the spectre, though when it comes to mobile use she knows most things. She uses the lab to a certain degree, but when she's there she often forgets to write it down in the current book for booking.

Scenario 1:

Pernille is on her way to school, but she forgot to book a room. She wants to book a room as soon as possible on her mobile phone before she gets to school.

Scenario 2:

Pernille was in a rush and she managed to book the wrong room at the wrong time. She wants to change her booking to the correct time.

Storyboard of scenario 1

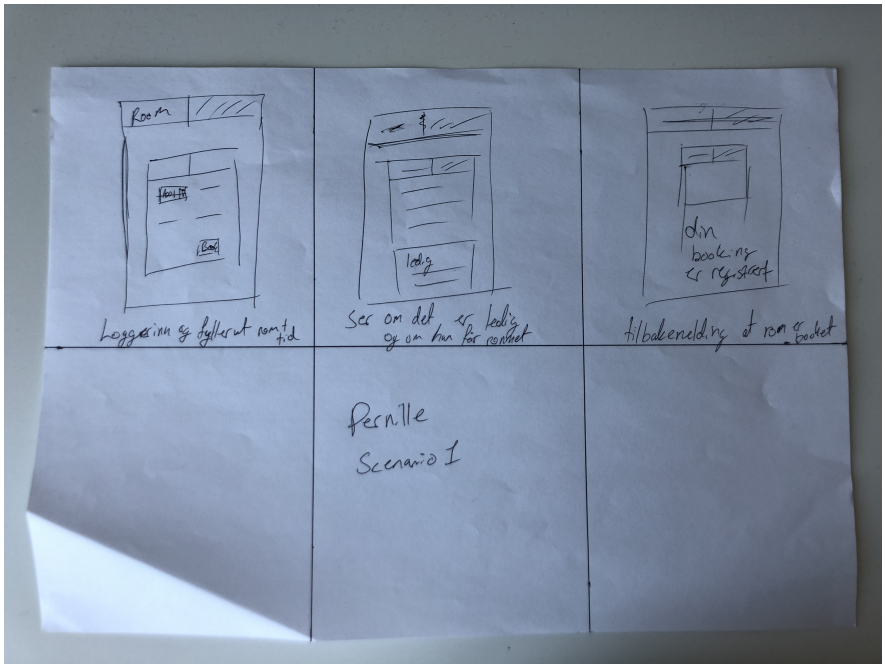


Figure 3.7: Pernille storyboard of scenario 1

As figure 3.7 depicts: Pernille signs in and fills out room and time, sees if there is a room available and books it, then gets feedback that the room has been booked.

Functionality that this storyboard requires is a portable solution via a phone view, a booking system to book rooms, feedback while booking to see if room is available and feedback after booking.

Storyboard of scenario 2

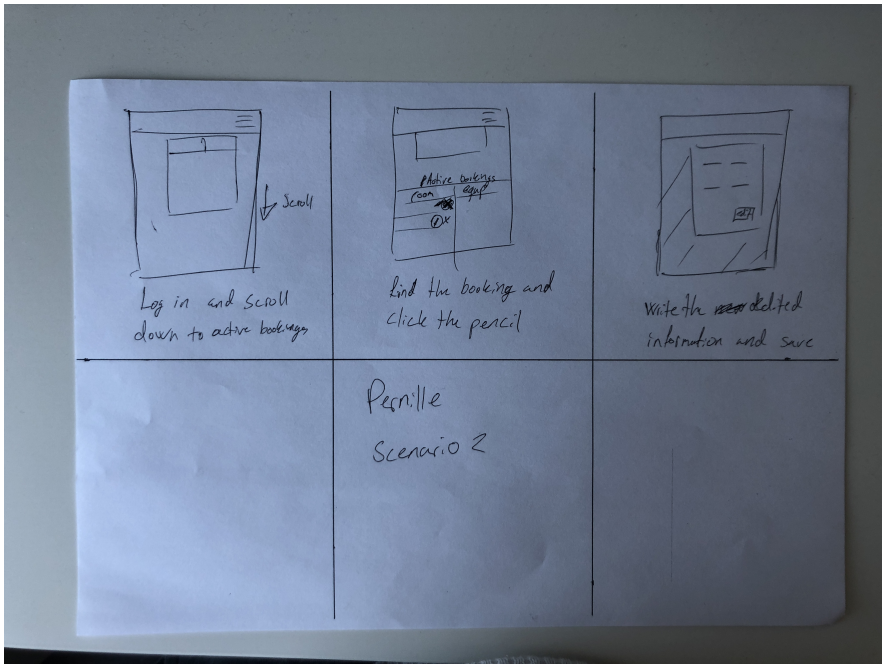


Figure 3.8: Pernille storyboard of scenario 2

As figure 3.8 depicts: Pernille signs in and scrolls down to see her active bookings, finds the booking and clicks the edit pencil, changes the date and time and saves it.

Functionality that this storyboard requires is a place where a user can see their current bookings and an edit function to change the booking.

NB: Later into the project a user editing their bookings was removed and replaced with a delete button. If Pernille would like to change her booking now, she would delete her old booking, and create a new one.

Persona and scenarios 3

Agne Vannbru

- Age: 34 years old
- Occupation: Leader Color Lab
- Relationship status: Engaged
- Residence: Lillehammer

Agne is really knowledgeable about new technology and IT in general. He also uses his knowledge in his spare time when he plays computer games and talks with his friends online. He got engaged to his partner last year and they're planning a wedding. As his way to work is quite far he works from home at least once a week. One of the difficulties of using a analog system has been that he can't check the bookings when he is working from home. Agne has a PH.D in Color Science, his daily responsibilities consist of keeping track of the usage of the Color Lab and guide other researchers. Agne also does his own research quite frequently. Agne is not happy with the old system as keeping track of the usage is quite challenging as not everyone uses the system. A new system would greatly Agnes work flow and efficiency and is something he feels is necessary for not only himself but others as well. Agne mostly uses his computer but also uses a cell phone and tablet.

Scenario 1: A new school year has started, a lot new students have been registered, and he

has been notified of one user inputting their name incorrectly. Agne has to approve this user and modify the user name.

Scenario 2: It is in the middle of the year, and Agne has been asked to check how frequently room A008 is in use from January to February.

Storyboard of scenario 1

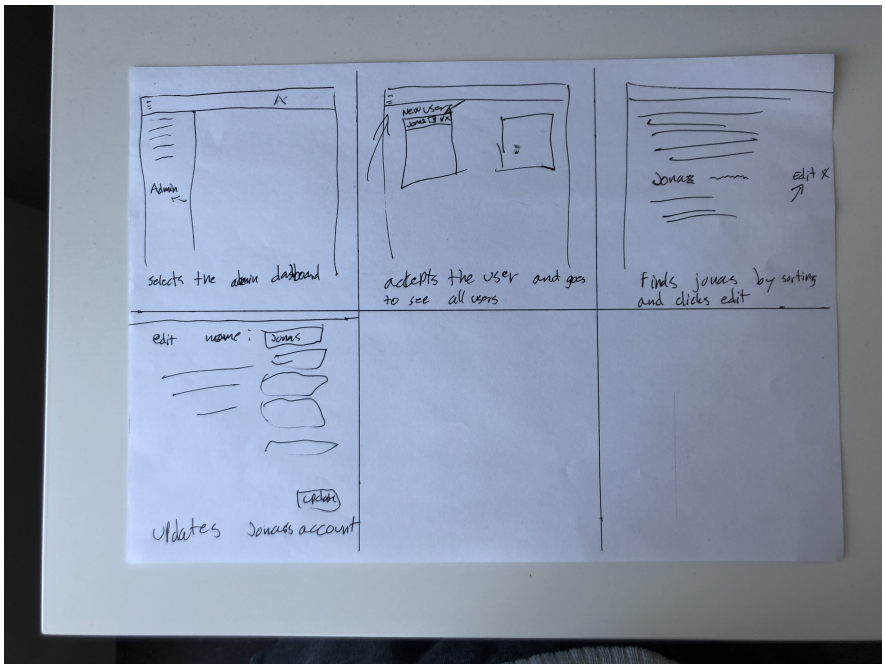


Figure 3.9: Agne storyboard of scenario 1

As figure 3.9 depicts: Agne selects the admin dashboard from navigation, accepts the user and clicks to see all users, filters table to find the new user, updates the new user.

Functionality that this storyboard requires is an edit user function as well as a table to filter to find that user, and a fast and easy way to accept new users from the admin dashboard.

NB: At a later date through an interview with product owner, we discovered that editing the name of a user is something admins should not do in this system, so that specific functionality was removed, but edit of user still exists for other fields.

Storyboard of scenario 2

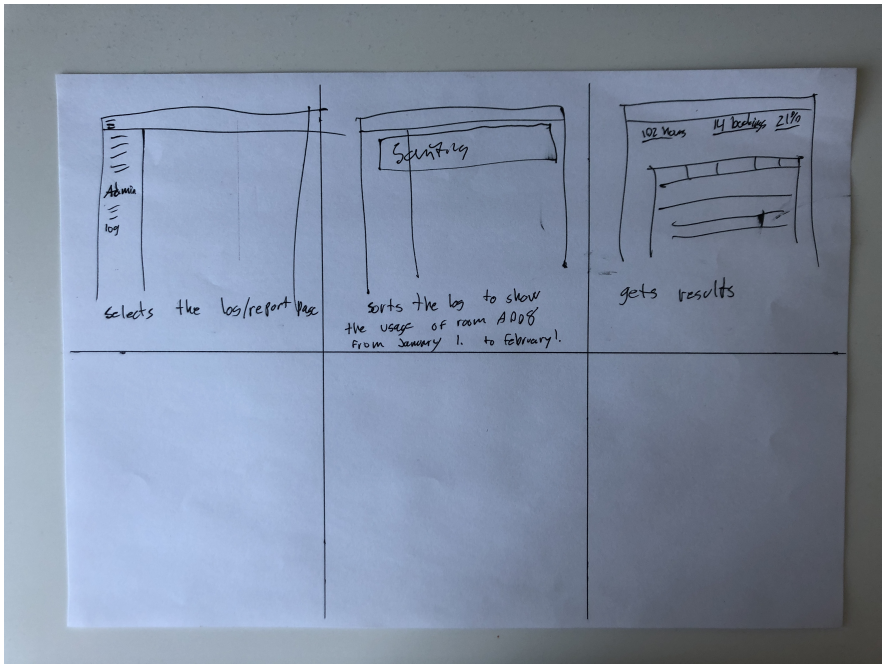


Figure 3.10: Agne storyboard of scenario 2

As figure 3.10 depicts: Agne selects the log-page from navigation, filters the log to show usage of room A008 from January 1 to February 1. and gets the results.

Functionality that this storyboard requires is a log-page where the admin can filter a table to show specific filtered information and get results about the usage, as well as being able to download these results.

3.2.3 Sketches

Sketches was made by every group member individually in the very start. This ensured that everyone got to share their ideas, without anyone taking lead and directing everyone to the same solution. Doing it this way allowed a wider perspective on the solution, making it easier to get an overview of what works and what might not. After completing the sketches individually, we made a new sketch together based upon the previous sketches. This way we could use the very best solutions in a final sketch. Some examples of these sketches are shown in figure 3.11 and figure 3.12. All these sketches were presented to the product owner and discussed further. The group learned that the design and functionality was heading in the correct direction and developed more detailed wireframes from these sketches. More sketches can be seen in the appendix.

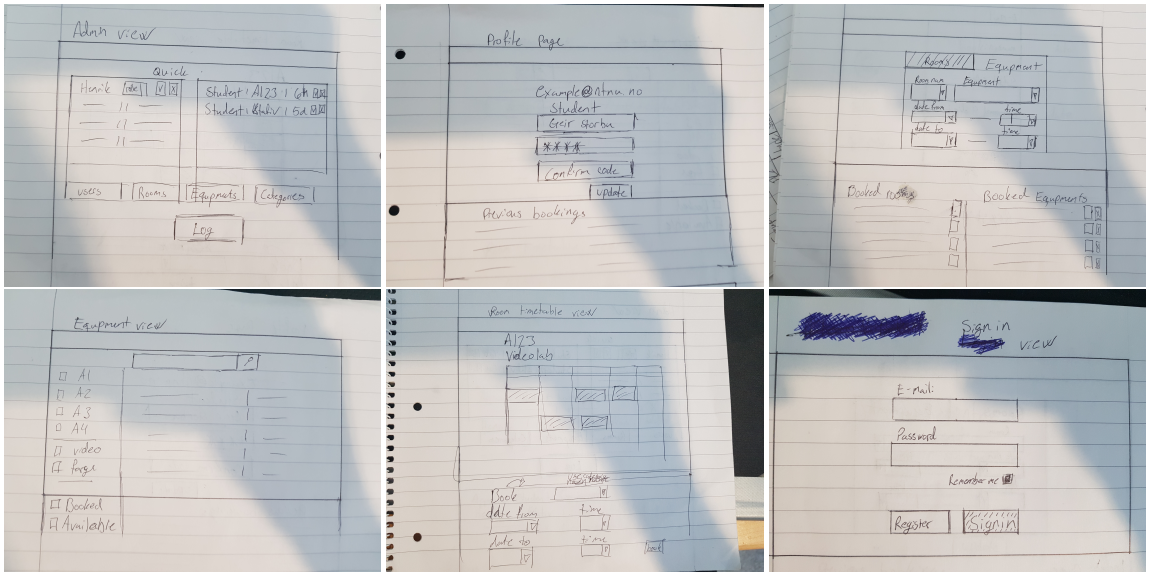


Figure 3.11: Example sketches

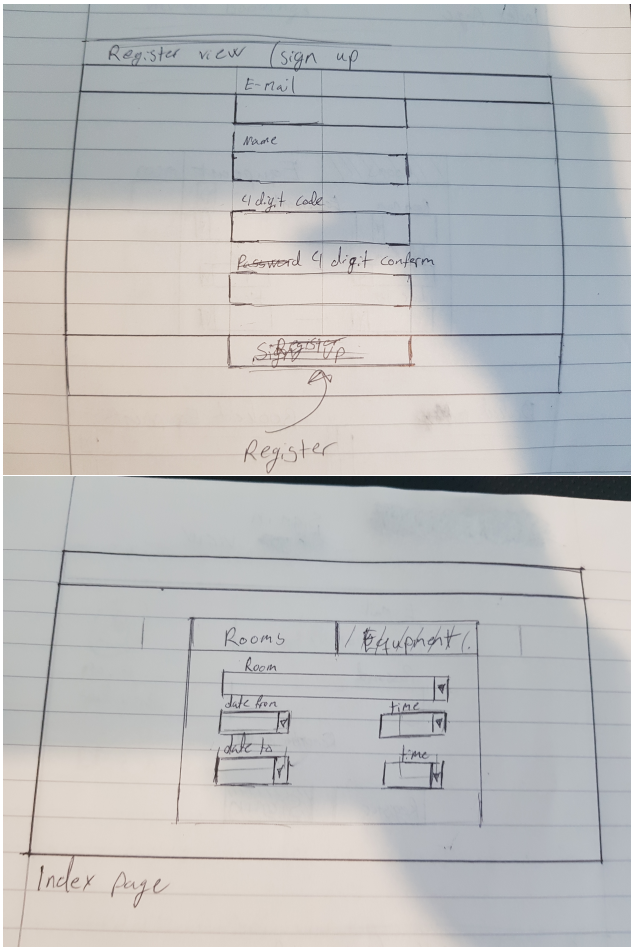


Figure 3.12: Example sketches 2

3.2.4 Wireframes and lo-fi prototype

Based on these sketches digital wireframes were created, using a program called Balsamiq (see chapter 2.4.4). As seen in figure 3.13 and figure 3.14 some changes were made to the log in screen and profile page. The wireframes had all the functionality and pages necessary. A test was done on the project owner with this prototype, that resulted in him approving of the concept and solutions displayed. See Appendix A.12 for a full list of wireframes.

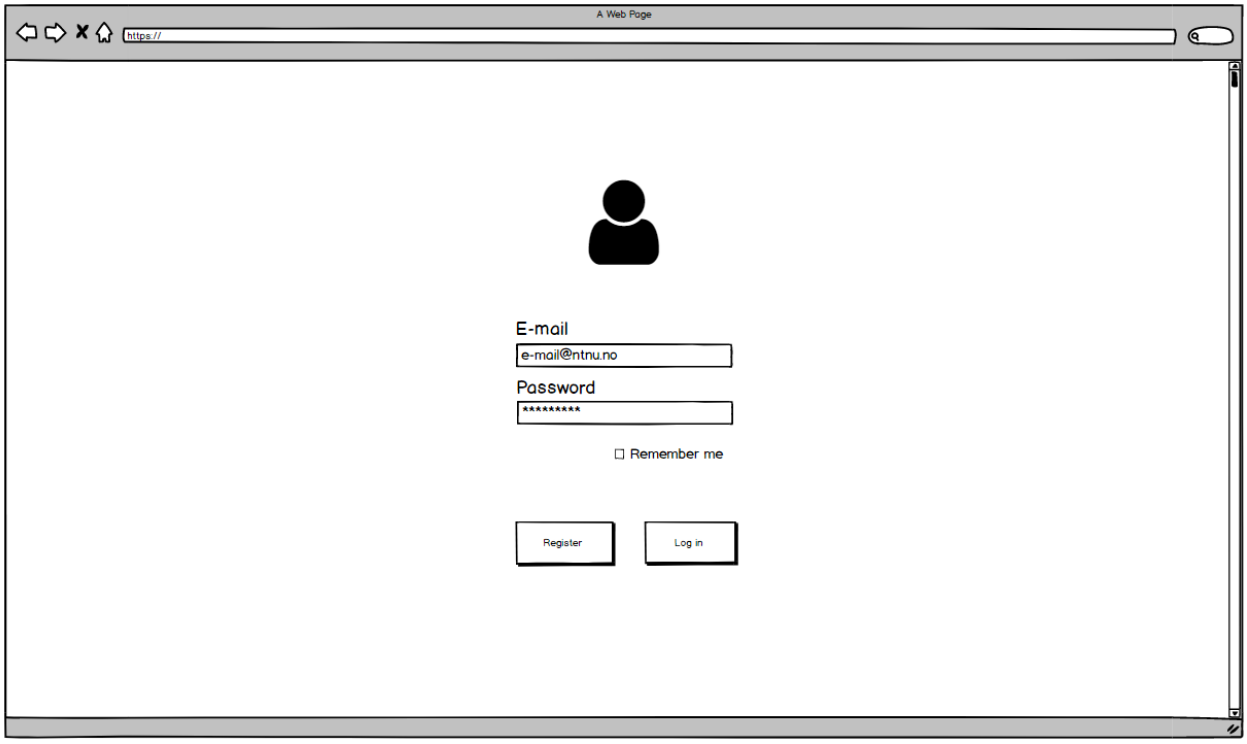


Figure 3.13: Log in overview

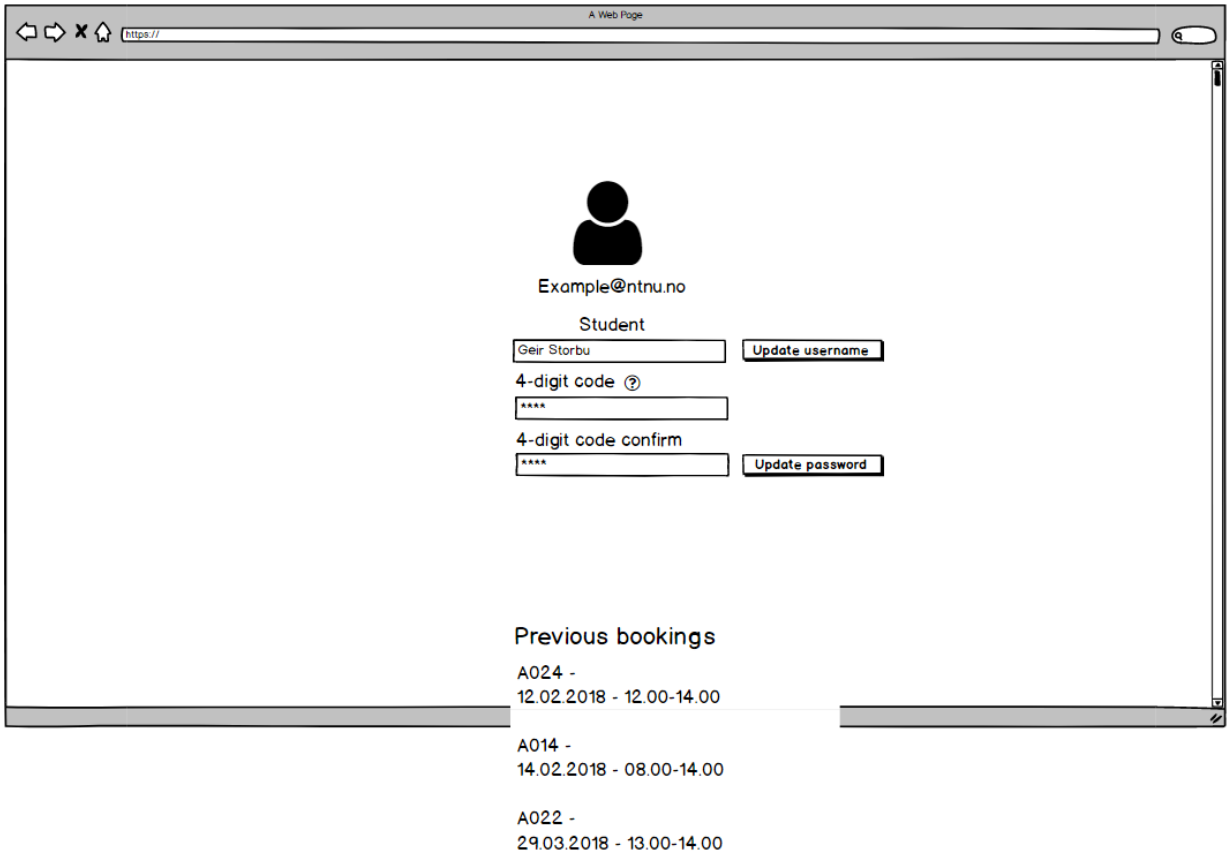


Figure 3.14: Profile overview

In figure 3.15 and figure 3.16 you can see one of our first iterations of the equipment and room list including the filter function.

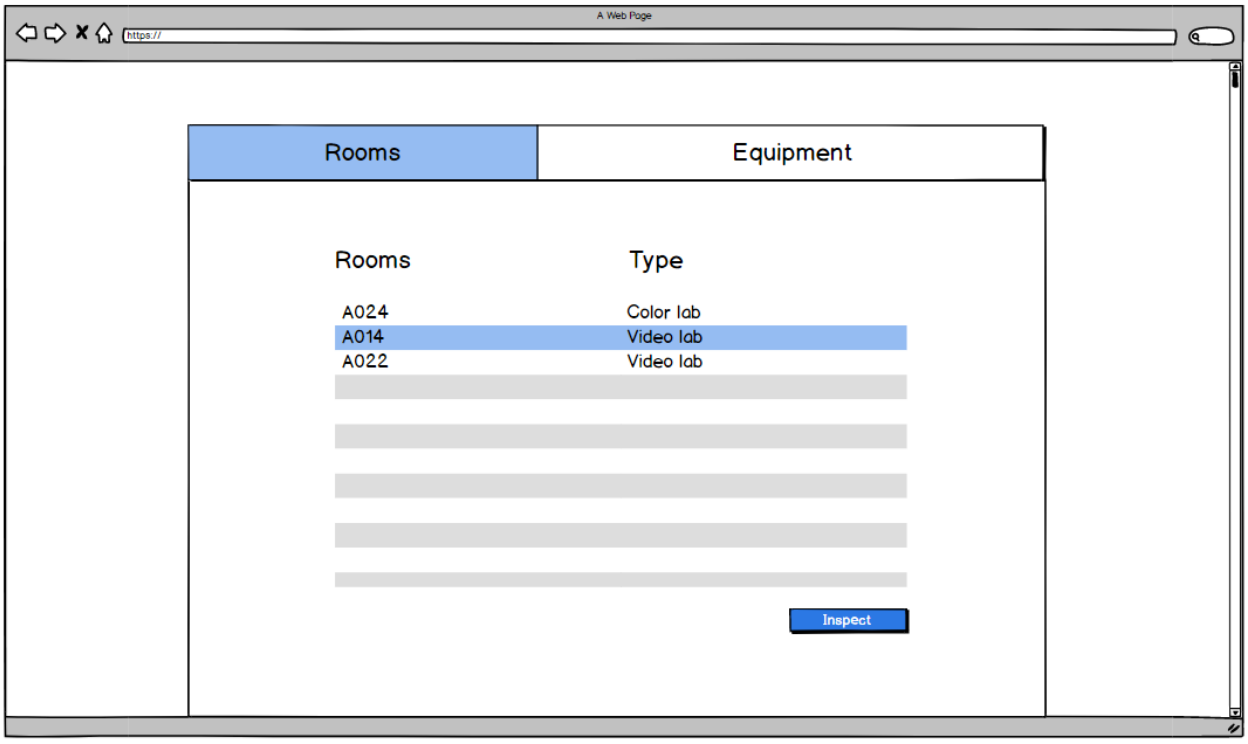


Figure 3.15: Rooms overview

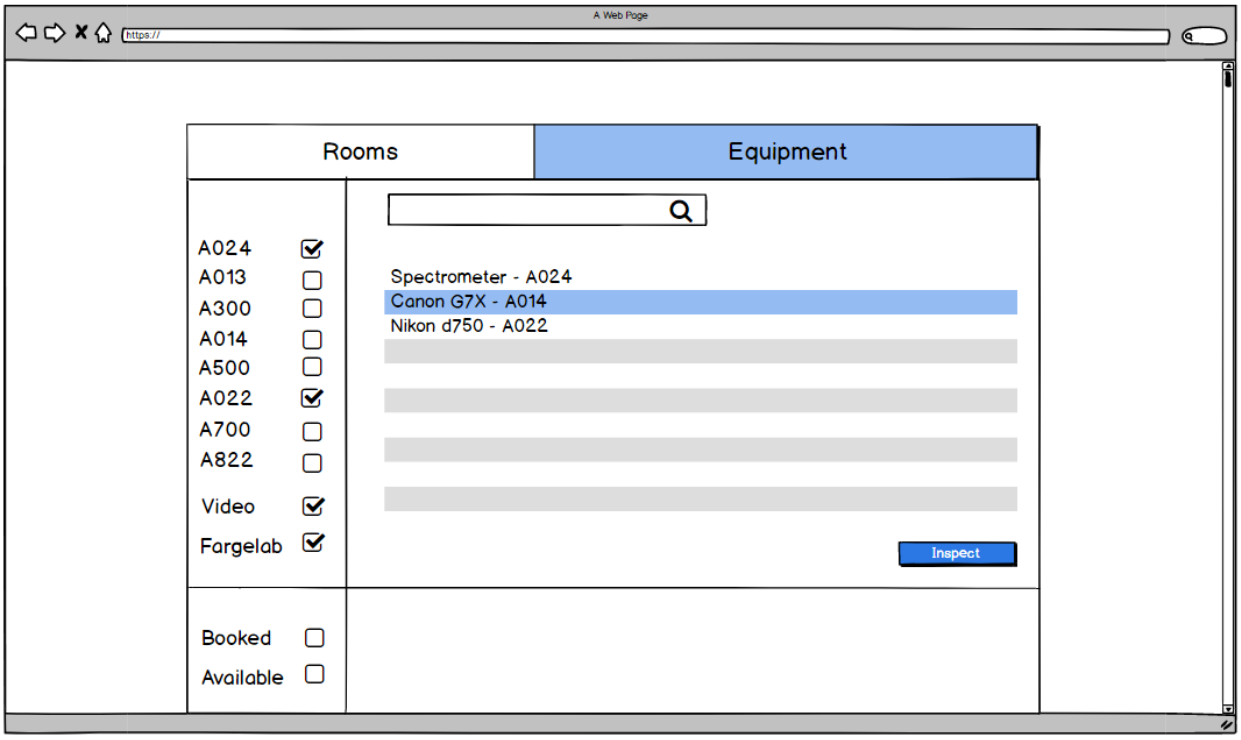


Figure 3.16: Equipment overview

The final product is quite different from these wireframes. In the start of the project the group had a different impression of what was needed for the system. Through user testing and interviews it was discovered that a deep-filter function and complicated descriptions of equipment was not needed.

One of the major changes from the wireframes is the booking page as seen in figure 3.17. The calendar view on this page is something that was a core functionality for the user experience in the system. However, back-end development took more time to do than expected - and the front-end development of a calender view seemed to be a daunting task.

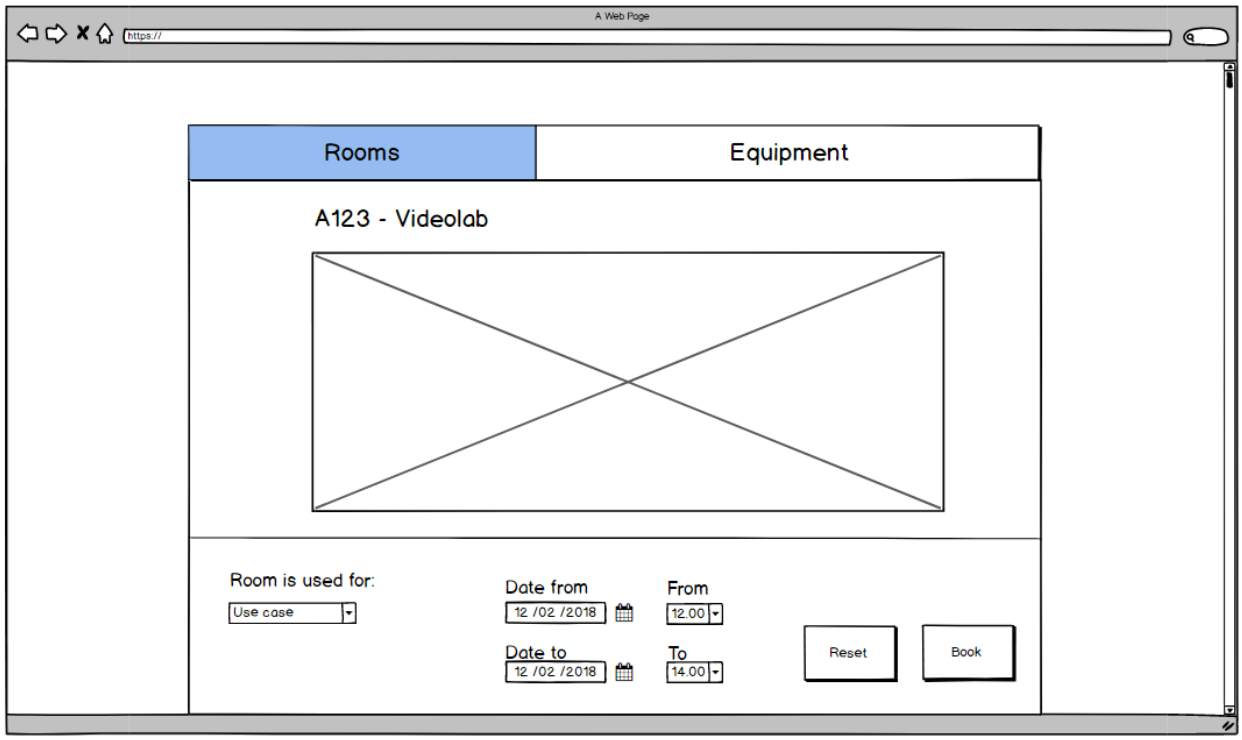


Figure 3.17: Booking page with calendar view

3.2.5 Guidelines

As previously mentioned the website uses Material Design as a guideline. The whole application is built on a framework called Material Design Lite. By using this framework we saved a lot of time on subtle design decisions, such as trying to create visual feedback on button clicks, feedback from buttons etc.

The final solution is very much inspired by Material Design, but it is not following the guidelines one hundred percent. We have taken a little freedom as to how to deal with navigation and content layout where we felt it was needed. We did not decide to use Material Design as a guideline from the very start, so our sketches and wire frames deviated of course from the layouts suggested in Material Design.

3.2.6 Mood board

Figure 3.18: Moodboard

The moodboard for this project (See figure 3.18) is a composition or clash of images that depicts ideas of how elements, text and design should look like. Each image represents and idea or feeling the user should have when they use the system. The main help the moodboard brought the project, was showcasing the ideas, the colors, the design-style such as Material design, squares, the main color would be blue, ideas for logging cake-graphs.

3.2.7 Design template

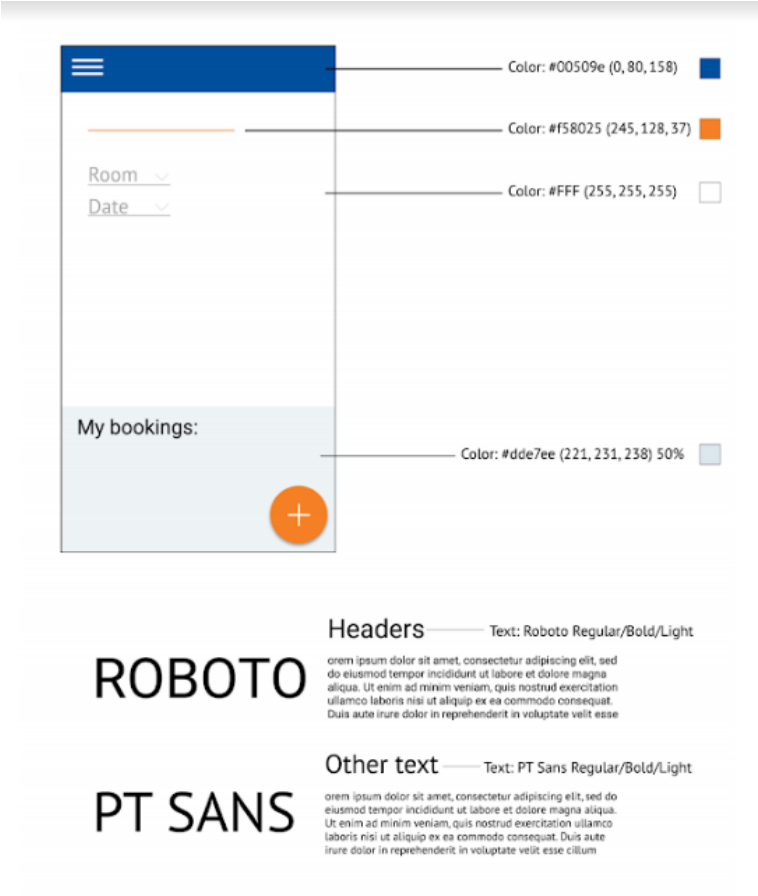


Figure 3.19: Design template

A very simple design template was done to have one place where colors, fonts, navigation bar and a simple feel of how the design should be.

3.2.8 User testing

For user testing a test plan was developed. In this test plan the roles of the team members were assigned, and task definition for the user. The user tests consisted of a test leader, an observer and a note-taker. This way all team members knew their respective tasks, thus making sure to pick up all small clues. One of the members would focus on interviewing and asking the right questions, one member would observe the visual cues and conversation, whilst the last member would take notes. The task definition is given to the user to inform them what is to be tested.

As described in SCRUM user testing is done at the end of every sprint. This way user testing is done from start to the final iteration. This was proven very beneficial to the final solution, as through testing, faults are continuously discovered and the user experience improved.

The results from user testing is used for improving further iterations.

User test 1

The first user test performed, was a test on the sketches that were made (Appendix: A.4 first user test). These sketches were mainly focused on how the system would be structured, and the test went through page for page how things connected and looked/felt.

Result

For the most part the product owner was happy with the way the sketches were made, they were easy to understand and set up in a logical sense. Only a few thing was brought up, which was that rooms and equipment should have their own views, and that the log was not finished (was not made at the time).

User test 2

In the second iteration the project owner tested the prototype (Appendix: A second user test). Here the focus was log in, registration, e-mail verification and admin functionality. Administrator tasks such as changing user roles, approving users, adding rooms and equipment were tested. User tasks like booking of equipment and rooms were tested.

Result

The registration process was flawless.

The project owner had little to no difficulties navigating the web page and administrating the content on the web page. One issue discovered was that the dashboard page for admins had an accept button to confirm changes, while the user table had an edit button to confirm changes. Since the Colourlab wants to log all user bookings he also wanted to change the deleted status on users to inactive. Marius also wanted a function to be able to search or filter for users.

User test 3

The project owner and a student tested the product in the third iteration (Appendix: A.6 third user test). The focus of this test was the booking form, booking of rooms and equipment. The student also tested the registration.

Result

The registration process up until the e-mail verification was flawless, an issue caused the verification e-mail not to be sent out, which brought the user test to a stop. The issue was discovered to be that student e-mails need a sub-domain included (example@stud.ntnu.no, instead of example@ntnu.no) in order to arrive. This was not an issue for employees at NTNU however.

For bookings there was a default value chosen for booking usage, which was changed to be blank by default to avoid logging usage in the wrong category. Marius also pointed out that multiple people use the same rooms simultaneously, so an option to share rooms or lock them would be nice to have. A toast when completing a booking went unnoticed, so this was made larger and further up from the footer to be more noticeable.

Another issue brought up was that bookings do not show immediately if they are available or not. The users had to click the book button before getting an update if they got the room or not. This was changed to check availability as soon as users fill in the information to the booking.

User test 4

In the final iteration the project owner tested the system once again (Appendix A.7). In this user test the focus was functionality of the logging system. Here actions like downloading CVS files, filtering and interacting with the pie charts were tested.

Result

No issues were discovered with navigating or understanding the log pages.

Marius wanted pie charts with stats of the all time bookings in the admin dashboard, including total hours spent. In the logging page he wanted to display the statistics for bookings the last month (30 days).

Chapter 4

Development

This chapter explains what has been done regarding developing the system, both front-end and back-end. Based on the results gathered during the design process and the project proposal delivered by the Colour lab, the following requirements have detected.

- Responsive user-friendly design so that all users use the solution.
- Roles with different permissions.
- Sign in/registration.
- Booking system that can be used for booking both rooms and equipment.
- Page to see all rooms/equipment.
- Page to see specific equipment.
- Profile page.
- Management system for administrators.

4.1 System functionality

Taking into account the aforementioned requirements, the system have been implemented the following functionality.

Sign in/Registration

- Sign in and registration system, which only accepts "ntnu.no" or "stud.ntnu.no" e-mail domains.
- Verify user e-mail accounts.

Booking system

- A booking system that can store:
  - User
  - Time period (from - to)
  - What they are using it for (project, education, other)
  - Privacy (public or private)
  - The booked Room
  - The booked equipment.
- If room is already booked, notify by showing visual feedback.
- Student bookings needs to be approved by an administrator.

Account/Profile

- Edit/Update username and password.
- Delete and see own bookings.

Administrator management

- Edit/Manage users.
- Create/Edit/Manage equipment.
- Create/Edit/Manage rooms.
- Create/Edit/Manage categories.

- View user bookings.
- Approve new users and give them a role.
- Approve bookings from students.
- Charts to visually display specific log information about how much time and how many times rooms, equipment or categories have been used.
- Logging of usage of rooms/equipment/categories by users over time.
- Download-able log to ".CSV"-file.

4.1.1 Use-case

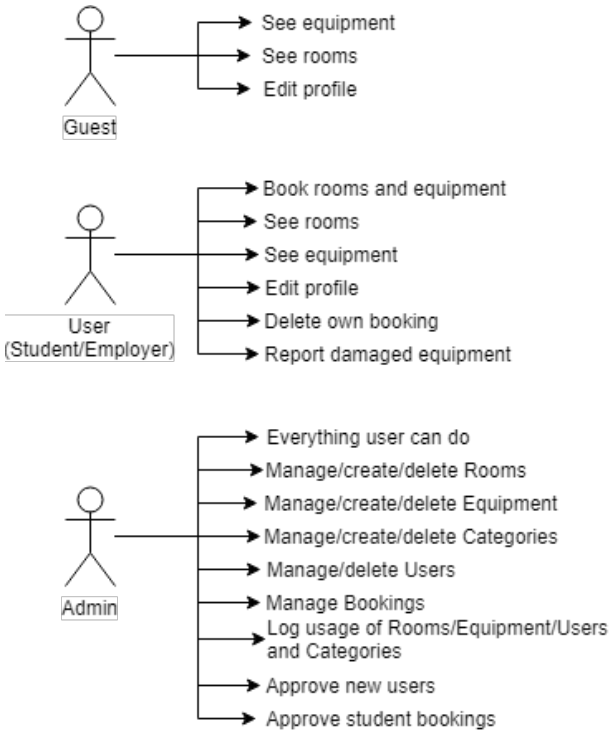


Figure 4.1: Use-cases

The use-case diagram (see Figure 4.1) helped visualize the functionality different users of the system would need, where overlapping or unique functionality would be necessary. Each user

has access to see equipment, rooms and edit their profile. A user can additionally create a booking and delete that booking, as well as reporting damage on equipment. Whilst admin can do everything a user can do, including using the back office to manage the system and read logs.

4.1.2 Site-map

Before starting the development work, a site-map was created. The diagram was created with the purpose to be a simple view of the different pages the system contains, and the flow between them. Which helped easily display the web page as a whole. The site-map were originally created on a whiteboard, where editing and changes were easier, and after an digital version was created (See figure 4.2).

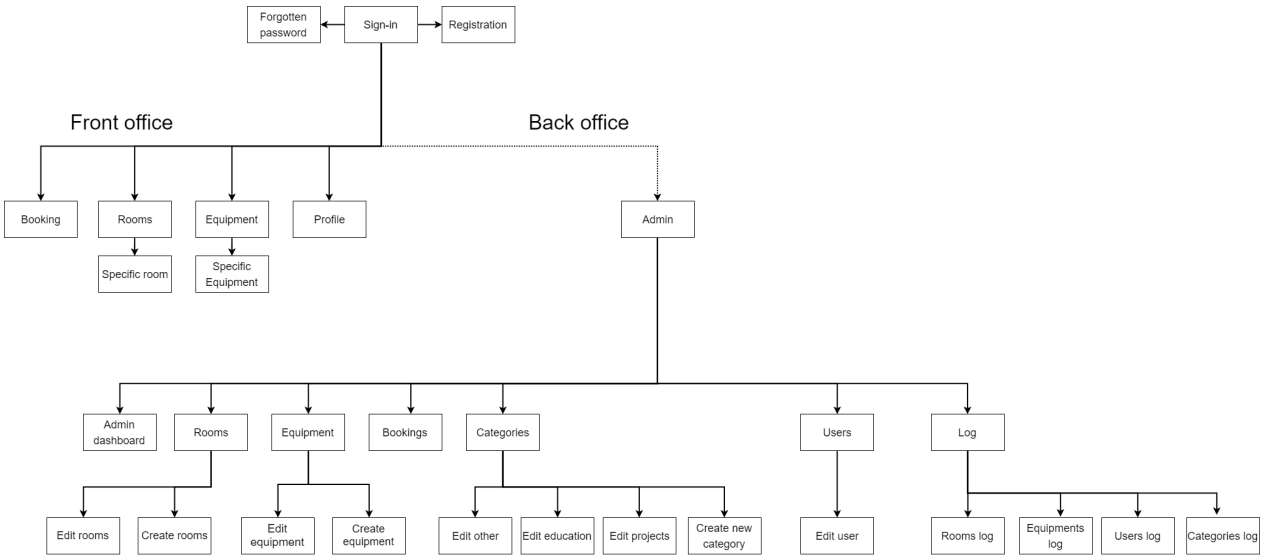


Figure 4.2: Site-map

4.2 Sprints

As stated in chapter 2.2 the project has been carried out using an agile methodology based on SCRUM. At the start of every sprint the group decided what functionality should be completed by the end of the sprint.

4.2.1 Sprint 1

In the very first sprint the group focused on preparing all the requirements for further development. Here the foundation of the project was created. In the project plan some research and existing solutions were done, this was expanded more on in sprint 1 (the results of this study can be seen in chapter 2.1.5).

Further the group made sure to talk closely with the project owner to filter out what was less important and what was the core of the project. User interviews (See Appendix A.8, A.9) was also done at this point to get an idea of who used the Colour lab. Based on what was told in the interviews personas/scenarios, sketches (See Appendix A.11) and wire-frames (See Appendix A.12) were created. User testing with the project owner was performed on these sketches.

Based on Material Design, mood-boards and design templates were created, to make sure everyone in the group was heading in the same direction with their ideas.

Towards the end of the sprint the group started making EER-diagrams (Section 4.3.2 expand on this) and looking into how the database should look and function.

4.2.2 Sprint 2

In the second sprint the group started the development process. After reviewing the EER-diagram, normalization of the database was completed. Further programs needed for development was installed and a repository on GitHub created. The first development of the system was in the front-end implementing components from the front-end framework. From there the functionality of the system developed was the registration and sign in system with roles and permission. After completing this part it felt natural to expand upon this system and work on on admin functionality. Such as creating data for the database, that would be used in a booking system.

At the end of the sprint user test of the prototype was performed.

4.2.3 Sprint 3

For the third sprint the main focus was the booking system. This is where the main bulk of the work on the booking system was done. Some administrator functionality was also added here, such as being able to approve/decline student bookings. User testing was again performed on

the new functionality (booking system and back office).

4.2.4 Sprint 4

For the last sprint development was split into developing the logging system, the rest of admin functionality and filtering tables. Work was also done on completing the booking system since not everything was completed from the previous sprint. Further functionality was added to the existing room/equipment page to see more information regarding these.

User testing was done with the product owner to test out the final system.

4.3 Architecture

4.3.1 Database

The database model used for this project is called relational database model (Explained in chapter 2.4.4). This is one of multiple models that exist, and was chosen for a few reasons. Although it takes more preparation to set it up, relational databases have the advantages of things like dynamic views, defined relations and good security. For this project these advantages fit perfectly. The model also use SQL, something that is easy to use and is a human readable language (meaning it can be understood based on logic by only reading the queries).

From looking at the requirements, a relation database was the most logical choice as the system would need several tables. A relational database allows to easily get related information from tables in a logical and efficient way, by using primary keys and foreign keys in the tables.

4.3.2 EER Diagram

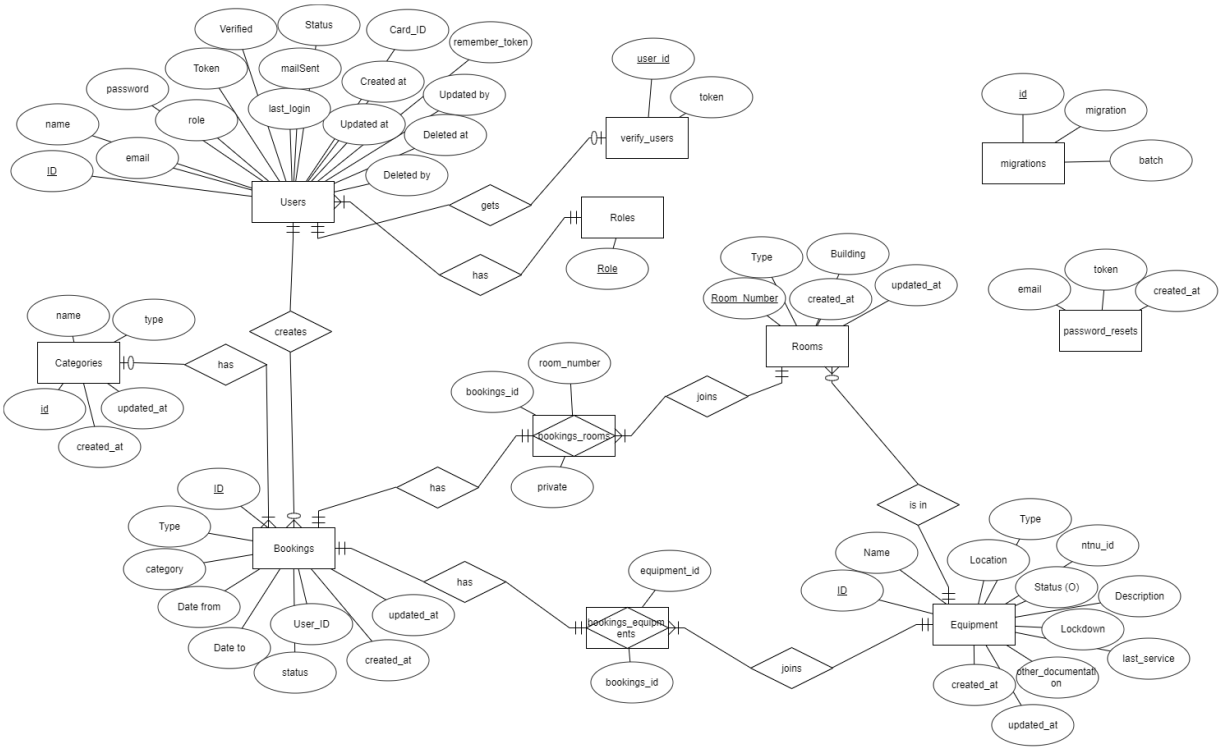


Figure 4.3: EER Diagram

Creating an EER diagram was helpful displaying the needs of all the tables in the database and to see the relationship between them. It allowed for an easier and simpler understanding of the database. In figure 4.3 squares represent the database tables, circles coming from them are the table columns, and the diamond-shaped square is representing a relation between two tables. A collection of all the circles above a square represents a table row. Bookings_rooms and Bookings_equipment tables have an relationship square in the middle of them, this square represents that these tables are associative tables also called linking tables.

4.3.3 Relation Schema

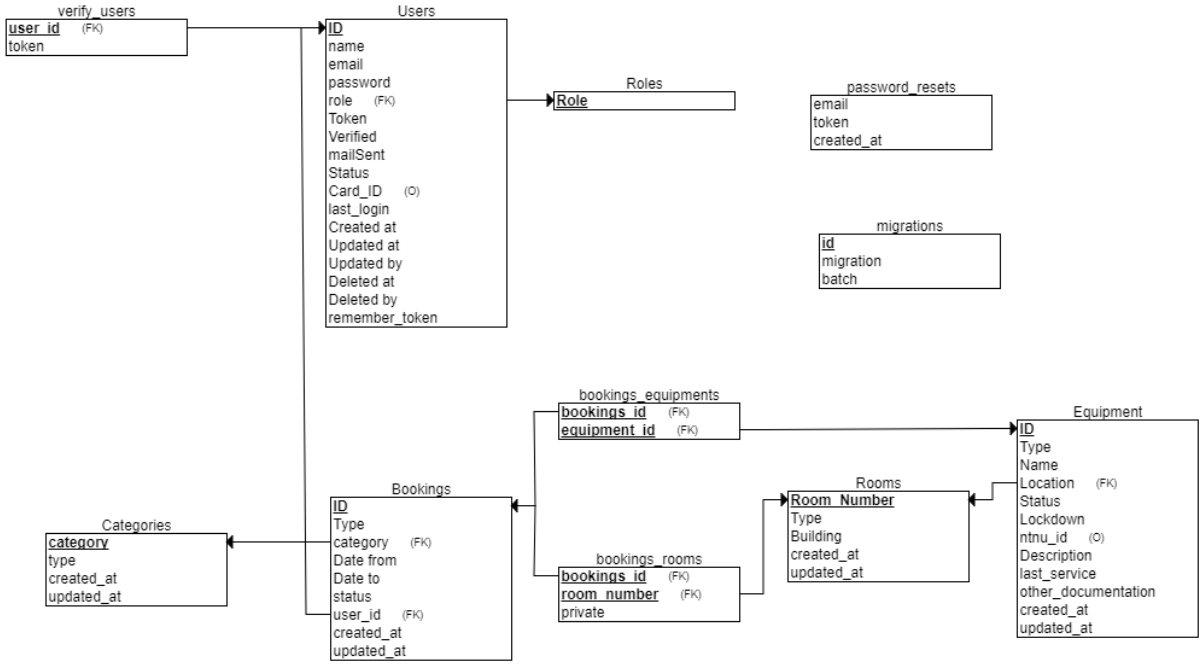


Figure 4.4: Relation schema

The information acquired from the EER diagram (Figure 4.3) allowed to create a Relation schema. Benefits of having a relation schema is that one can see which columns in the tables have a relation with each other (through foreign key(FK)), and to make sure the table is normalized.

As seen in the relation schema (Figure 4.4) the booking table is not connected to the Rooms or Equipment table directly. Reasoning for this is because the booking table would then need to have a column for room_number and equipment_id/name, which would create empty columns in the table row. To fix this issue, two tables were created to connect a booking with a room or an equipment by storing the booking id together with the room number or equipment id in a separate table.

4.3.4 Front- and back office

As visible in figure 4.5 the final solution consists of a front office, a back office, Laravel and the database.

The front-end of the system is split into two parts, the front office and the back office. The front office is where the standard users interacts with the system and the back office is where administrators manage the system and queries the database through Laravel (Read more about Laravel in section 4.4.2).

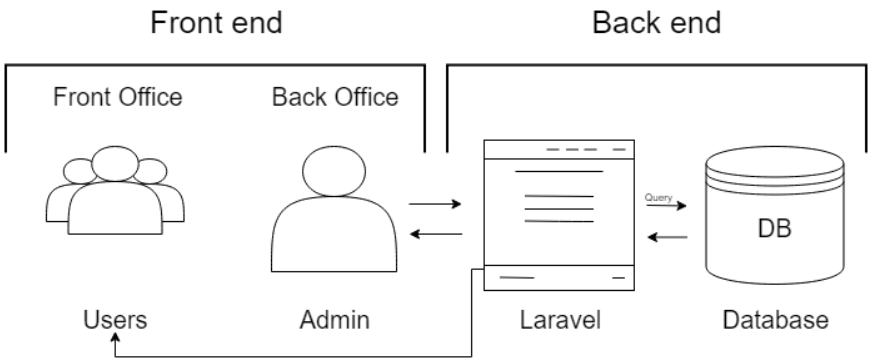


Figure 4.5: Implementation of back-end and front-end

4.4 Back-end implementation

4.4.1 Choice of framework

When looking into what frameworks that were going to work for this project, the main consideration was the back-end. Looking into the frameworks available we narrowed it down to Node.js and Laravel. Node.js is used with JavaScript to execute code in the back-end and is often used for newer applications. However since for this project a relational database fit the system best (See section 4.3.1), a framework like Laravel would benefit this system more, as Laravel works well with PHP, SQL and relational databases.

4.4.2 Laravel

Laravel is a framework for PHP which have a lot of functionality such as Model View Controller (MVC), Eloquent ORM, Routing, Authentication, Form Security from the start. The functionality Laravel provides help developers be more efficient while creating a modern system.

Laravel comes with a predefined folder structure which can be seen in figure 4.6. However the vendor folder is fairly huge and comes with several of packages, thus it has to be downloaded separately using Composer[1] (which is a dependency manager for PHP) when initially setting up a Laravel project.

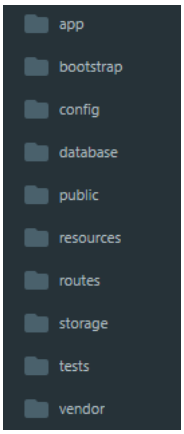


Figure 4.6: Laravel folder structure

4.4.3 Model View Controller(MVC)

MVC is an architectural pattern which separates the system into three logical components, Model, View and Controller. These components handles different specific aspects of system and lets them talk to each other. User initiates a controller, the controller utilizes the model and the model returns the view.

Model

Each table in the database has a its own model. The model is used to interact with the table to query for data, as well as insert/create and delete. The model is also used store database related help-functions which generates pre-written code to reduce the amount of SQL needed in database-queries. Models are also used to utilize Laravels Eloquent ORM, Eloquent allows SQL queries to be written a lot faster and easier. For example of retrieving all the bookings of rooms in SQL see figure 4.7 and in Eloquent see figure 4.8. As depicted it becomes shorter and simpler with Eloquent, and if the query is more complex as many of the queries of this system

[1] https://getcomposer.org/

are, Eloquent saves a lot of time. Laravels models are stored in the app folder as seen in figure 4.9.

```
SELECT *
FROM Bookings b
WHERE b.type = 'Room'
```

Figure 4.7: SQL query example

```
Bookings::where('type','Room')->get();
```

Figure 4.8: Eloquent query example

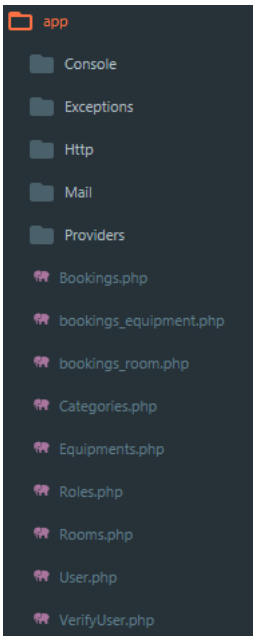


Figure 4.9: Models folder location

View

The views is what the user of the system interacts with and what is displayed in the browser. Views in Laravel uses ".blade.php"-files which gets compiled into HTML files. Blade allows for

functionality that improves efficiency and usability. For example displaying a variable in blade see figure 4.10 and the difference in PHP see figure 4.11.

```
{{$variable}}
```

Figure 4.10: Blade print variable example

```
<?php
    echo $variable;
?>
```

Figure 4.11: PHP print variable example

Blade also has features which allows printing HTML only when a condition is set as seen figure 4.12's foreach loop. The code will print all the users of the system's name after each other, which is very useful.

```
<div id="allUsersBox">
    @foreach($allUsers as $user)
        <div class="username">{{$user->name}}</div>
    @endforeach
</div>
```

Figure 4.12: Blade foreach example

The front office and back office have different requirements regarding what has to be displayed on the web pages, however for simplicity and organization all these pages are contained within the same folder.

Views are found under the folder "Resources" in the folder "Views". In this project each page has been split up into folders, which contains the different views for that page. The sub-folders of the views folder contains .blade.php files that represent the different views of the web page.

As stated both front office and back office have an equipment page with different requirements, both require different views.

In figure 4.13 the folder structure can be seen. In this example the "equipments" folder is open and contains 5 different blade.php files with different views. The first file contains the admin view, the second file contains adding new equipment view, the third file contains editing existing equipment view, the fourth file contains the user equipment view and the last file contains additional information view.

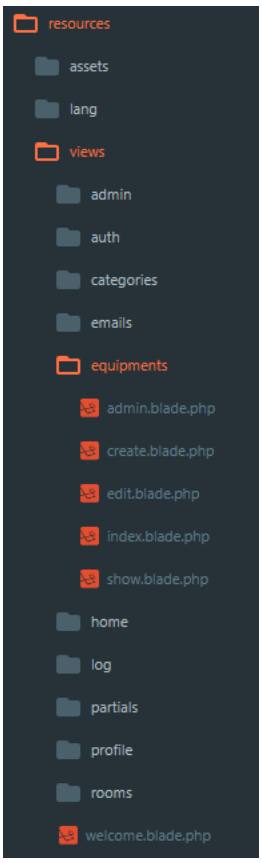


Figure 4.13: Views folder location

Controller

Controllers handles all the logic, this is where the database models are used, where data is sent to the views and other functions exist. A controller function is initialized from a route which carries requests and variables to be used in controller functions. A controller functions could be used to for example load a new view or talk to the model to modify a table.

Controllers are stored in the Controllers folder, located in Http which is in the app folder as seen in figure 4.14.

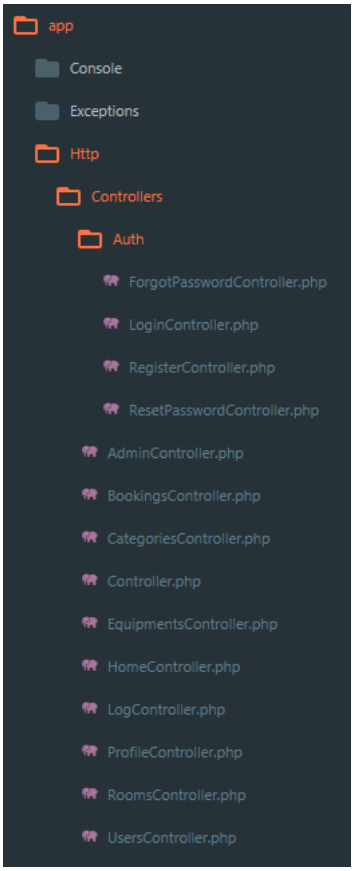


Figure 4.14: Controllers folder location

4.4.4 Routing

Routing is the part of the system that connects requests and URLs with the controller. Routing also supports "method spoofing" which allows new types of request by adding a hidden method field to a form. When adding a method for deletion (seen in figure 4.15), the route file know which type of request it is and can run a different controller function within the same URL. A

route can also take variables by specifying the variable in curly brackets. For an example of routes on the same URL with different functions see figure 4.16. Routes can be found in the file web.php stored in the routes folder as displayed in figure 4.17.

```
@method('delete')
```

Figure 4.15: Form method delete example

```
//Display a specific test
Route::get('test/{id}', 'testController@show');
//Do something to a specific test
Route::post('test/{id}', 'testController@something');
//Delete a specific test
Route::delete('test/{id}', 'testController@delete');
```

Figure 4.16: Routing example

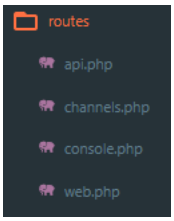


Figure 4.17: Routes location

4.4.5 Public folder

The public folder works as a normal root folder in other projects. Here folders to CSS files, JavaScript files, jQuery-ui, and images can be found. Favicons and the index file is located here as well. The index.php runs the application and catches the request to be used in a route to return the correct view. This lets routes and the MVC model control everything that happens on the page rather having HTML/PHP files.

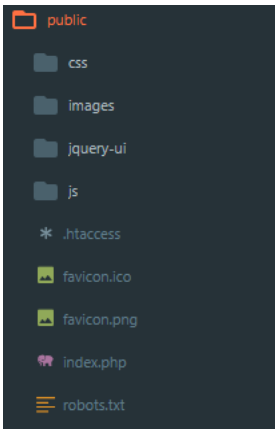


Figure 4.18: Public folder

4.4.6 Sign in and registration

Laravel han an authentication system for registering and logging in users, that works very well with this system. It is easy to configure and change if needed. Using and learning this system saved time from creating Log in and registration systems from scratch. Each time a user signs in they also get a random CSRF-token added to their session, which stops Cross-site request forgery attacks (explained in more detail in section 4.4.8).

For this project when signing in and registering a user needs to provide their @ntnu.no or @stud.ntnu.no emails given by the university. This ensures that the only users that use the system belong to the university and are the only ones who will have access to it. Additionally to make sure users are actual members of NTNU, a mail-verification is done.

4.4.7 AJAX

AJAX was used several times in the booking system to update information on the web page while the user input data. When a room is selected, the booking form opens and brings with it a JSON object containing the equipment for the room. After a user selects all the dates and times for the booking AJAX displays a table showing if a booking is available or booked. Lastly AJAX is used when selecting a Usage for the room to change the contents of the Specify use drop-down. An example of the booking system can be seen in Chapter 5, Figure 5.10.

4.4.8 Security

Mail-verification and email-domain

Explained in the previous section 4.4.6 about Sign in and registration. The users using and registering on the system, needs to have an email provided by the university NTNU, which is where the Colourlab is located. This prevents unwanted people from registering and using the system. Another layer is that the mail has to be verified, as displayed in the next chapter, under section 5.1.1.

CSRF protection

CSRF protection or protection against Cross-Site Request Forgery attacks is something that comes with Laravel. Each authenticated user has a unique random CSRF-token in their session, and each time a form is sent this token prevents user from executing commands they do not have access to.

Form validation

When submitting a from, a check to see whether or not values provided are correct is done. This ensures that all values that enter the database are formatted correctly.

Passwords

Passwords from users are hashed, and encrypted. This way it can not be read directly from the database.

Roles and permissions

Users of the system have different roles with unique permissions, which limit what they can and can not do.

- A guest with a NTNU.no-email can visit the site, however he can not book anything.
- A student account (has to be approved by admin) can use the the entire front office. However when booking, the booking has to be approved by an administrator.

- An employer is completely the same as student, with a minor difference where a booking does not need approval.
- An admin account has the same permissions as employers and access to the back office.

To do this the admin has to approve all new accounts (guest accounts) and give them a role (can be changed later). Navigation also changes for the different levels of permissions the role have access to, and also changes when entering the back-end of the client-side (See figure 4.19).

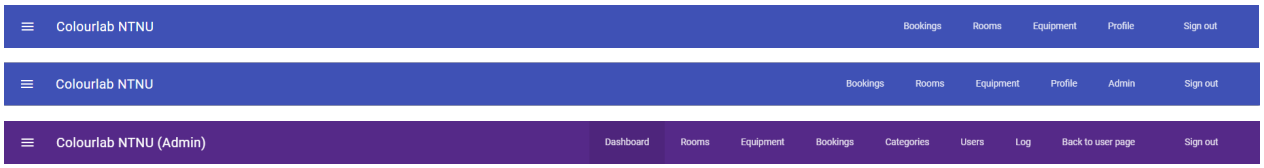


Figure 4.19: Navigation bars (Front office, Front office for Admin, Back office)

4.5 Front-end implementation

4.5.1 Choice of front-end framework

For front-end frameworks there were a lot of contenders. Larger frameworks like Angular, React and Vue were considered, including a light-weight framework such as Bootstrap and Material Design frameworks like Material design lite (MDL) and materializeCSS[2].The possibility of not using any framework at all was also an option.

After discussions a decision that a big front-end framework like Angular, React and Vue was unnecessary for this system and that either no- or a lighter front-end framework would be the best. Research on the lighter-frameworks resulted in that using a material design framework would be beneficial to decrease time developing the design of the front-end using material design elements.

When thinking about future development and other people taking over the project good documentation and ease of use were taken into consideration. MDL was chosen after researching these options. The documentation[3] with code-snippets was informative and useful, and

[2]https://materializecss.com/
[3]https://getmdl.io/components/index.html

the framework had been proven to work professionally by Google which had used it on several websites[4]. These things made the framework very comfortable, knowing that it works and is reliable.

4.5.2 Material design lite (MDL)

As explained in chapter 2.6.3 MDL is a front-end framework that uses CSS and JavaScript to provide easy implementation of material design components for front-end development.

MDL has a layout-structure that is used for this project, this structure is based on the normal header, main, footer tags in HTML. In the header the MDL component for navigation is used, and can be found under layout on the getmdl.io site as seen in figure 4.20. The same goes for the footer, which is located at the end of the layout section.This creates the clean look of MDL promises.

MDL offers everything from the basic structure, to buttons and other elements that are easy to use. Some of the elements used are, input fields, card, tables, buttons and dialogs. Input fields have been used for every form in the system, these are easy to understand and they are pleasing to the eye. Card have been used when there has been information to display, and for making forms look cleaner. All tables in the system use the MDL component, this component makes tables that are easy to understand and read. These tables bring JavaScript functionality with hovering and are clickable. Dialogs are used as pop-ups, for filtering tables where this is necessary.

[4]https://getmdl.io/showcase/index.html

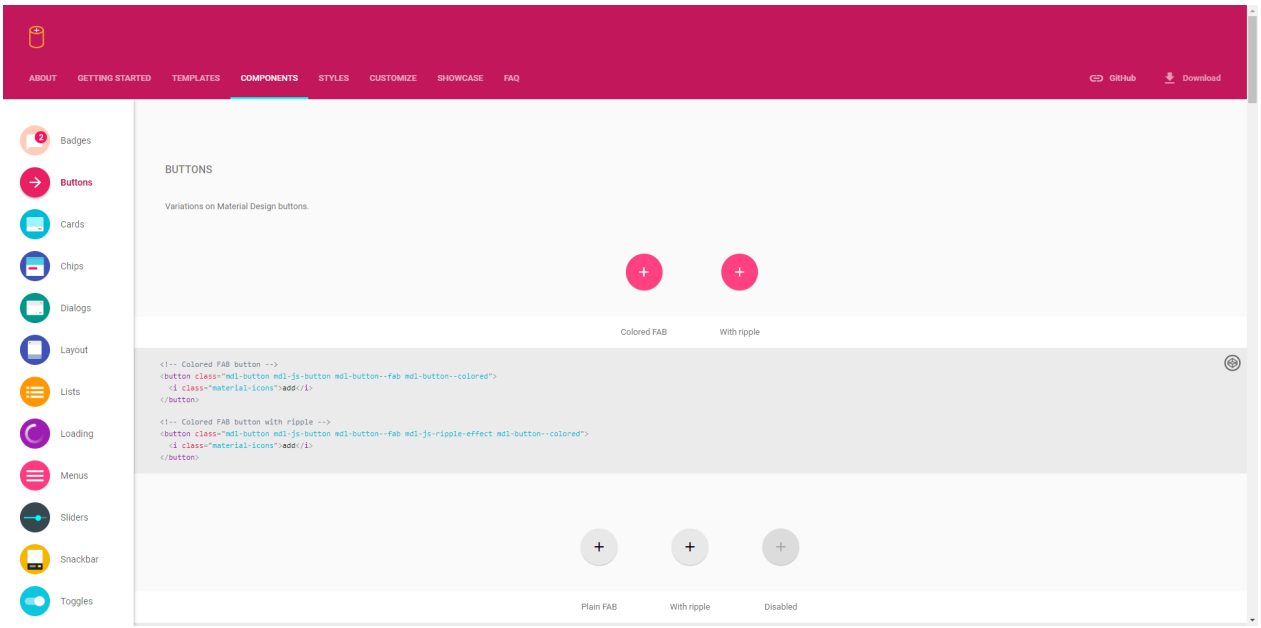


Figure 4.20: MDL components screenshot

4.5.3 CSS3

In the project CSS3 was used to customize elements not styled or positioned by MDL. For example to add colors and fonts, position boxes and buttons and adding margins between elements. CSS media queries where also used to make elements responsive, this is expanded on in section 4.6.6.

4.6 Visual design

4.6.1 Typography

For readability fonts without serifs where chosen. On screens fonts without serifs are easier to read in both small and large text sizes (Krug, 2014). The fonts chosen are the Google font **Roboto** and **Open Sans**. These are fonts made by Google which have a clean modern look which also follows Material Designs guidelines. Open Sans was used for body text and headings have the Roboto font. This was done to separate headings from body text easily.

Originally PT Sans was meant to be used for the body text(as seen in the moodboard 3.18 and the design template 3.19), however user testing and research showed that Open Sans was a

better choice for readability.

4.6.2 Icons

Icons are easier to recognize for users, as they see what it is and can immediately understand what it does. Additionally using the commonly known and used Material icons further strengthen this. Luckily Material icons are part of an online font-style as well as being included in MDL, which makes it easy to implement and use in an web-project. There were not that many icons needed for the system, however where it felt natural for an icon, one was added. In Figure 4.21 the icons used and what they do/represent is depicted.

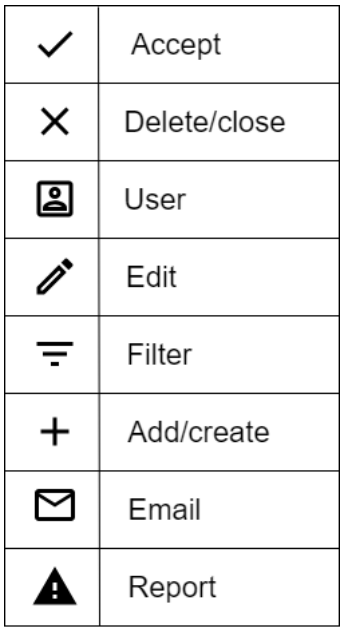


Figure 4.21: Material design icons used

4.6.3 Colors

When choosing Colors the group wanted to chose color that helped us bring attention to specific elements or actions. A blue color was chosen to resemble the NTNU colors. An orange color as accent to actions and elements that need extra attention from the user. Colors were chosen from NTNUs color palette[5] and material design color scheme[6]. The blue color on navigation changes

[5]https://innsida.ntnu.no/wiki/-/wiki/Norsk/Farger+i+grafisk+profil
[6]https://material.io/design/color/the-color-system.html#tools-for-picking-colors

to purple when an administrator uses the web page, to signify that they are using their admin privileges. In the start of the project, the navigation for administrators was orange (seen in the early prototype A.13 and in the moodboard 3.18), however some readability and contrast issues were discovered which had to be corrected to fit the WCAG 2.0 standard. According to WCAG 2.0 a readability rating has to be over 4.5 (AA rating) and now the contrast is 8.9 with a purple colour, still stay true to the NTNU colors.

4.6.4 Navigation

The website uses two types of navigation, one in the navigation bar, and one in the hamburger menu. However on mobile devices only the hamburger bar is available. The site also uses different navigation menu for different users on the system and their roles. (See figure 4.22)

The navigation while not logged in stays simple, and contains only the navigation to the sign-in form. To navigate to the registration form the user has to click a link, at the bottom of the sign-in form (See figure (See figure 4.23).

When logged in the user always have access to the sign out "button" in the navigation. Users also get navigation between Bookings, Rooms, Equipment and Profile.

However when logged in to an admin account, they also get navigation to admin part of the site. The admin back office navigation is visually different with a color change to let the administrator know that they have left the front office of the system and entered the back office. The navigation bar also changes to let the admin access Dashboard, Rooms, Equipment, Bookings, Categories, Users, Log and "Back to user page". "Back to the user page" takes the administrator back to the front office. The admin navigation bar changes when the user clicks on "Admin" and "Back to user page".

On mobile the navigation bar gets reduced to just the "logo" (name of the company) and a hamburger menu. The hamburger menu contains all the navigation options located in the navigation bar previously (See figure 4.24). The sign out button is located further away from the other links, with a divider, to make sure the user do not sign out on accident. The hamburger menu navigation is also available on the desktop-version (See figure 4.22).

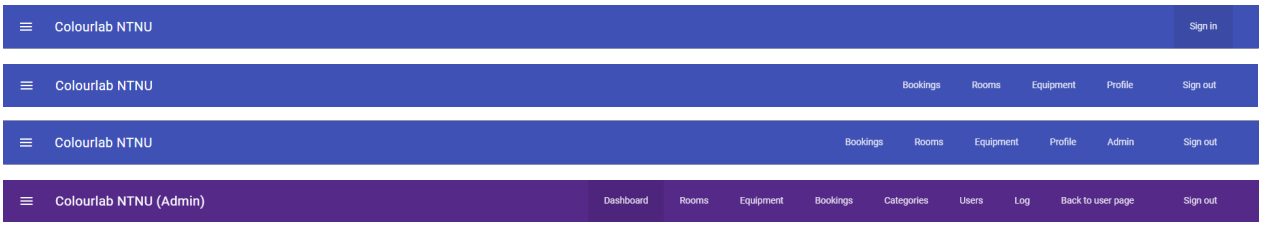


Figure 4.22: Navigation bars

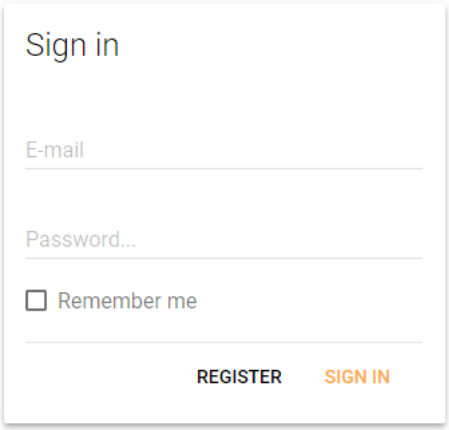


Figure 4.23: Sign-in form navigation

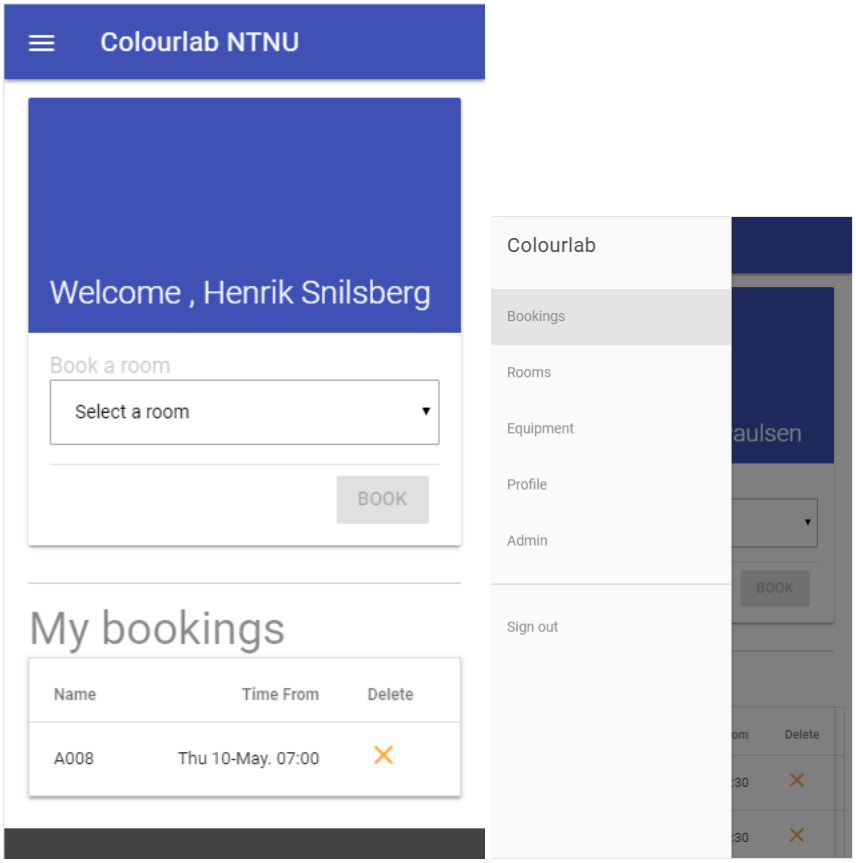


Figure 4.24: Mobile navigation

4.6.5 Footer

The footer is simple without much clutter, as the system do not need navigation or other information there. The information it provides however are the name of the company and two links, a link to the about-page from Colourlab's own web page and a link to NTNU's web page to quickly get to those sites if necessary (See figure 4.25).

Figure 4.25: Footer

4.6.6 Responsive design

Making the system responsive was an important aspect of the front-end implementation process, as the system will be used on all devices. The front office is responsive on all devices, as the

users could be using the system on a mobile, a tablet or their computer(See Figure 4.26). The back office however was designed primarily for desktop, which stated by the product owner is where administrators would interact with the back office (Appendix A.8).

MDLs responsive grid classes is used to create the responsiveness on the views. Furthermore CSS MediaQueries is utilized in the custom style-sheet to manually edit and change certain styling and details for mobile and tablet.

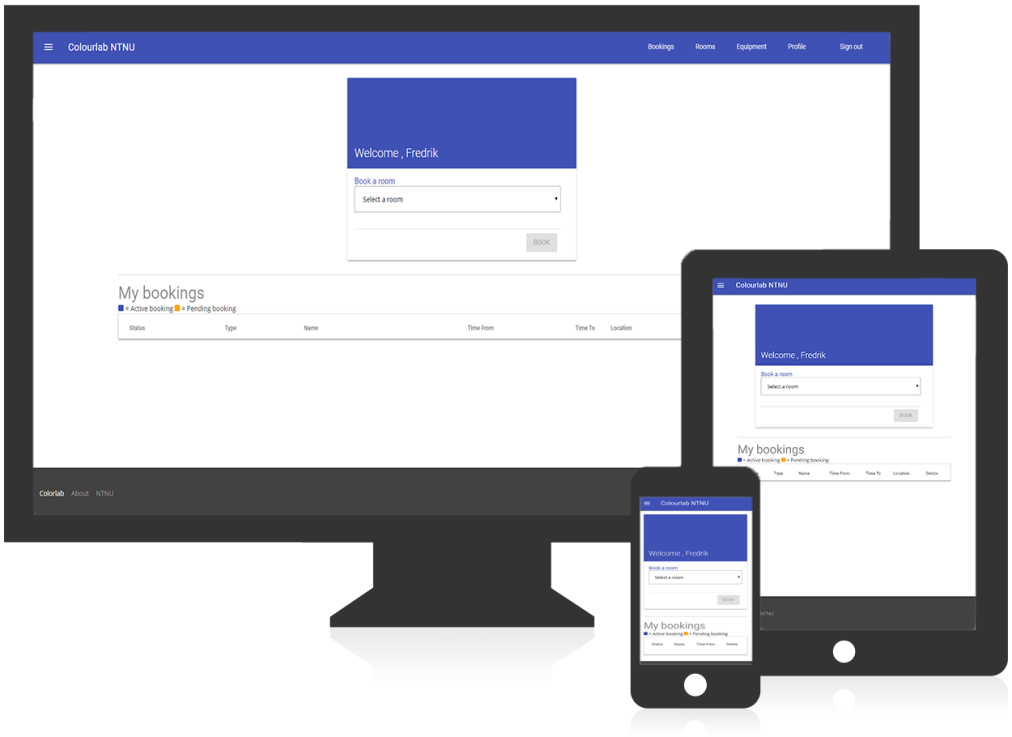


Figure 4.26: Responsive design example

Chapter 5

Results

In this chapter the result of the project is shown, and there is a page by page rundown of how the final product turned out.

5.1 Front office

For users the layout of the site is quite simple as seen in figure 5.1. The first layer consists of registration, sign in and forgotten password. The second layer has bookings, rooms, equipment and profile information, while the third layer is a sub page of rooms and equipment with more information.

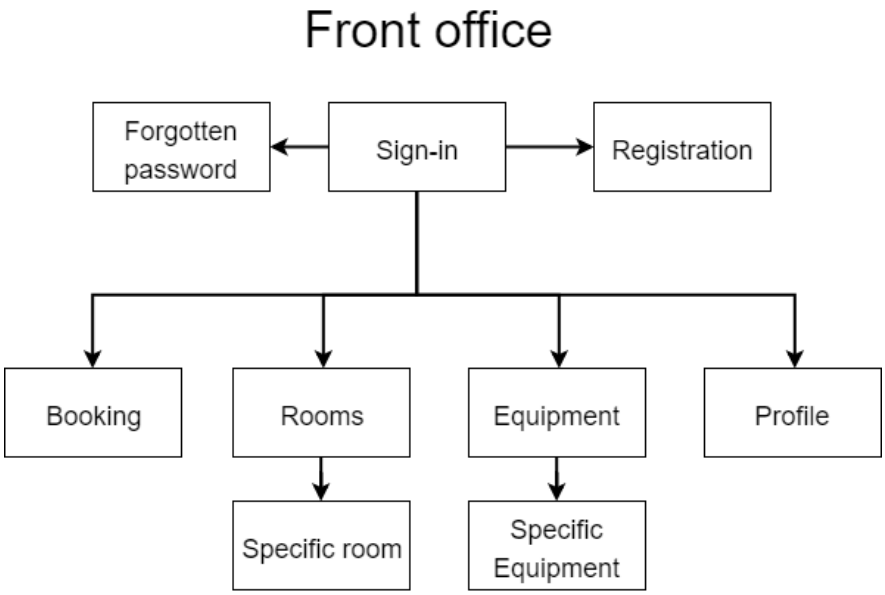


Figure 5.1: Front office layout

As figure 5.2 shows, the design of the user index page is clean and simple. This is intentional to make users automatically focus on the issue at hand without any distractions. The header has a blue color similar to NTNU's color scheme. On both the desktop and mobile versions the navigation bar have different links depending on the permissions of the user role.

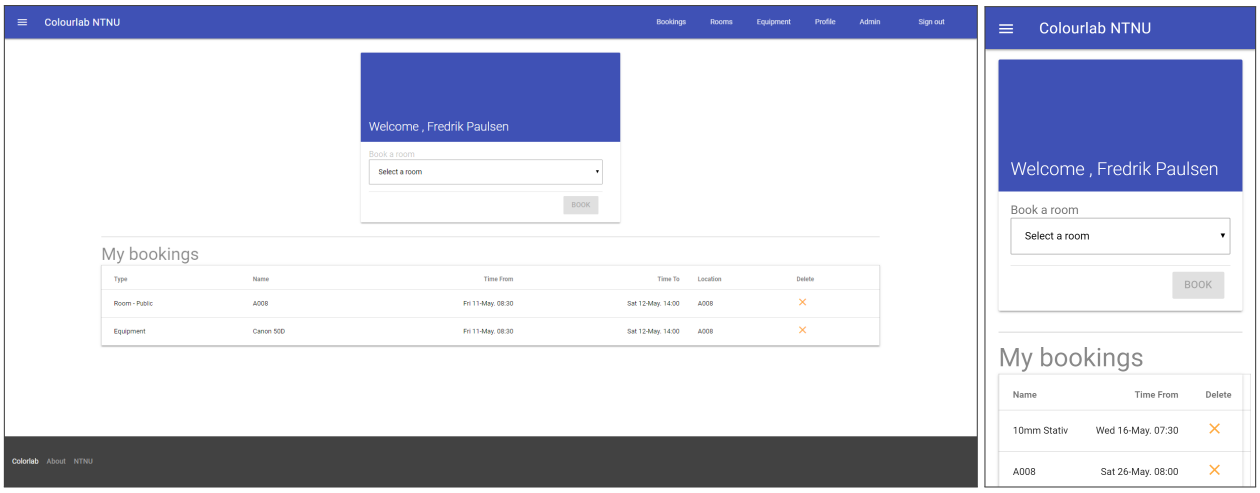


Figure 5.2: Index page, including admin navigation (Desktop and mobile)

If the user is logged in as an administrator the navigation bar will change color (as seen in 5.3) to indicate to the user that they are using their admin privileges. The sign out button is separated

from the other grouped elements to signify that it is not a part of the main functionality of the navigation.

The admin panel is made for use on desktop, considering there is a lot of information to comprehend. The views will still work on mobile, but they are optimal on desktop. Further the admin panel is used to control the backside of the system, and manage users, rooms, equipment as well as see logging information.

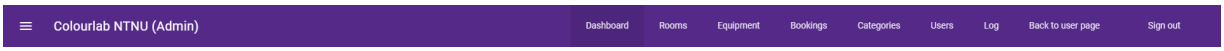


Figure 5.3: Admin navigation

5.1.1 Sign in and registration

The first view the user encounters when going to the page is a sign in card. This card is an element from getmdl.io (*Material Design Lite*, 2018), making it clean and simple. From the card the user can either sign in or navigate to the registration view by simply clicking the "registration" button in the card. While the sign in button will be orange, indicating that this button performs an action and is not pure navigation (figure: 5.4)

If the user is not already in the system, they will need to register by navigating to the register view. In the registration view they will yet again be met with a clean card from material design, where they can fill in their info. Also if the user has forgotten their password, they can quickly recover it by clicking the "lost your password?" link.

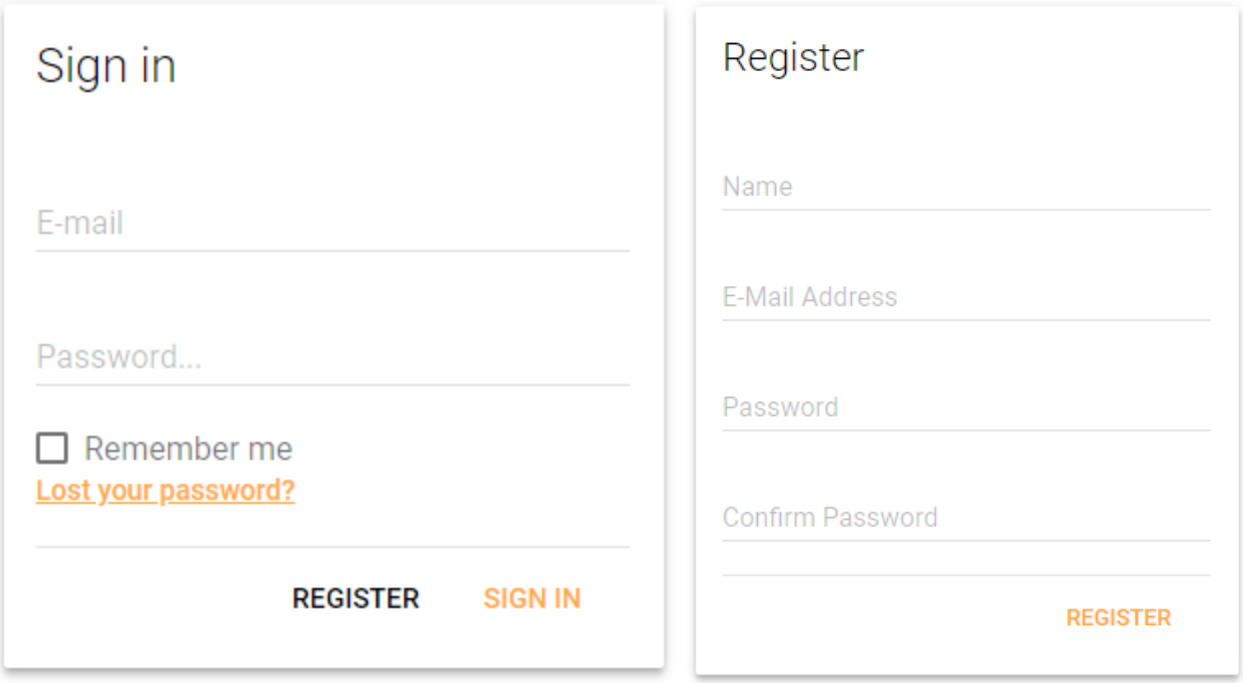


Figure 5.4: Sign in and registration page

If a user were to open on mobile instead of desktop, they would be met with the same screens. Clean and simple, only scaled down for a mobile screen.

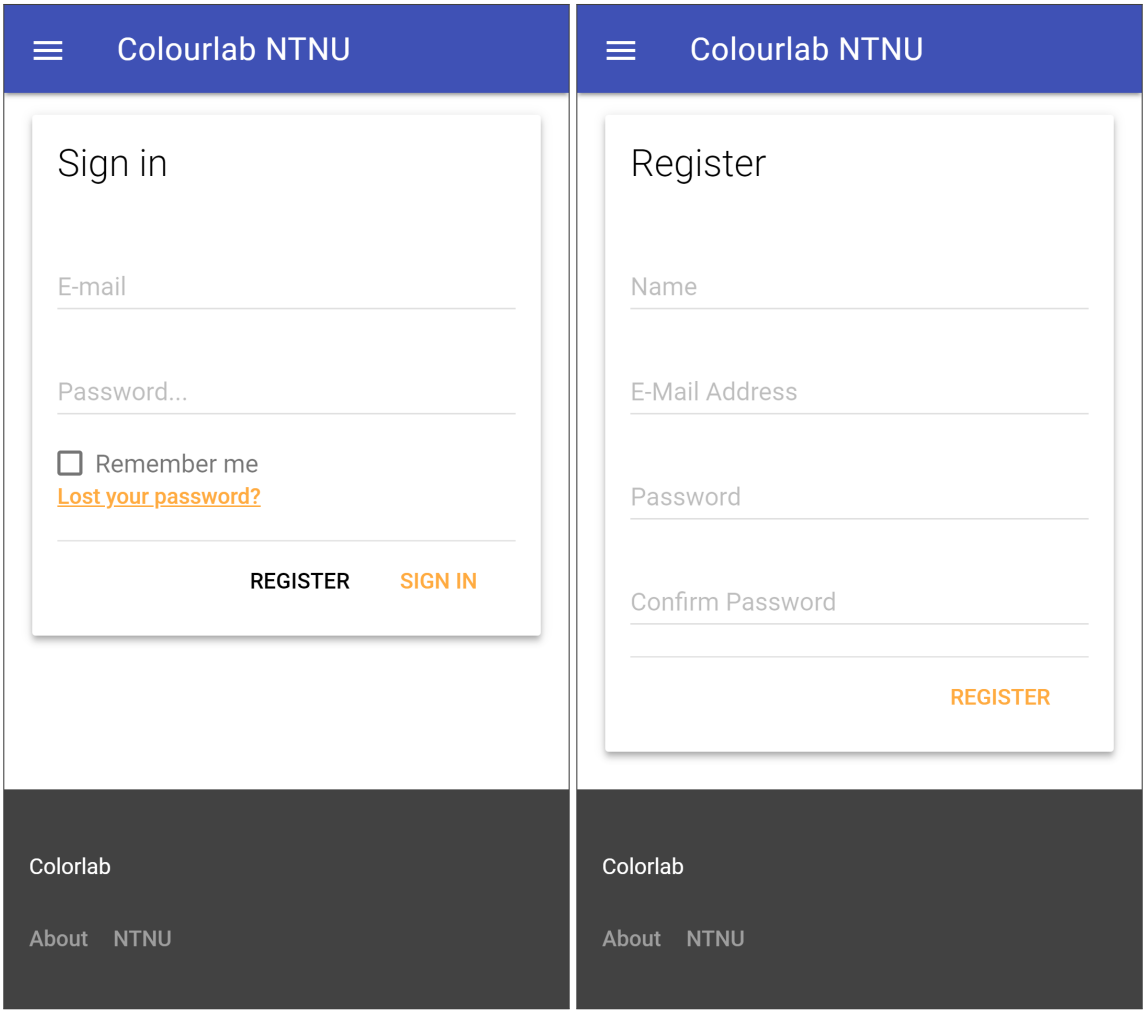


Figure 5.5: Mobile Sign in

In figure 5.6 a close up of the register form can be seen. As users fill in the form feedback is given instantaneously. A red color and an underline appears as well as an error message explaining what might have been done wrong. Accepted information will be highlighted with a yellow background.

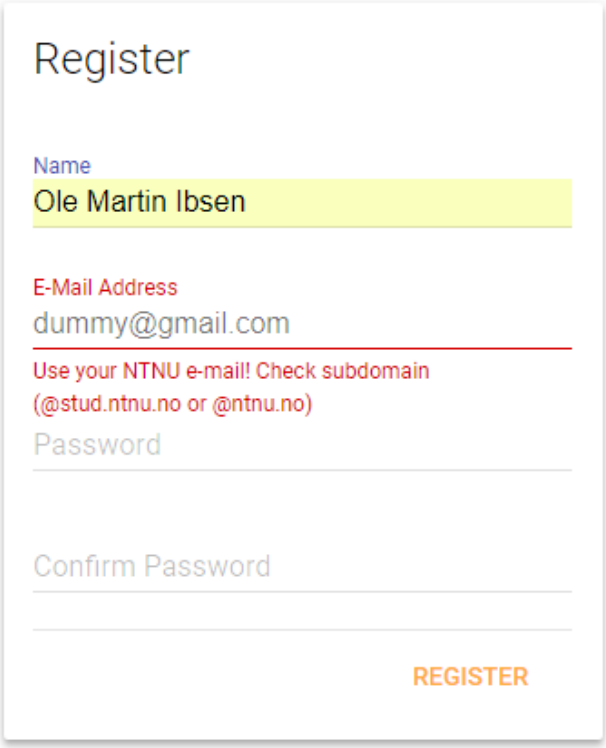


Figure 5.6: User wrong input

When a user has registered with valid information, they will be sent to the sign in screen with a status as seen in figure: 5.7. This tells the user that they have received a email with further instructions.

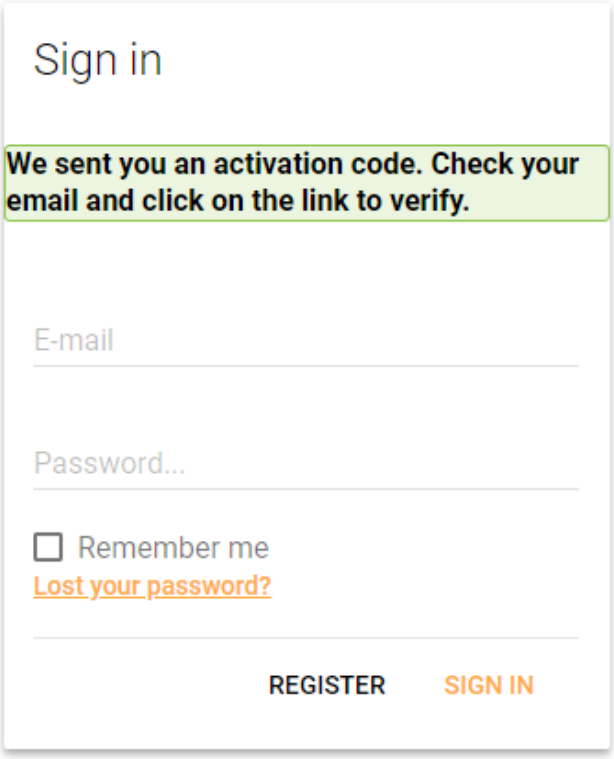


Figure 5.7: Sign in, e-mail sent

The email contains the following information as seen in figure: 5.8, and when the user clicks the link their email is verified. The link also redirects the user to the sign in view, with a status stating that their email is now verified and that they can now sign in.

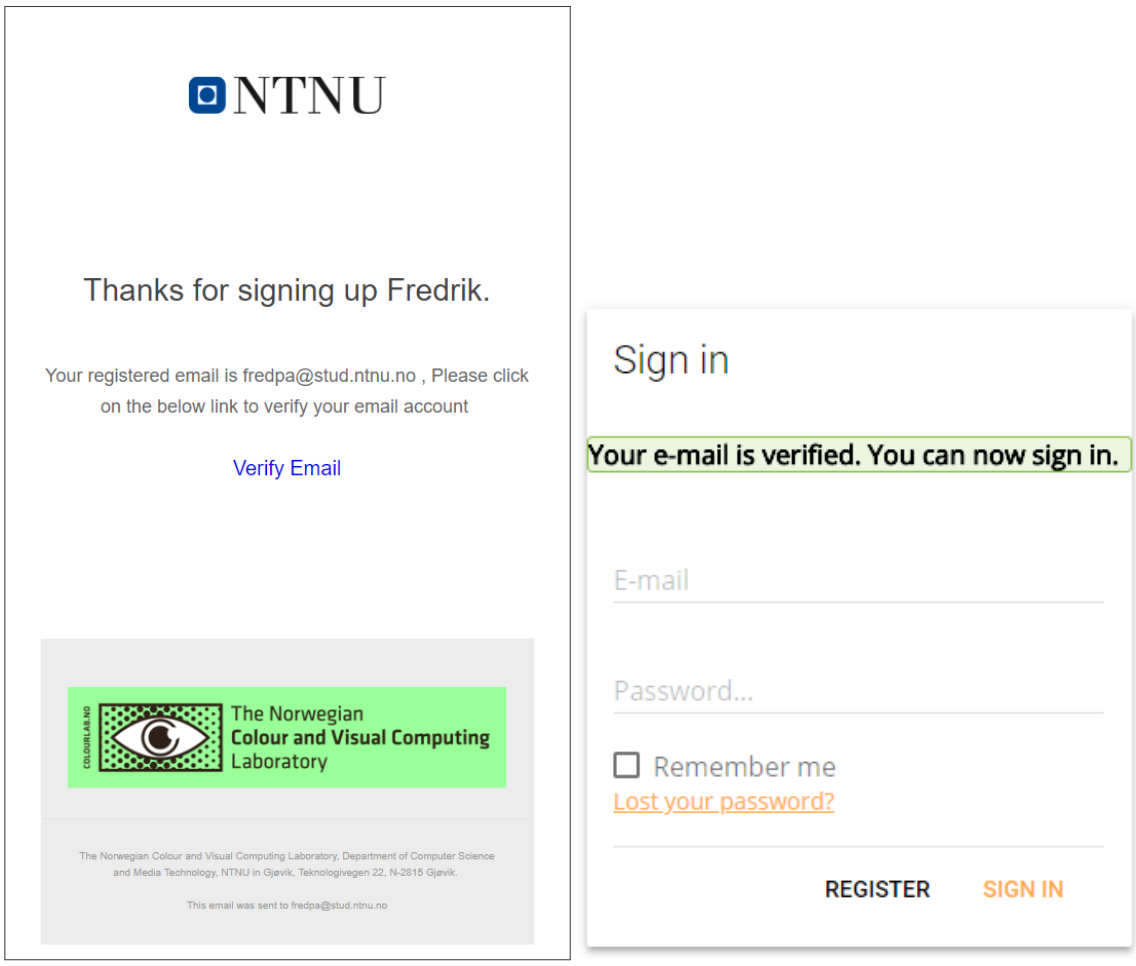


Figure 5.8: E-mail and sign in, e-mail verified

When a user is registered and verified, an admin has to set their role to student/employee/admin. When a new student logs in, they are met with the view as seen in figure: 5.9. From here they can book a room (as student the booking has to be approved by an admin), see all rooms and equipment or change profile information.

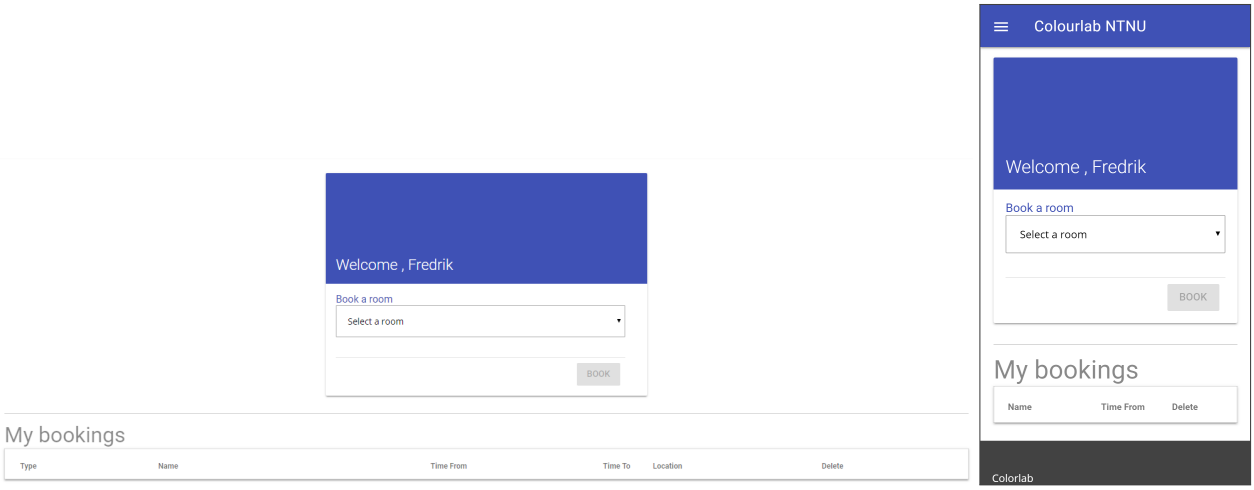


Figure 5.9: Index new student

5.1.2 Booking

As seen in the last section, when a user is signed in, they are greeted with a clean page containing one card and a table for bookings. If the user chooses a room in the drop down list located in the card on the page, more options will appear (figure: 5.10). Once all options are selected with wanted information, they will get instant feedback on weather or not their time is available to book. They can also check off all equipment they want to use connected to the room, then they just need to click book.

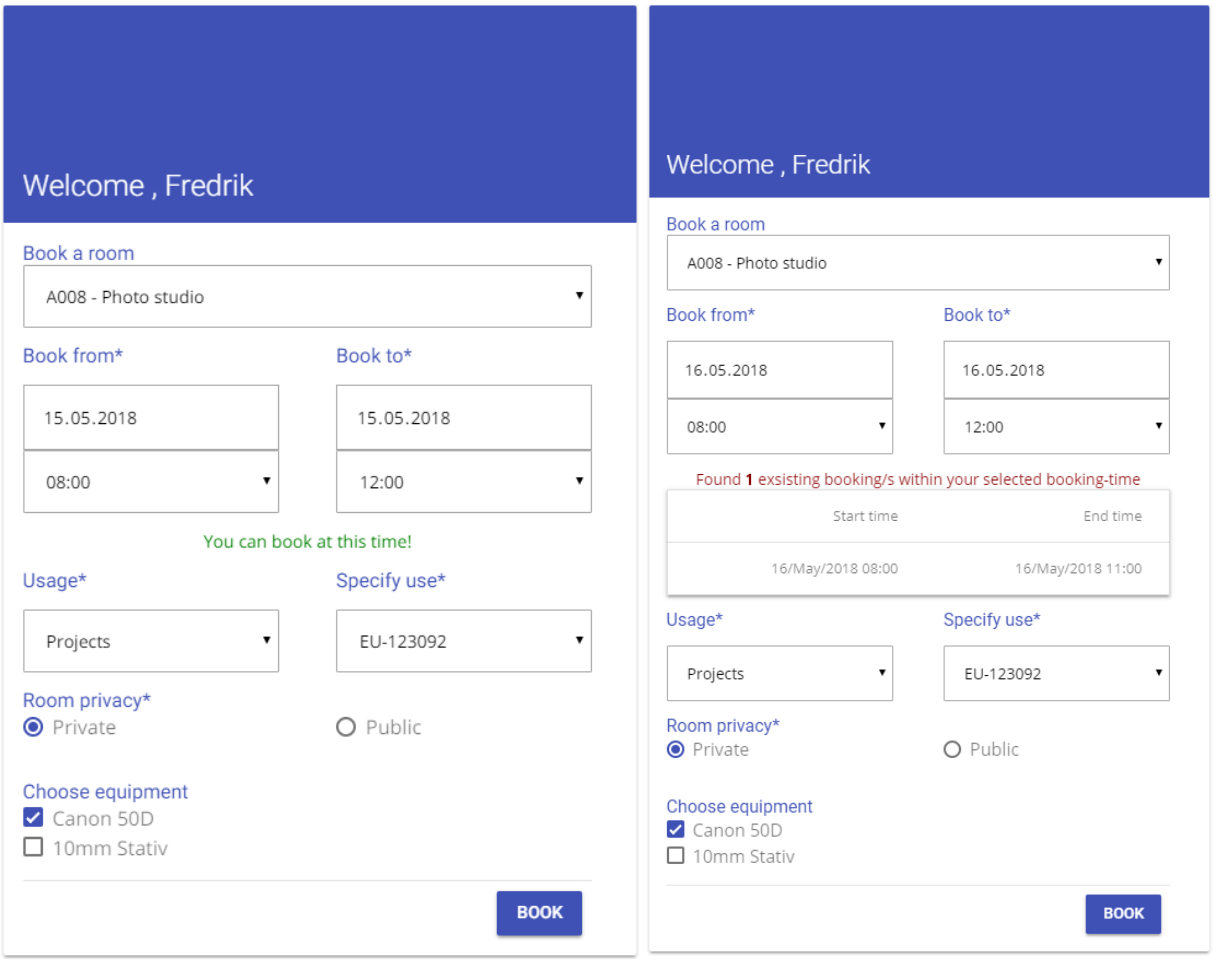


Figure 5.10: Booking form

Users can then see their upcoming bookings on the index page as seen in figure 5.11. A "status" of a booking can be either "Active" or "Pending". When a bookings status is "Active" it means that the booking has been accepted by an administrator or by the system, and is a valid booking. If the booking status is "Pending" it means that it needs to be approved by an administrator before it can become an active booking. When a student creates a booking, it will automatically get the status "Pending" and will be on hold until the administrator accepts that booking.

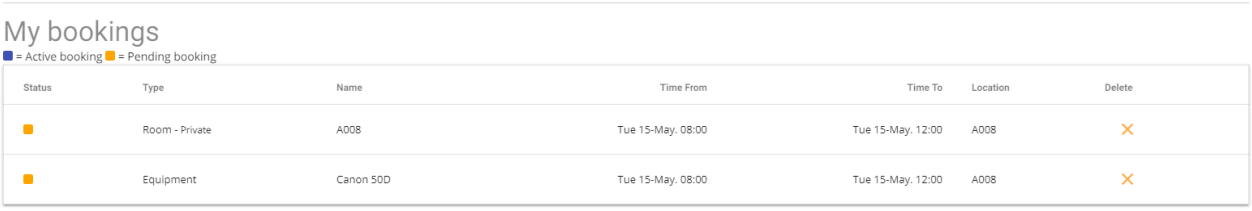


Figure 5.11: My Bookings View

In figure 5.12 there is an display of what this process also looks like on mobile. The only real change here other than scaling, is the fact that the table now has a bit less information.

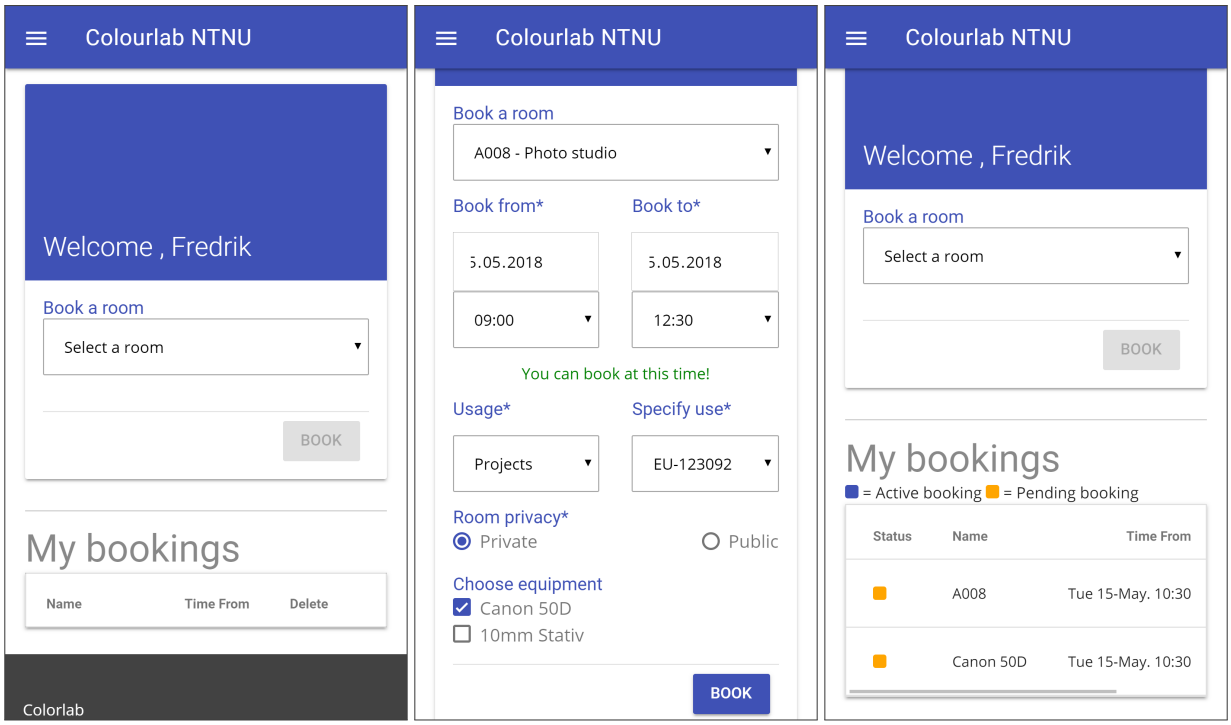


Figure 5.12: Mobile Index

The index page consists of two main elements, the booking form and my bookings table. Bringing users directly to these functions makes the most sense, since this is the main functionality users need. In this table all the information regarding their booking is displayed, such as the type of booking, name of the booked equipment or room, time to, time from and location. This is also where the users cancel their own bookings if necessary. The navigation bar now has more options, with links to bookings, rooms, equipment, profile. If the user is an admin an extra option for going to the admin page is present. This option is hidden for normal users and can't be accessed. Logging in will bring the user directly to the booking page, as this is the primary

function of the web page for users. An element in presented in the middle of the page content with the users name. Under this element are upcoming bookings made by the user.

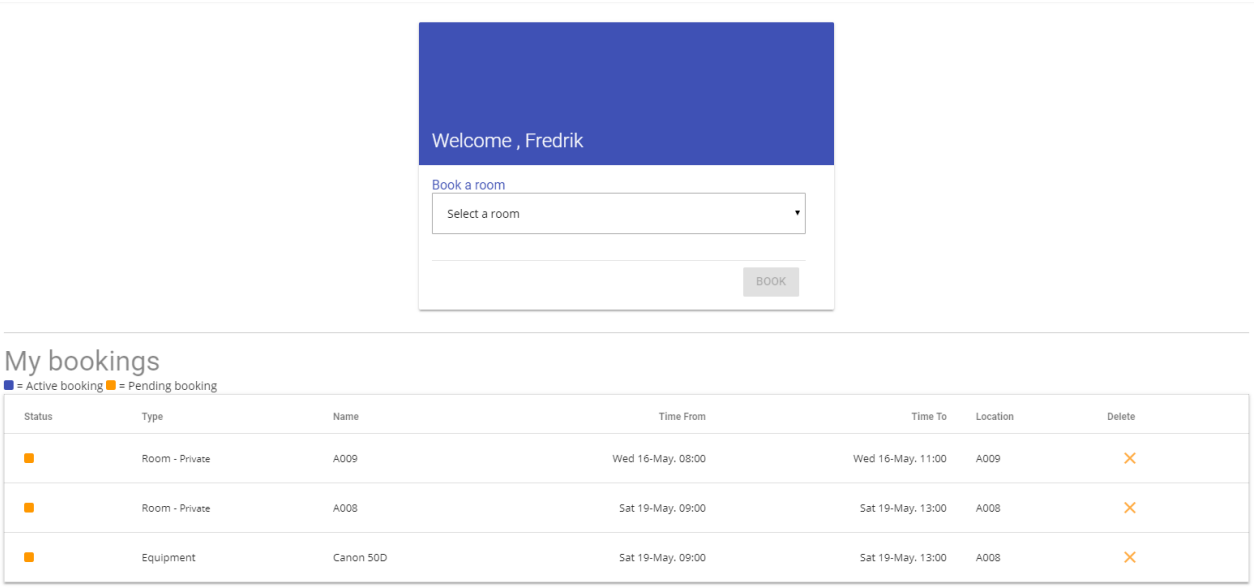


Figure 5.13: User index page

If a room is selected in the booking form the element will expand and show more options as previously seen in figure 5.10. This is hidden by default to limit the information presented to the user when logging into the system.

The booking form is a major part of the system. The logging of usage and book rooms/equipment is dependent on the functionality of booking. Several discussions and qualitative interviews were done to figure out what the booking form needed and how the users of the system used to book rooms and equipment. As it was discovered, users mainly book rooms and used to just use the equipment they needed, and if the equipment had to be used over an extended time users would put post-it notes on equipment and doors telling others that it is not available. Equipment are also mostly never taken out of their respective rooms. The result of this was that when doing a booking in this system, a room will need to be booked first, and then a user can select the equipment to book. If a user has to book a room where other people can not enter, an issue would be that anyone else could not use any of the equipment. This is why when booking the user can select between a public or private booking as previously seen in figure 5.10. If the room is public other people can also use the room, and book equipment. When set to private, only the user will be able to use the room, and other people can not use the room or equipment in

that room.

The booking form also allows users to select what the booking is to be used for. These categories are projects, education or other. When selecting either of these the specific usage drop down gets filled with all the names of the categories they can select from. The booking system was created to fulfill the requirements and needs the Colourlab specified.

5.1.3 Rooms

Figure 5.14 shows how the rooms table looks on desktop and mobile. On desktop this table contains room number, type of room and location (what building). While on mobile it only displays room number and type of room, this is to make the whole table fit on the screen. The tables can be sorted by headers in both views, when you click a header a arrows appear showing the direction of the sorting.

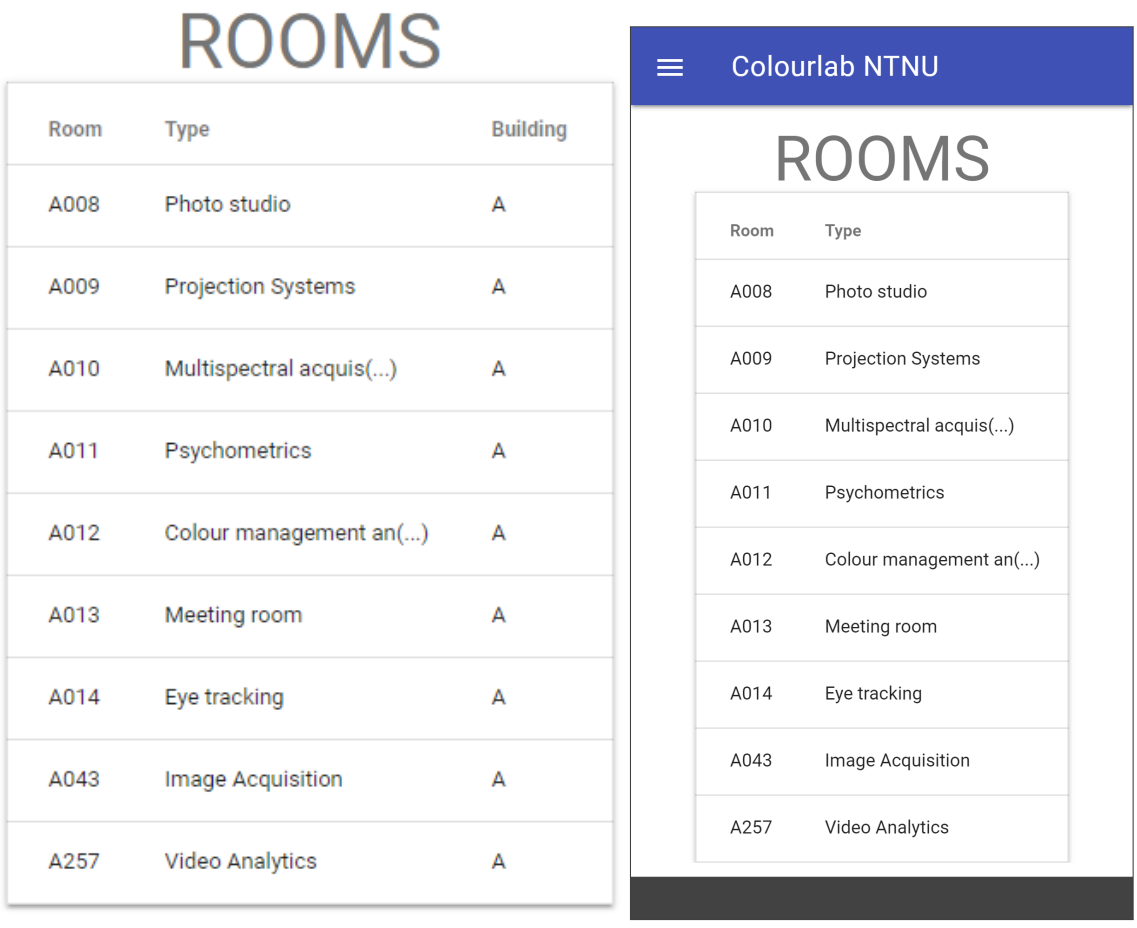


Figure 5.14: Rooms views

Show figure for a specific room here!

If the user clicks a room in the table, they are redirected to a specific rooms view (figure: 5.15). In this view there are more information about this room, and displays all current booking the room has. The user can also see all equipment that is in this room by clicking the "see equipment located in this room." link.

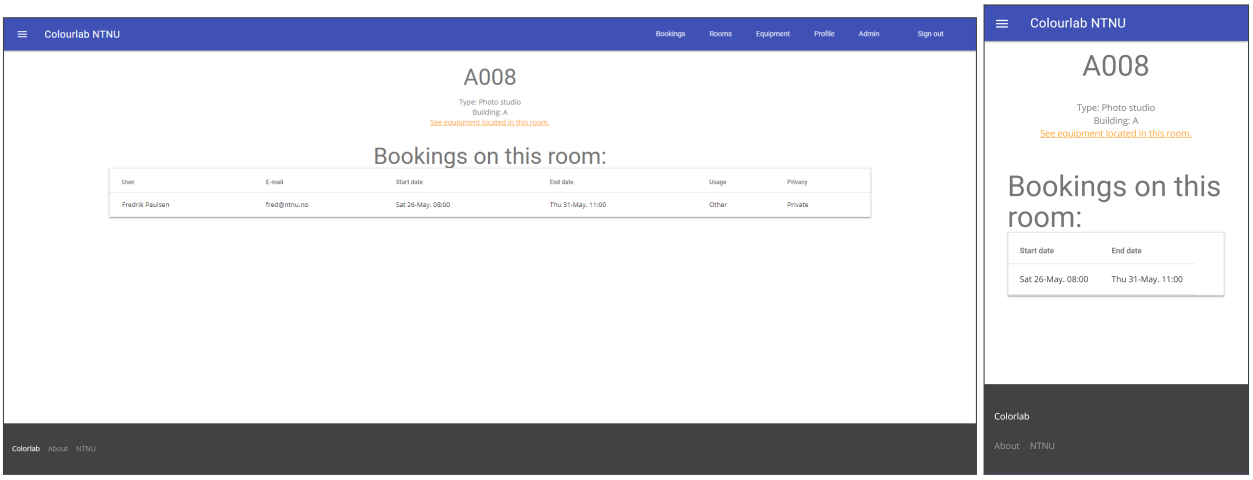


Figure 5.15: Specific room view

5.1.4 Equipment

When accessing the equipment view, the user is presented by the same clean table as seen in the rooms view. This table has more information, because equipment needs more than just name, type and location, they also have a description describing the equipment (figure: 5.16). While on mobile the table only displays name and location. All the same interactions from the rooms table also applies to the equipment table. With the extra ability of filtering the table and pagination if there are more then 10 items in the table.

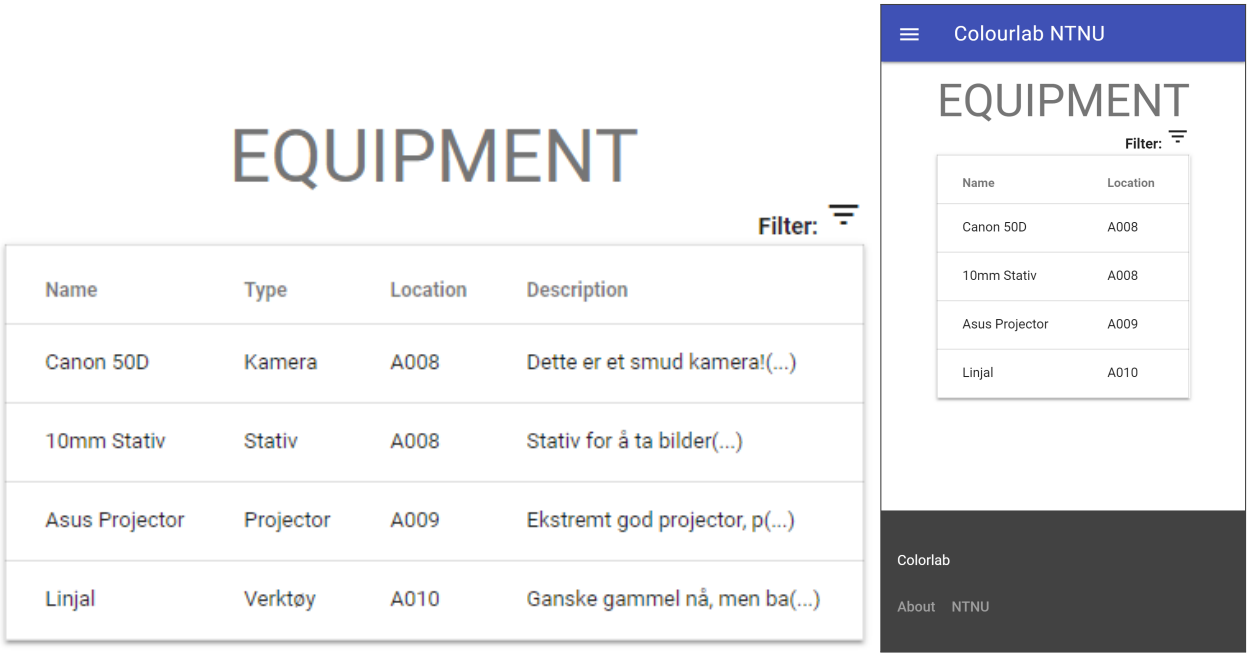


Figure 5.16: Equipment views

As figure 5.17 show, filtering can be done by rooms where the equipment is located or by name.

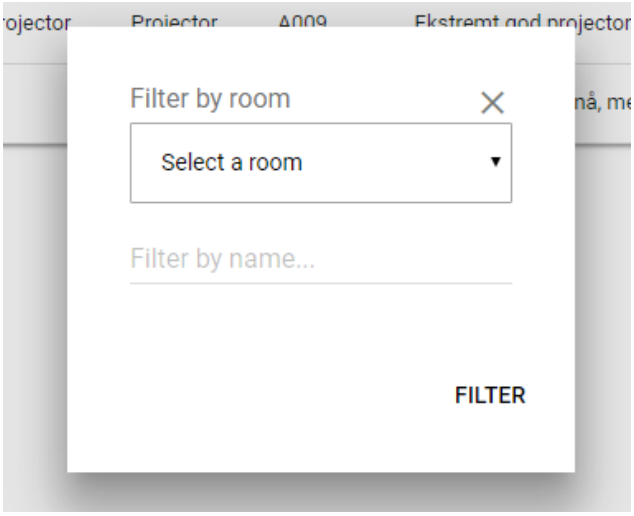


Figure 5.17: Equipment filter

If a user clicks on a specific equipment, they are redirected to a new page containing more information about that equipment. From this view (figure: 5.18) a user can read about equipment, see bookings for the equipment or even send a damage report if the equipment is damaged. They can also navigate to the view about the room in which the equipment is located.

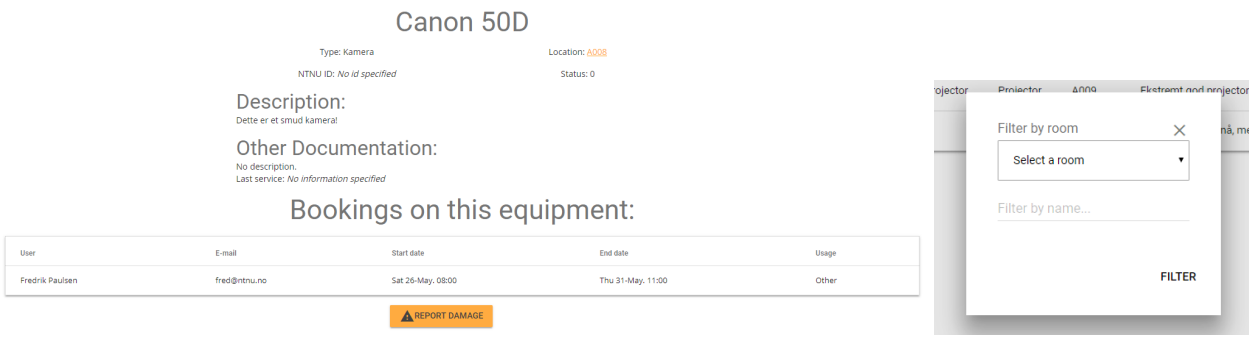


Figure 5.18: Specific Equipment view desktop

On mobile this view scales down, so that all information will still fit inside of the screen (figure: 5.19). All bookings then only show start and end date for the booking, so that the user can know when it is in use.

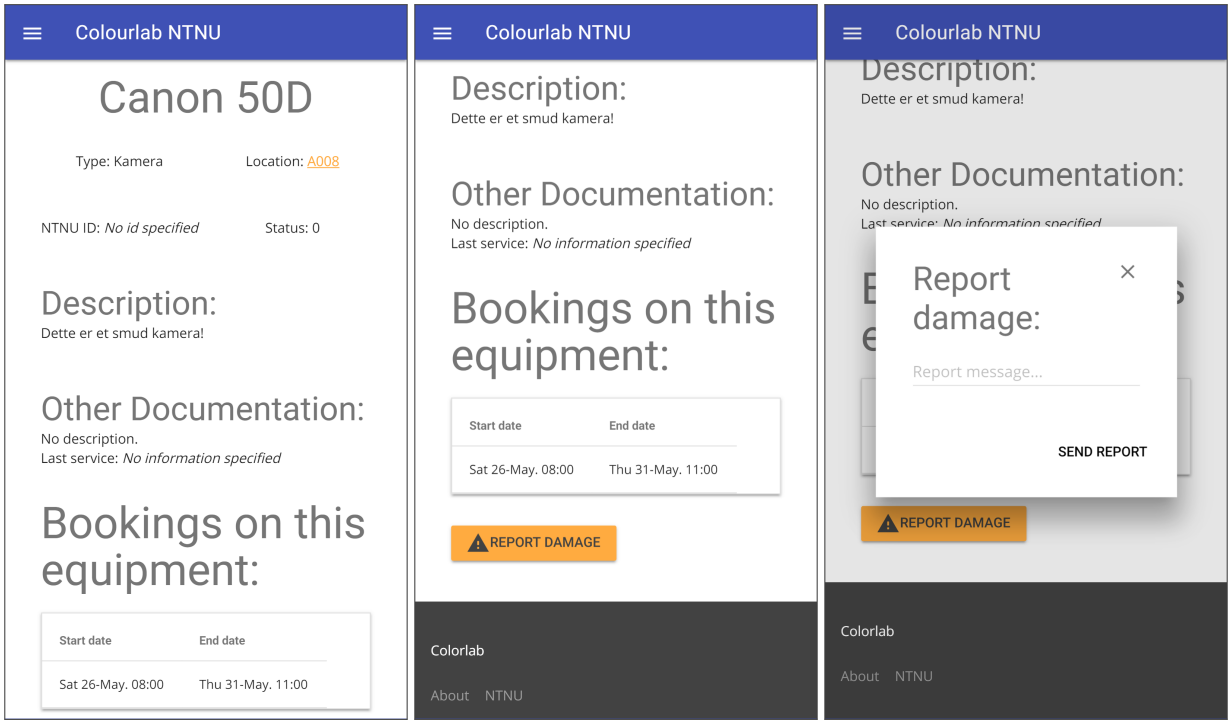


Figure 5.19: Specific equipment view mobile

5.1.5 Profile

On the profile page users can see their basic information such as name, role, email, account status and last log in. User details can also be updated if needed as seen in figure 5.20.

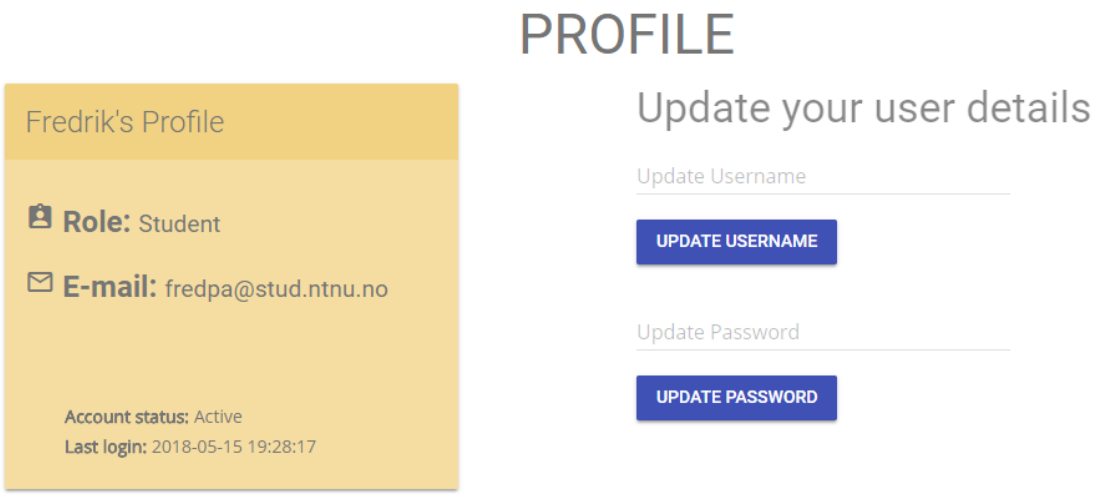


Figure 5.20: User profile

Figure 5.21 also displays how these screens look on mobile, where the content wraps for everything to fit inside the screen.

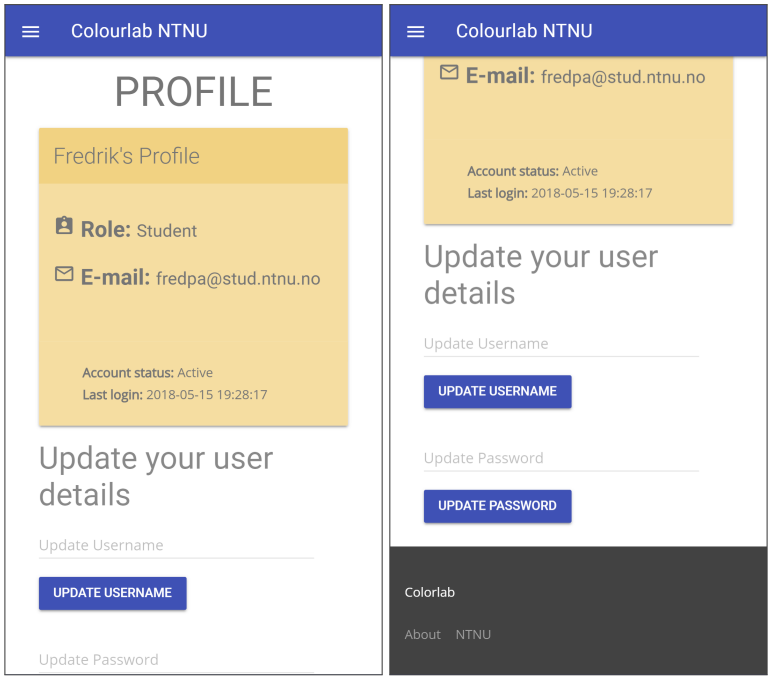


Figure 5.21: Mobile user profile

5.2 Back office

For admins the site layout is more complex with several sub pages. 5.22.

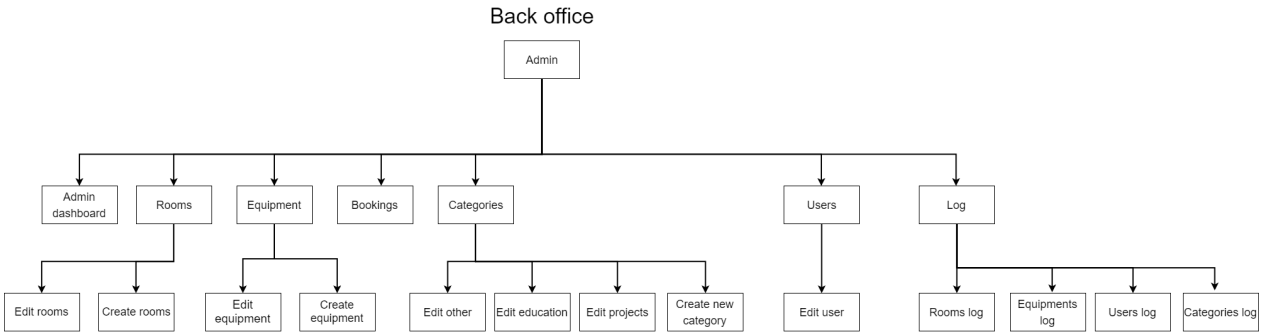


Figure 5.22: Admin site layout

5.2.1 Admin dashboard

Admins who log into the system are sent to the same page (booking/home) as normal users. If they want to use their administrator privileges they will navigate to the admin page that are only visible to them in the top navigation as seen in figure 5.24. As previously explained the navigation changes color and expands on the available links. Administrators have additional links to categories, users and log.

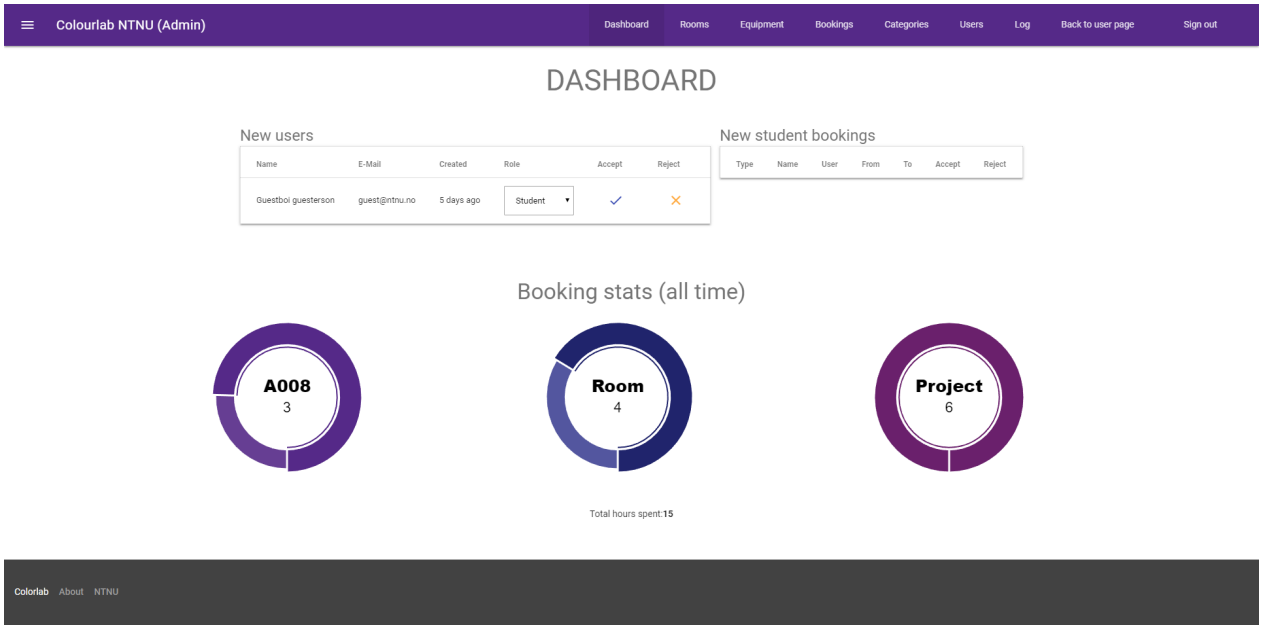


Figure 5.23: Admin Index

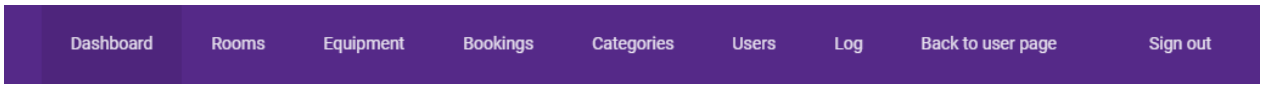


Figure 5.24: Admin navigation

The dashboard for administrators can be seen in figure 5.25.

In the dashboard most recent new users and student bookings are shown, with an easy way to accept or reject these. The administrator can also edit a users role by changing it in the drop-down menu.

As student bookings of rooms and equipment need to be approved by an administrator, this is also done here by the admin.

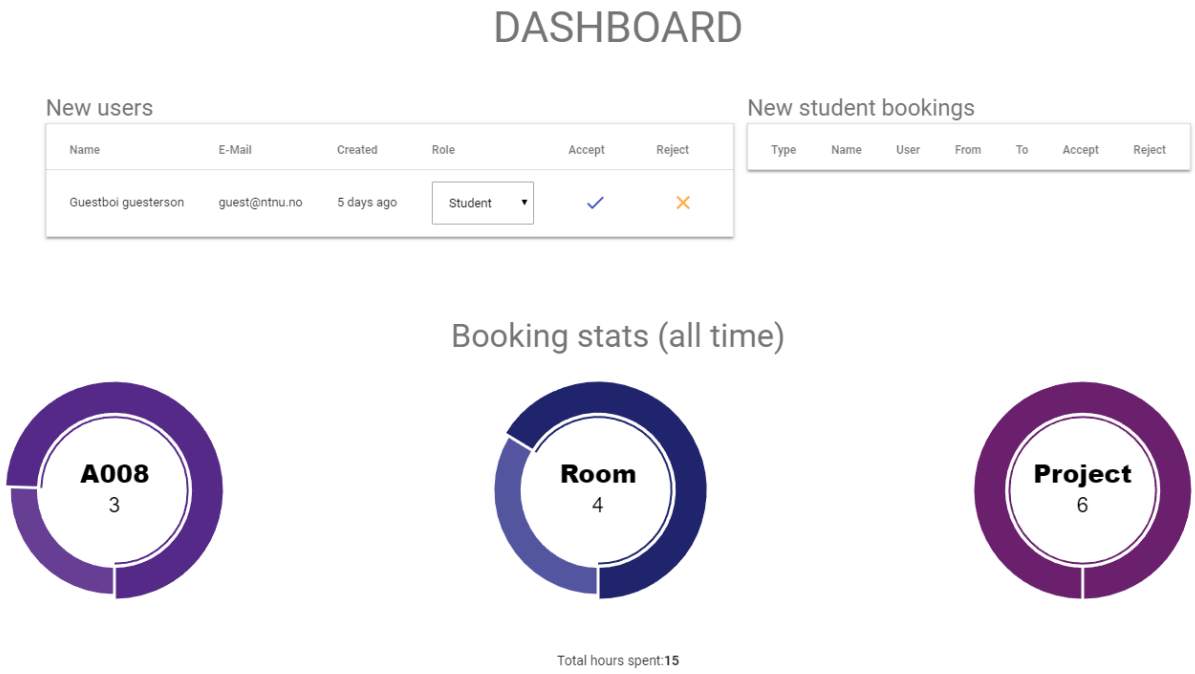


Figure 5.25: Admin Dashboard

Below these tables bookings stats can be seen. Here you can see three pie charts with different stats for the system. In the left pie chart administrators can see which rooms has been used the most, in the middle chart room versus equipment bookings can be seen - and in the last chart administrators can see if bookings has been used for project or education related purposes. As seen in figure 5.26 the pie charts can be interacted with and shows in this example how many bookings there has been on each room.

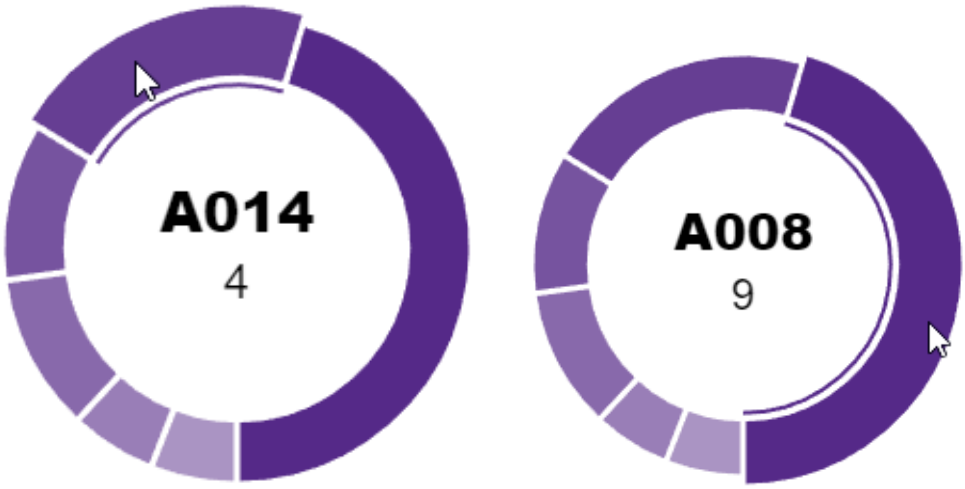


Figure 5.26: Pie chart example

5.2.2 Equipment and room

As an admin the equipment table looks similar as it does for normal users, however you have a few more categories, - such as lockdown (lockdown meaning if the equipment also books the room it is in), status, time created and time updated. Admins can also edit the equipment added by clicking the blue pen icon, or add new equipment by clicking the orange circle with the plus icon seen in figure 5.29 and 5.30

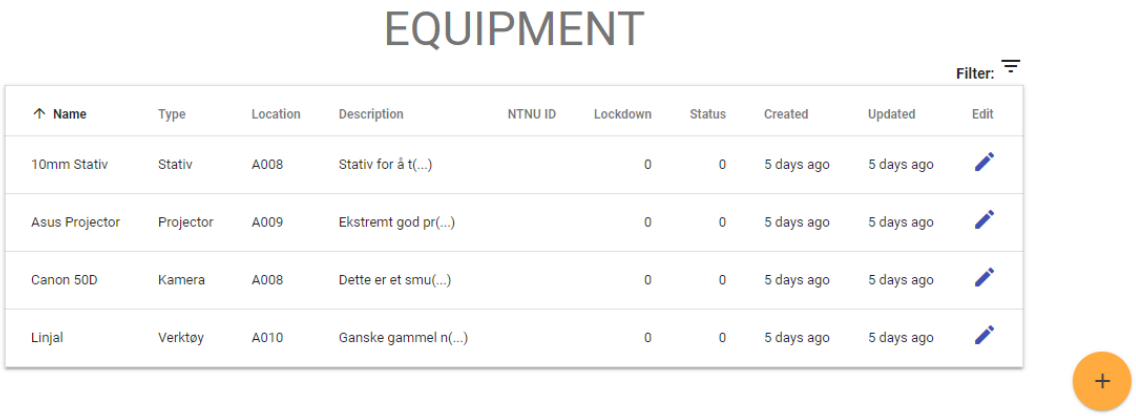


Figure 5.27: Admin Equipment View

The room page is also very similar. Here you can also edit the existing rooms or add new rooms as seen in figure 5.29.

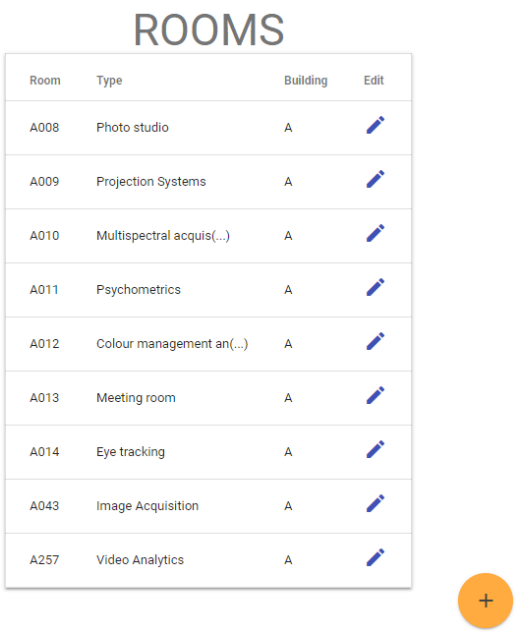


Figure 5.28: Admin Rooms View

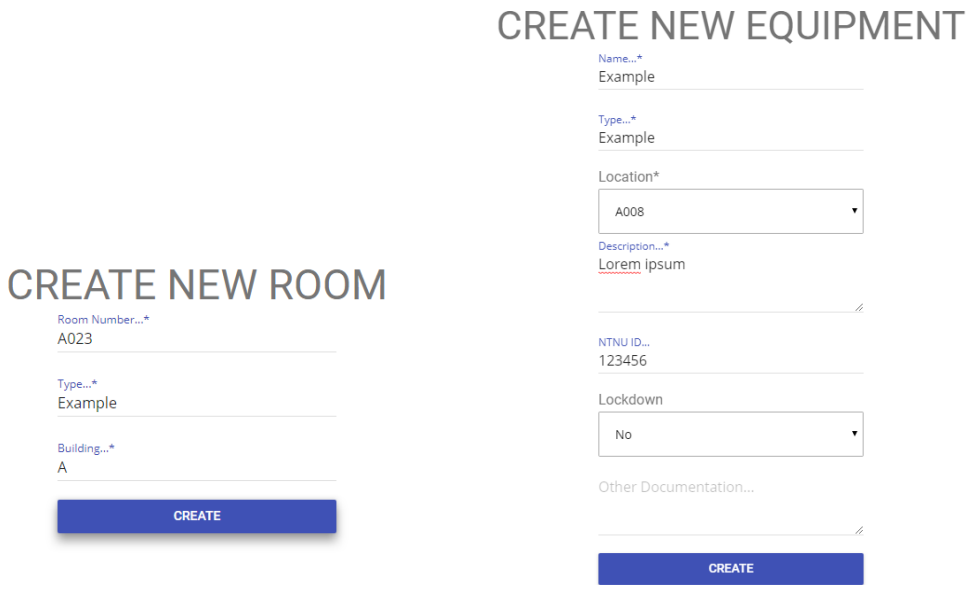


Figure 5.29: Add equipment and Rooms

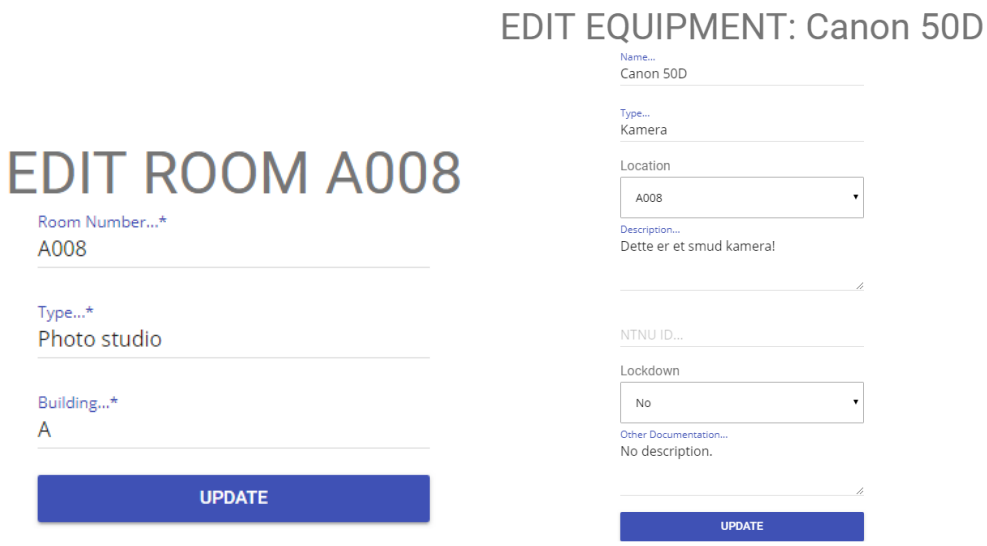


Figure 5.30: Edit Equipment and Rooms

5.2.3 Category

Administrators also have the option to add new subcategories to the project, education and other categories. These can also be edited. (seen in figure 5.31 and 5.32

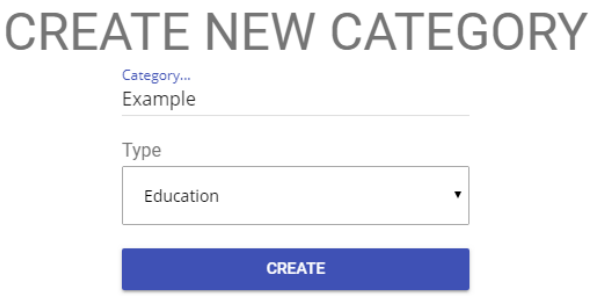


Figure 5.31: Add Category

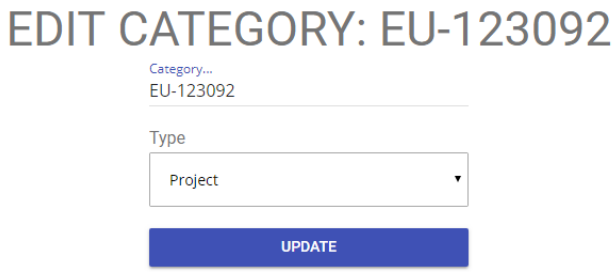
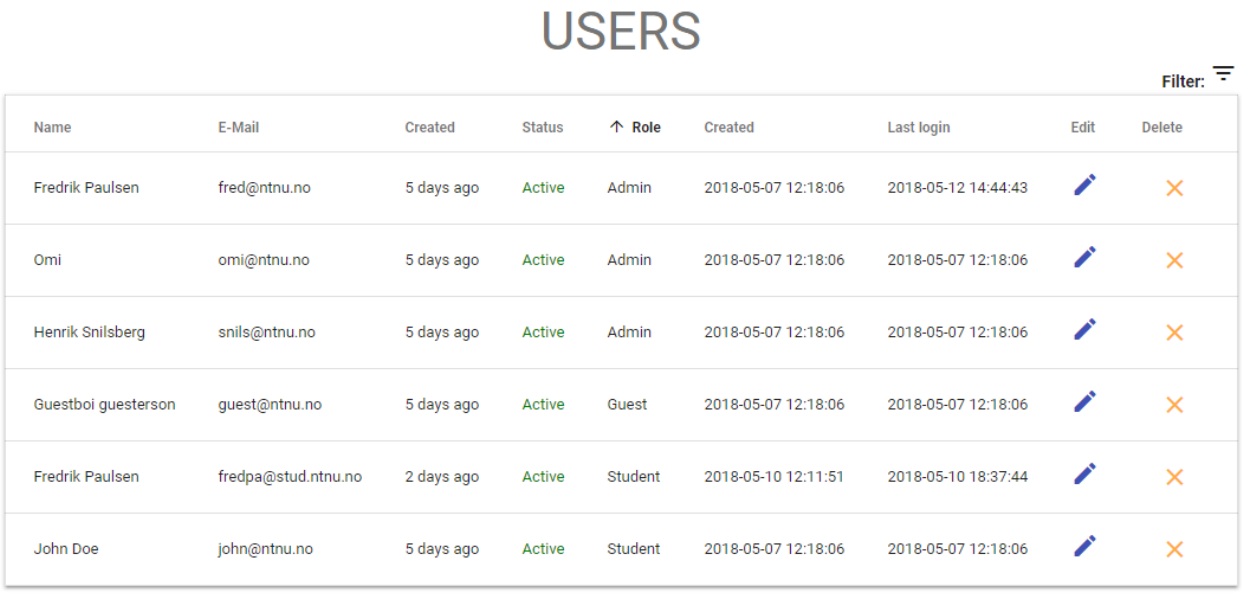


Figure 5.32: Edit Category

5.2.4 User

In the admin user table (figure 5.33 you can see all information regarding the users, such as their e-mail, name, created at, status, role, created date and last log in. In addition you can edit and delete users.



Name	E-Mail	Created	Status	Role	Created	Last login	Edit	Delete
Fredrik Paulsen	fred@ntnu.no	5 days ago	Active	Admin	2018-05-07 12:18:06	2018-05-12 14:44:43		
Omi	omi@ntnu.no	5 days ago	Active	Admin	2018-05-07 12:18:06	2018-05-07 12:18:06		
Henrik Snilsberg	snils@ntnu.no	5 days ago	Active	Admin	2018-05-07 12:18:06	2018-05-07 12:18:06		
Guestboi guesterson	guest@ntnu.no	5 days ago	Active	Guest	2018-05-07 12:18:06	2018-05-07 12:18:06		
Fredrik Paulsen	fredpa@stud.ntnu.no	2 days ago	Active	Student	2018-05-10 12:11:51	2018-05-10 18:37:44		
John Doe	john@ntnu.no	5 days ago	Active	Student	2018-05-07 12:18:06	2018-05-07 12:18:06		

Figure 5.33: Admin Users View

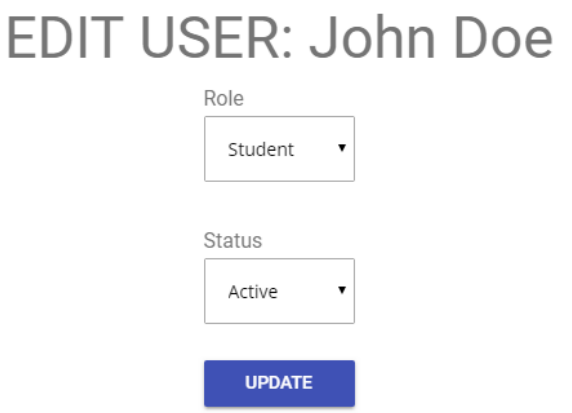


Figure 5.34: Edit User

5.2.5 Edit user

When an admin deletes a user, the user does not actually get removed from the system but rather, that status of that user becomes "Inactive". This ensures that an old account that no longer need or has access to the system still can be seen in the logging system and in case and old user needs to know at a later date how much time he spent on an project its still available. When an user has the status "Inactive", that user can no longer log into the system.

5.2.6 Log

In the log page admins can see booking stats for the past month and total hours spent. If the administrator wants to see more specific stats they can click one of the four buttons below seen in figure 5.35.

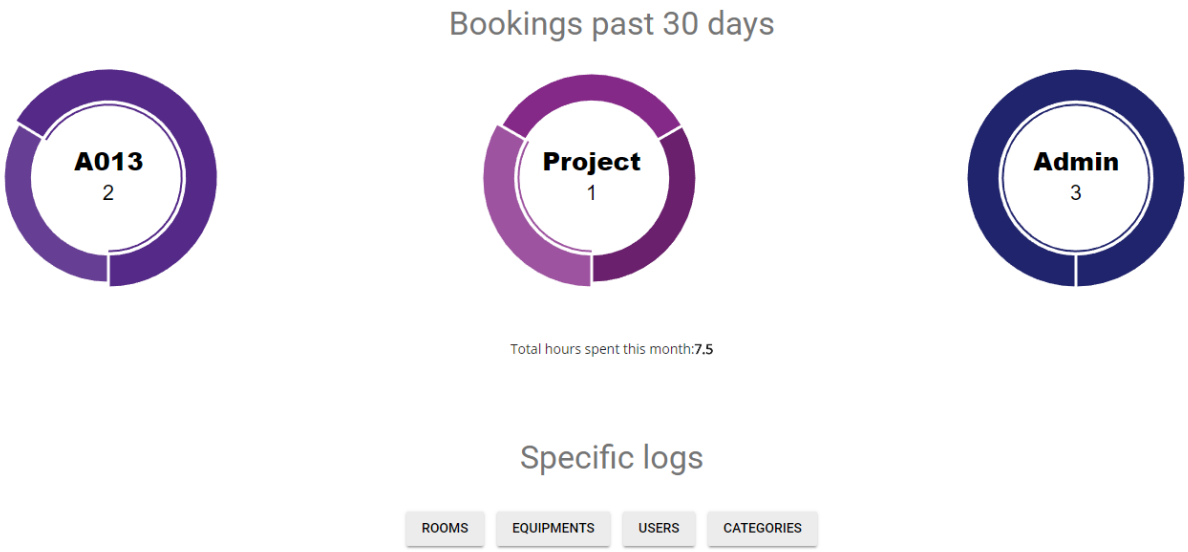


Figure 5.35: Admin Log

Clicking one of these buttons will bring the administrator to a new page as seen in figure 5.36. This will bring up a more detailed view of the chosen log category. Depending on what is chosen in the filter function, total hours and total bookings will be shown. Admins also have the option to download all data directly to a CSV file (an example of this download can be seen in figure).

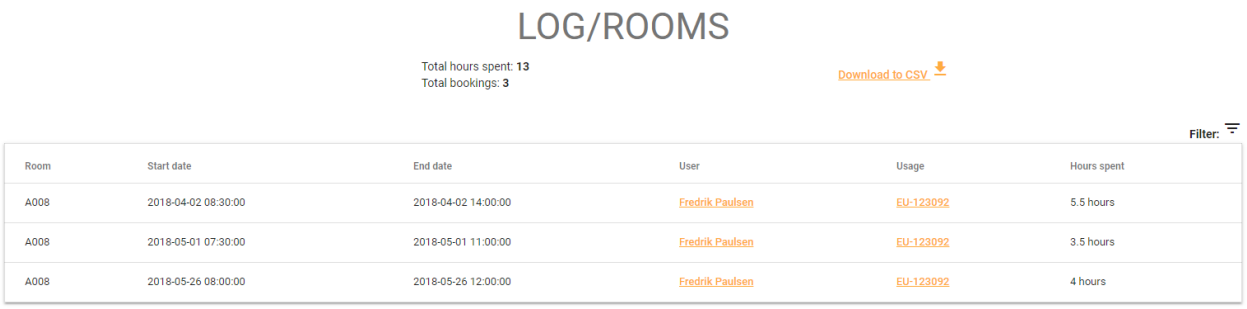


Figure 5.36: Admin Log rooms

	A	B	C	D	E	F	G
1	Room	Start date	End date	User	Usage type	Usage	Hours spent
2	A008	2018-04-17 7:00	2018-04-18 11:3	Henrik Snilsberg	Project	EU-123092	28.5 hours
3	A008	2018-04-16 8:00	2018-04-11 11:0	Henrik Snilsberg	Project	EU-123092	117 hours
4	A008	2018-04-20 9:30	2018-04-21 11:0	Henrik Snilsberg	Project	EU-123092	25.5 hours
5	A008	2018-04-23 7:00	2018-04-25 9:30	Henrik Snilsberg	Project	EU-123092	50.5 hours
6	A009	2018-04-25 10:0	2018-04-26 10:0	Henrik Snilsberg	Project	EU-123092	24 hours
7	A008	2018-05-10 7:00	2018-05-10 10:0	Henrik Snilsberg	Project	EU-123092	3 hours
8	A014	2018-05-15 7:30	2018-05-16 8:30	Henrik Snilsberg	Project	EU-123092	25 hours
9	A014	2018-05-29 13:3	2018-05-31 15:3	Henrik Snilsberg	Project	EU-123092	50 hours
10	A008	2018-05-29 15:3	2018-05-31 16:0	Henrik Snilsberg	Project	EU-123092	48.5 hours
11	A011	2018-05-30 7:30	2018-06-01 8:30	Henrik Snilsberg	Project	EU-123092	49 hours
12	A010	2018-05-15 7:00	2018-05-16 8:30	Henrik Snilsberg	Project	EU-123092	25.5 hours
13	A011	2018-04-23 7:00	2018-04-23 8:00	Henrik Snilsberg	Education	IMT 1301	1 hours
14	A014	2018-05-16 12:3	2018-05-18 14:3	Henrik Snilsberg	Education	IMT 1301	50 hours
15	A008	2018-05-14 12:3	2018-05-26 15:0	Henrik Snilsberg	Education	IMT 1301	290.5 hours
16	A008	2018-04-27 7:30	2018-04-29 9:30	Henrik Snilsberg	Education	IMT 1321	50 hours
17	A013	2018-05-03 7:30	2018-05-06 9:30	Henrik Snilsberg	Other	Other	74 hours
18	A014	2018-05-02 7:00	2018-05-05 9:30	Henrik Snilsberg	Other	Other	74.5 hours
19	A012	2018-05-14 8:00	2018-05-16 8:30	Henrik Snilsberg	Other	Other	48.5 hours
20	A008	2018-06-01 15:0	2018-06-03 15:3	Henrik Snilsberg	Other	Other	48.5 hours
21	A009	2018-06-15 14:3	2018-06-16 15:3	Henrik Snilsberg	Other	Other	25 hours
22	A013	2018-07-05 7:30	2018-07-06 7:30	John Doe	Other	Other	24 hours
23	A009	2018-05-16 12:0	2018-05-18 12:0	John Doe	Other	Other	48 hours

Figure 5.37: CSV example

If the administrator want to download a CSV file from a specific time period or just for one room, they can use the filter function to adjust the logs to their liking as seen in figure 5.38

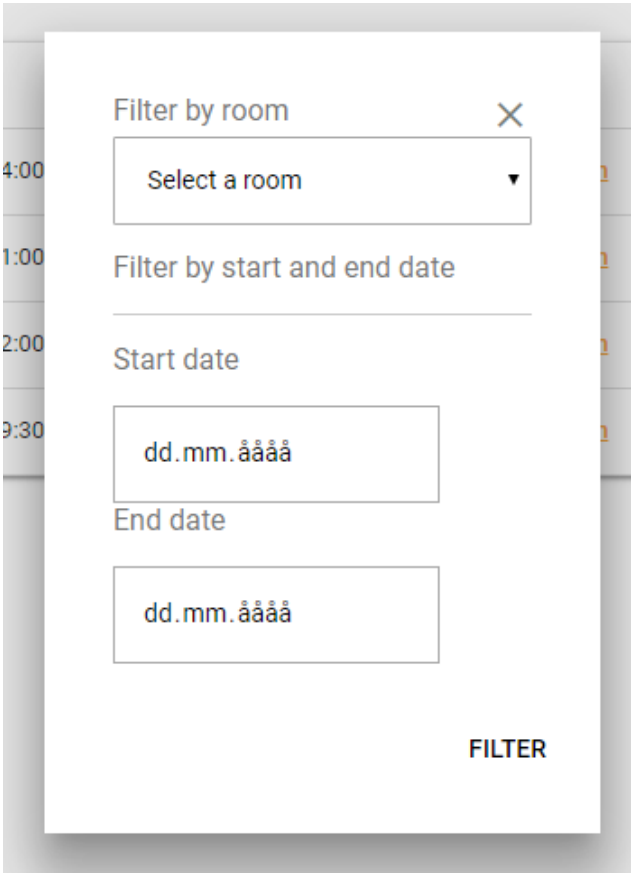


Figure 5.38: Admin Log filter

The last administrator specific page can be seen in figure 5.39. Here administrators can add more project codes, courses or other categories.

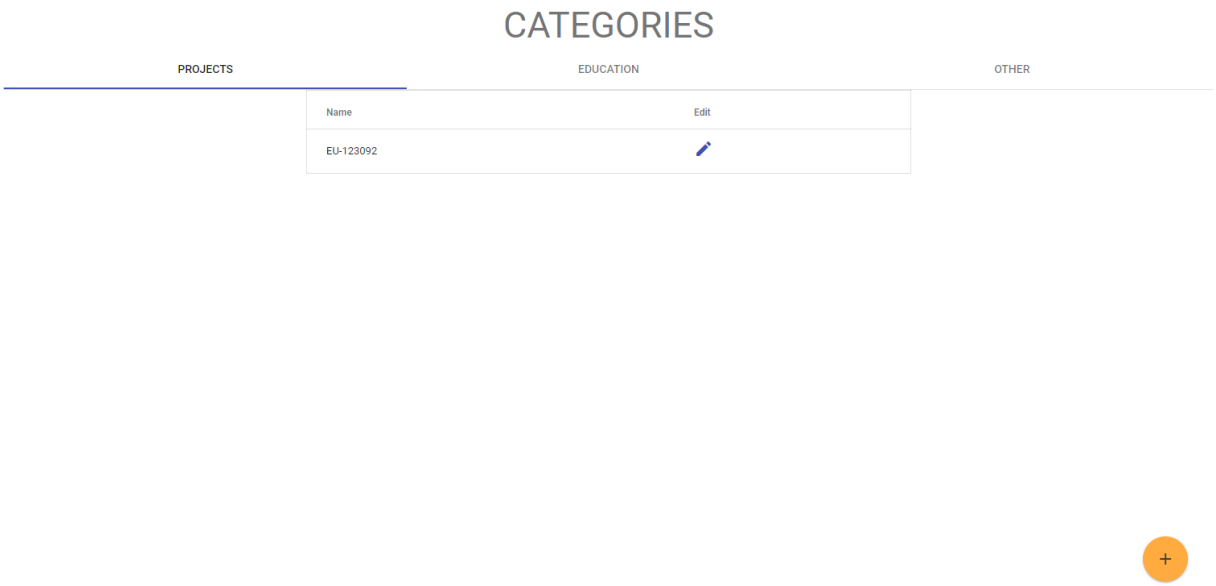


Figure 5.39: Admin Categories

Chapter 6

Discussion

In this chapter there is a discussion about different aspects of the results and the process. This is where faults are explained and digressed, further there is an explanation on what could be improved.

6.1 Organization

In the start of the process a project plan was made, something a lot of time and effort was put into. Creating this plan gave a rich insight on what the project was going to entail, and what had to be done. For the plan there was also done a lot of research on similar solutions which made it into the report in the end. After the plan was delivered the group had already defined roles, rules, and some methods. Although the plan gave us a lot of insight and preparations towards the project, the group felt like more of this time could have been spent working on the task at hand.

Together with the project plan a GANTT diagram was created, this shows the time schedule of the project from start to end. This was a helpful method to visualize the entire time-line of the project.

Using an iterative and incremental methodology like SCRUM for the project was a good way to ensure constant progress with the system. It forced regular deadlines for development, user testing and evaluation of the choices made. Planning an user test at the end of every sprint was a good way to test new functionality of the system. SCRUM helped to ensure that user tests were

done frequently throughout the project on all parts of the system. Planning what to complete in the start of sprints was helpful in organizing the work and giving an overview of what had to be done for the time-period set. The sprints enabled the development team to concentrate on limited parts of the system at a time.

An issue with using SCRUM was that it was sometimes hard to estimate how long an issue or functionality would take to fix/add, because of this some sprints had a larger amount of work tied to them than others. This was especially true for the last sprint when there was a lot more work to be done.

Combined with SCRUM we used ZenHub, which proved to be very useful for organizing the different sprints. If it wasn't for ZenHub it would have been a lot harder to get an overview of the sprints and progress during these sprints.

6.2 Design process

6.2.1 Interviews

Doing user interviews before starting the development helped tremendously in mapping the user needs and system requirements. Interviews ensured that the web solution was heading in the right direction from the start. Qualitative interviews with the project owner were the most useful to the project, since interviews would always bring up new information that was valuable. However, the weekly meetings with the project owner led to some of the information being discussed to be not documented as these meetings were more of a conversation rather than an structured qualitative interview. Regardless, without these interviews the solution would not have looked the same.

6.2.2 Personas and scenarios

Personas and scenarios was a part of the design process that proved to be not so useful as hoped. The project owner was involved enough that user testing and interviews were not an issue to do. The personas and scenarios were still used, but the results of these were not anywhere near as valuable as the other parts of the design process.

6.2.3 Sketches

Sketching on paper was a efficient way to brainstorm and test layout of the web solution quickly. This method of being able to disregard the design and think about just the basic layout was essential for bringing out different ideas. However, the group would have benefited more out of this if the sketching had been done after some thorough user interviews, as it was discovered after the interviews that there was more requirements for the system. This way there could have been more sketches of different parts of the system and the layout could have been different.

6.2.4 Wireframes or lo-fi prototype

Wireframes was an useful way to present a more detailed and clickable version of the sketches. Using the wireframes made for a more smooth and natural way of user testing the concept. The digital wireframes was easier to understand than sketching that sometimes could lead to the user trying to interpret of what was actually drawn.

6.2.5 Moodboard and design template

Both the moodboard and the design template served a similar purpose, they represent in a simplistic way how the application should look like. The moodboard was a good way to get an representation of the look and feel the design direction was heading in. And the design template was useful in the beginning of developing the front-end. They were also a presentable way of showcasing the initial design ideas and choices to the product owner.

Even though they were useful in the beginning, further into the development they were barely used.

6.2.6 User testing

User testing proved to be a very useful method for discovering faults and lacking features. Every fault or error made by an user testing the system was valuable feedback, which was gathered and reiterated in the next sprint with new design solutions.

6.2.7 Prototype

Having a prototype to user test in later iterations was also very useful, as user tests and playing around with the system could help us discover bugs in the code and design. There was some instances in which user tests would stop because there was discovered new bugs or issues with the code during tests. One example is the verification e-mail talked about in Chapter 3.2.8.-

6.3 Implemented solution

The final system and product explained in Chapter 5 is something the group are very proud of and satisfied with. The system looks professional and modern, with a design which is both recognizable and user friendly.

A few additional features were not implemented to the system, as expanded on in section 6.3.4. However the system are not dependant on these features and do not make it feel uncompleted or lacking in any way.

6.3.1 Laravel

After developing the whole system, utilizing Laravel was definitely a great choice. Laravel improved work flow and efficiency by a lot, and learning the frame-work and its functionality was very insightful and a great learning experience.

Eloquent ORM and blade.php-files were a joy to work with, and made reading and writing the code more logical and simple. The shortcuts it provided helped a lot as well.

6.3.2 Material design lite

Material design lite provided a easy to use components to quickly get material design on the system. It undoubtedly saved the group several hours from styling the all the elements and components themselves. Overall material design was great to work with and the knowledge gotten from using a framework like this will be useful in the future when developing a system from scratch. However one issue unfortunately appeared with MDL which can be read about in section 6.3.3.

6.3.3 Issues

In this subsection issues and pointers will further discussed and explained.

Admin manually accepting new users

The group thought manually accepting all new users might be a lot of maintenance for the administrator. The issue at hand was if a lot of accounts gets created all the time, however the project owner said (See appendix:A.9) that mostly it is about 30 new students at the start of each semester and that it would not be an issue. Since the biggest influx of users would be at the start of the semester.

MDL Framework Issue

The fact that MDL does not offer a styling on select-elements (drop-down menus) to make them use Material Design were unfortunately discovered after development had started. This meant that the drop-down menus would not use material design components. When the project owner was asked about this issue, he stated that it was not an issue, and that the functionality was more important than design(See appendix: A.6).

6.3.4 Future work

Calendar

A type of calendar is what would have definitely been very beneficial for the best user experience of the system when it comes to seeing when rooms/equipment are booked. It was what was planned to implement this from the very first sketches, however - back-end implementation, time and the guidelines from Material Design limited our options severely.

The calendar development would need to be done from scratch since there was no component or plugins for a calendar view following the guidelines of material design. This came across as a huge challenge with the limited time and knowledge of the group. However a system that was highly considered to implement was fullcalendar.io[1], which is based on JavaScript and

[1] https://fullcalendar.io/

seemed like it could work, however time to try this did not appear. Therefore there was developed an simpler alternative book-displaying solution that is in the final product. The plan was to look further into this issue if time allowed, but unfortunately it did not - since back-end took more time than expected.

NTNU ID-card (NFC)

Something that the group wanted to implement was the NTNU id-card (NFC) sign in, this was wanted for making users able to sign in on tablets provided at each room. This way, when someone wanted to quickly do something in a lab, and it is available, they could simply use their card to sign in, book and log their stay. At first this seemed like a solution that would be possible to implement. After some consideration, and a visit to the IT department at the university, it was decided that the solution would have to be set aside. The IT department never came back with a reply on whether of not this would be possible for this project, ever after sending follow up emails. Although it was not made in this iteration, there is always a chance for a later implementation of this feature as the column in the users-table for card_id already there (See Figure 4.4 about the Relational schema).

Minor suggestions

Through user testing and user interviews here are some additional features discovered.

- Allowing users to re-book equipment.
- Favorite equipment.
- Pre-select most used room or category.
- More graphs when it comes to visualization of log.
- When reporting an equipment currently the report is stored in the other_documentation column, but it probably should have been in its own table.
- Change select boxes look use material design.

6.4 Group dynamic

One of the big benefits in this group is how in parallel the personalities of the members are. Though the members are similar in some aspect, the members are different in regards to capabilities and knowledge about coding. This did not turn out to be a problem, because what some lacked in coding they performed in designing or writing/documenting- something that made everything smooth out. Having different strengths and weaknesses together with having similar personalities worked very well, every time the group met it was fun and upbeat. The group also engaged in activities like playing video games and drinking together in their spare time.

6.4.1 Distribution of work

For the project plan and first sprint of the project, the group worked together every time something was done on the project. As the start of the project was where planning, user interviews, architecture and design process were done. This required all of the group members to participate equally and mostly on the same tasks. After reaching the development process, the work distribution became more skewed toward assigning tasks based on skill levels in coding, writing, design and user experience. Some of the work was done individually, but only after discussing what to do and how with all group members. Client meetings and user testing was done together throughout the whole process.

As the group members had different schedules and courses planned for the semester this was taken into account when distributing work.

6.4.2 Learning outcomes

This project has been undoubtedly a very educational for the whole group and each person as an individual.

The group dived further into SCRUM and agile methods, and achieved a deeper understanding of the design and implementation of a larger system. Working with material design was a completely new experience, and is something that the group will definitely use in the future. Beyond MDL the group now has a wider view of Laravel and its connection to the users and database.

This is the first time any of the members have used a system to write documents like LaTeX. Learning how to use this has been difficult, but worth it as the finished product shows, it looks very professional.

Making a larger scale system with difficult booking and logging queries, resulted in a lot of new knowledge about querying and making a better back-end system. Additionally diving into and learning the frameworks for both front- and back-end helped tremendously and provided a lot of new knowledge. Preparation of creating such a system proved to be very valuable and is something the group will undoubtedly utilize fully in their next projects.

Working this close to a real employer has also been a new experience. Where a new understanding of how customers and developers work together to create the best result possible, was also very interesting and educational.

A lesson has been learned about how important preparations is, both with preparing the system and documenting, taking notes and recording/transcribing every meeting.

Branches in GitHub was used for the first time, something that allowed for a safer work environment. This also allowed for multiple people to work on different functionality without messing with the other participants code.

Chapter 7

Conclusion

In this project, a web based logging and booking system custom-made for the Colourlab at NTNU was developed and implemented. The web application developed covers all the requirements specified by the Colourlab and is ready to launch. The system is ubiquitous and able to book equipment and rooms. An administrative page has been developed that allows creating, editing and removal of different entities. Further this allows rigorous logging of the usage in the Colourlab. Once in use, the system is going to show its ease of use and practicality to its users and administrators, thus completely replacing the existing solution.

A solid foundation has been created for further development of the system, that can easily be continued by others, by following the report and documentation.

The report has given insight in to the whole process of the project from start to finish. It documents the planning phase, organization process, theory, methodologies used, development/implementation, results and discussion.

The Colourlab and Marius Pedersen is satisfied with the solution tailored specifically for their needs. The system should be deployed and start being shortly after the project has been delivered.

Bibliography

Benyon, D. (2010), *Designing Interactive Systems A Comprehensive Guide To HCI UX And Interaction Design*, Pearson Education Limited, Edinburgh Gate, UK.

Colourlab (2018), '*Norwegian Colour and Visual Computing Laboratory*'. Available at:.
URL: *https://www.ntnu.edu/colourlab#/view/about* (Accessed: 22.03.2018)

Elmazri, S. N. . R. (2010), *The Enhanced Entity-Relationship (EER) Model. Fundamentals of database systems*, 6 edn, Pearson Education inc., Boston.

Hansen, K. T. and Mallaug, T. (2014), *Databaser*, 2 edn, Gyldendal Norsk Forlag, Polen.

Hernandez, M. J. (2013), *Database design for mere mortals*, third edition edn, Pearson tech group, Michigan, USA.

Krug, S. (2014), *Don't Make Me Think Revisited: A Common Sense Approach to Web and mobile Usability*, Pearson Education, New Riders, Birkeley, USA.

Kumar, V. (2013), *101 Design Methods: A Structured Approach for Driving Innovation in Your Organization*, Wiley, Hoboken, NJ.

Kvale, S. and Brinkmann, S. (2009), *Det kvalitative forskningsintervju*, 2. utgave edn, Gyldendal Norske Forlag A/S, Oslo.

Laravel Eloquent (2018). Available at:.
URL: *https://laravel.com/docs/5.6/eloquent* (Accessed: 26.04.2018)

Layton, M. C. (n.d.). Available from:.

URL: *http://www.dummies.com/careers/project-management/10-key-benefits-of-scrum/* (Accessed: 13.05.2018)

Material Design Introduction (2018). Available at:.

URL: *https://material.io/guidelines/#introduction-principles* (Accessed: 22.03.2018)

Material Design Lite (2018). Available at:.

URL: *https://getmdl.io/* (Accessed: 12.05.2018)

Nielsen, J. (2008). Available from:.

URL: *https://www.nngroup.com/articles/site-map-usability/* (Accessed: 13.04.2018)

Relational Database (2018). Available at:.

URL: *http://www-03.ibm.com/ibm/history/ibm100/us/en/icons/reldb/* (Accessed: 27.04.2018)

Reserving group rooms (2018). Available at:.

URL: *http://www.uio.no/english/services/it/email-calendar-chat/help/webmail/calendar/reserving-group-rooms.html* (Accessed: 27.01.2018)

Rubin, J. and Chisnell, D. (2008), *Handbook of Usability testing*, Wiley Publishing, Inc., Indianapolis, USA.

Schwaber, K. and Sutherland, J. (2018), '*The Scrum Guide*'. Available at:.

URL: *https://www.scrumguides.org/docs/scrumguide/v2016/2016-Scrum-Guide-US.pdf* (accessed: 22.03.2018)

TheLaTeXProject (2018), '*An introduction to LaTeX*'. Available at:.

URL: *https://www.latex-project.org/about/* (Accessed: 02.05.2018)

Unger, R. and Chandler, C. (2009), *A project guide to UX design*, Pearson Education, New Riders, Birkeley, USA.

WCAG 2.0-standarden (n.d.). Available from:.

URL: *https://uu.difi.no/krav-og-regelverk/wcag-20-standarden* (Accessed: 13.05.2018)

Acronyms

AJAX **A**synchronous **J**avaScript **A**nd **X**ML.

APMS **A**gile **P**roject. **M**anagement **S**ystem.

CSV **C**omma **S**eperated **V**alues.

CSS **C**ascading **S**tyle **S**heets.

CSRF **C**ross-**S**ite **R**equest **F**orgery.

EER **E**nhanced **E**ntity **R**elationship.

HTML **H**yper**t**ext **M**arkup **L**anguage.

JSON **J**ava**S**cript **O**bject **N**otation.

Lo-fi **Lo**w **Fi**delity.

MDL **M**aterial **D**esign **L**ite.

MVC **M**odel **V**iew **C**ontroller.

ORM **O**bject-**r**elational **m**apping.

PHP **PHP**: **H**ypertext **P**reprocessor.

SQL **S**tructured **Q**uery **L**anguage.

URL **U**niform **R**esource **L**ocator.

WYSIWYG **W**hat **Y**ou **S**ee **I**s **W**hat **Y**ou.

Appendix A

Appendix

This is an example of an Appendix. You can write an Appendix in the same way as a chapter, with sections, subsections, and so on.

A.1 Project Proposal

Reservasjonssystem for Fargelaben

Oppdragsgiver: Fargelaben (Norwegian Colour and Visual Computing Laboratory)
Kontaktperson: Marius Pedersen, marius.pedersen@ntnu.no, 61135246

Beskrivelse:
Fargelaben (Norwegian Colour and Visual Computing Laboratory, www.colourlab.no) har behov for et system for å reservere og logge bruk av utstyr og laboratorium. I dag gjøres dette ved hjelp av fysiske loggbøker. Fargelaben har i dag 8 forskjellige laboratorium (rom) med forskjellige utstyr. Det er viktig for laben å ha en god oversikt over hva slags utstyr som er tilgjengelig i hvilke laboratorium og hvor mye utstyret brukes. Per i dag vi ingen god måte å reservere utstyr eller rom, eller å få rapporter på hvor mye disse brukes. Laboratoriene brukes av både ansatte og studenter, og kan til tider ha høy belastning som gjør at et slikt system er nødvendig.

Systemet bør ha følgende funksjonalitet:

- Reservere rom og utstyr (helst med kobling til NTNU ansattes kalender)
- Oversikt over utstyr i de forskjellige laboratoriene
- Vise når utstyr eller rom er ledig, og hvis opptatt hvem som har reservert rommet/utstyret.
- Historisk oversikt over bruk av rom og utstyr.
- Fungere på pc, nettbrett og mobil
- Registrere bruk av rom og utstyr (enten via mobil, pc, nettbrettet i laboratoriet eller via student-/ansattkort)
- Generere rapporter om bruk av rom og utstyr
- Rapportere om manglende utstyr eller skader på utstyr
- Brukervennlig grensesnitt

A.2 Project Agreement

1

NTNU

Vår dato Vår referanse

Norges teknisk-naturvitenskapelige universitet

Prosjektavtale

mellom NTNU Institutt for design (ID) (utdanningsinstitusjon), og

Fargelaben

(oppdragsgiver), og

Fredrik Paulsen

Henrik Reft Snilsberg

Ole Martin Ibsen

(student(er))

Avtalen angir avtalepartenes plikter vedrørende gjennomføring av prosjektet og rettigheter til anvendelse av de resultater som prosjektet frembringer:

1. Studenten(e) skal gjennomføre prosjektet i perioden fra 10/1/18 til 16/5/18.

   Studentene skal i denne perioden følge en oppsatt fremdriftsplan der NTNU ID yter veiledning. Oppdragsgiver yter avtalt prosjektbistand til fastsatte tider. Oppdragsgiver stiller til rådighet kunnskap og materiale som er nødvendig for å få gjennomført prosjektet. Det forutsettes at de gitte problemstillinger det arbeides med er aktuelle og på et nivå tilpasset studentenes faglige kunnskaper. Oppdragsgiver plikter på forespørsel fra NTNU å gi en vurdering av prosjektet vederlagsfritt.

2. Kostnadene ved gjennomføringen av prosjektet dekkes på følgende måte:
   - Oppdragsgiver dekker selv gjennomføring av prosjektet når det gjelder f.eks. materiell, telefon/fax, reiser og nødvendig overnatting på steder langt fra NTNU på Gjøvik. Studentene dekker utgifter for ferdigstillelse av prosjektmateriell.
   - Eiendomsretten til eventuell prototyp tilfaller den som har betalt komponenter og materiell mv. som er brukt til prototypen. Dersom det er nødvendig med større og/eller spesielle investeringer for å få gjennomført prosjektet, må det gjøres en egen avtale mellom partene om eventuell kostnadsfordeling og eiendomsrett.

3. NTNU ID står ikke som garantist for at det oppdragsgiver har bestilt fungerer etter hensikten, ei heller at prosjektet blir fullført. Prosjektet må anses som en eksamensrelatert oppgave som blir bedømt av intern og ekstern sensor. Likevel er det en forpliktelse for utøverne av prosjektet å fullføre dette til avtalte spesifikasjoner, funksjonsnivå og tider.

4. Alle bacheloroppgaver som ikke er klausulert og hvor forfatteren(e) har gitt sitt samtykke til publisering, kan gjøres tilgjengelig via NTNUs institusjonelle arkiv hvis de har skriftlig karakter A, B eller C.

Tilgjengeliggjøring i det åpne arkivet forutsetter avtale om delvis overdragelse av opphavsrett, se «avtale om publisering» (jfr Lov om opphavsrett). Oppdragsgiver og veileder godtar slik offentliggjøring når de signerer denne prosjektavtalen, og må evt. gi skriftlig melding til studenter og instituttleder/fagenhetsleder om de i løpet av prosjektet endrer syn på slik offentliggjøring.

Den totale besvarelsen med tegninger, modeller og apparatur så vel som programlisting, kildekode mv. som inngår som del av eller vedlegg til besvarelsen, kan vederlagsfritt benyttes til undervisnings- og forskningsformål. Besvarelsen, eller vedlegg til den, må ikke nyttes av NTNU til andre formål, og ikke overlates til utenforstående uten etter avtale med de øvrige parter i denne avtalen. Dette gjelder også firmaer hvor ansatte ved NTNU og/eller studenter har interesser.

5. Besvarelsens spesifikasjoner og resultat kan anvendes i oppdragsgivers egen virksomhet. Gjør studenten(e) i sin besvarelse, eller under arbeidet med den, en patentbar oppfinnelse, gjelder i forholdet mellom oppdragsgiver og student(er) bestemmelsene i Lov om retten til oppfinnelser av 17. april 1970, §§ 4-10.

6. Ut over den offentliggjøring som er nevnt i punkt 4 har studenten(e) ikke rett til å publisere sin besvarelse, det være seg helt eller delvis eller som del i annet arbeide, uten samtykke fra oppdragsgiver. Tilsvarende samtykke må foreligge i forholdet mellom student(er) og faglærer/veileder for det materialet som faglærer/veileder stiller til disposisjon.

7. Studenten(e) leverer oppgavebesvarelsen med vedlegg (pdf) i NTNUs elektroniske eksamenssystem. I tillegg leveres ett eksemplar til oppdragsgiver.

8. Denne avtalen utferdiges med ett eksemplar til hver av partene. På vegne av NTNU, ID er det instituttleder/faggruppeleder som godkjenner avtalen.

9. I det enkelte tilfelle kan det inngås egen avtale mellom oppdragsgiver, student(er) og NTNU som regulerer nærmere forhold vedrørende bl.a. eiendomsrett, videre bruk, konfidensialitet, kostnadsdekning og økonomisk utnyttelse av resultatene. Dersom oppdragsgiver og student(er) ønsker en videre eller ny avtale med oppdragsgiver, skjer dette uten NTNU som partner.

10. Når NTNU også opptrer som oppdragsgiver, trer NTNU inn i kontrakten både som utdanningsinstitusjon og som oppdragsgiver.

11. Eventuell uenighet vedrørende forståelse av denne avtale løses ved forhandlinger avtalepartene imellom. Dersom det ikke oppnås enighet, er partene enige om at tvisten løses av voldgift, etter bestemmelsene i tvistemålsloven av 13.8.1915 nr. 6, kapittel 32.

Norges teknisk-naturvitenskapelige universitet
Institutt for design

12. Deltakende personer ved prosjektgjennomføringen:

NTNUs veileder (navn): CARLOS VICIENTI - MAULLAG

Oppdragsgivers kontaktperson (navn): MARIUS PEDERSEN

Student(er) (signatur): Fredrik Pedersen dato 17/1/18

Henrik Pettersen dato 17/1/18

Ole Martin Ibsen dato 17/1/18

dato

Oppdragsgiver (signatur): dato 17/1/18

Signert avtale leveres digitalt i Blackboard, rom for bacheloroppgaven.
Godkjennes digitalt av instituttleder/faggruppeleder.

Om papirversjon med signatur er ønskelig, må papirversjon leveres til instituttet i tillegg.
Plass for evt sign:

Instituttleder/faggruppeleder (signatur): dato

A.3 Project Plan

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Project plan

Bachelor 2018

NTNU i Gjøvik

Webutvikling

Written by
Ole Martin Ibsen
Henrik Reff Snilsberg
Fredrik Paulsen

Project plan

1 Introduction

The Colorlab at NTNU in Gjøvik is a research group that are currently specializing in colour science, colour imaging, image processing, and video processing (Norwegian Colour and Visual Computing Laboratory, 2018). They have several rooms on campus dedicated to research and practical lectures. These rooms contain a lot of equipment, both mobile and immobile. The rooms and equipment are used by both students and employers, but also guests such as researchers that come from other locations than NTNU Gjøvik.

The Colorlab has been using a book for 17 years when booking and cataloging the use of equipment. The facilities consists of different rooms, while the book is located in only one room. This requires someone who wants to book equipment to leave their current location and go look through the book, which is both time-consuming and inefficient. Furthermore, if someone wants to book a room they need to send emails to all participants of the Colorlab to notify them that the room is occupied.

The Colorlab also needs to log hours that has been used in the lab and with equipment to know what is being used alot and what isn't being used as frequently. When there is a project with EU it is required to log all hours you have worked on the project (Pedersen, 2018).
The administrator can then see this log and figure out what equipment they need more of , - this will also help making an argument to the school administration as to why they could need more equipment.

Another issue brought up by the employer is that equipment which is broken or missing need to be brought to their attention. Currently there is no easy way to report this, which can cause problems when the equipment is needed by the Colorlab.

To solve these issues, the Colorlab want a new, responsive system that works on all devices and is easy and fast to use to ensure that everyone uses it. They are going to put tablets outside (and inside) the labs so that you can easily log your usage even if you haven't booked it prior. The system needs to contain different roles so that they can log what equipment or rooms different roles use the most. They want it to be flexible for administrators to add new equipment and rooms if necessary.

2 Scope

In this project the goal is to develop a booking system that is easy to use and works on all platforms. It will contain a hierarchy of users with roles. It will log all bookings so that administrators easily can see who has used what and how long something has been used. To achieve such a system the Colorlab needs:

User friendly design

- System should work on PC, tablet and phone
- User friendly design, to ensure the system actually gets used
- Registering and usage needs to be as easy and quick as possible

User functionality

- Different users roles: Guests, Student, employe, scientist/researcher and administrators
- Create users in our system with name and NTNU email
- Verify that user owns the registered email
- Update user, name/email/password
- Chose standard activity for user, example project number X or subject Y for a certain room or all rooms
- Users need to be approved by an administrator to be able to book equipment.
- Notify admin about damaged/broken/missing equipment.

Administrator functionality

- Approve/update/remove users
- Approve bookings from students
- Administrators need to be employees
- Add projects and subjects
- Add new rooms or equipment
- Create new users and assign user categories
- Edit bookings

Booking of room and equipment

- Register who have booked, time period (from - to), what they are using it for (research, education, demo etc.), subject code/name
- If its a research project, also register the project number
- If room/equipment is already booked, notify user
- Student bookings needs to be approved by an administrator
- Administrators can edit a booking at a later time to add for example project number
- When some specific equipment is used, the system needs to “lock” the room/s or indicate other users to not enter.
- Bookings should be time-limited, longer bookings needs to be approved by admin. Different time-limits for different roles, Student < Teachers < Guests.
- Mainly first come first served on booking.

Other functionality

- Show what type of equipment is in the different rooms, and number of equipments.
- Possibility to look through a list to see where the equipment is located.
- Show when equipments and rooms are available, if booked, then show who has booked it
- Show if equipment is tied to a specific room, if it is mobile and can be moved to other rooms.
- Tablets located in the rooms need their own interface.

Usage history and report

- List of usage of rooms and equipment over time (Only for admin)
- Create logging-system to display information about use of rooms and equipment over time.
  Examples:
    - How much time(or %) has the room or equipment been used
    - What have labs been used for in projects or education
- Possibility to search through and see who is using what room and equipment
- Possibility to see who has used what and when in a calendar view

Things the group need to research/look into

- Mirroring timetables for the rooms, if a room is supposed to be used by a subject this should be in our schedule.
- Mail booking to existing solution.
- Student-/employer card NFC.
- Specific room administrators, if the time it takes and complexity it creates is worth the feature
- PHP API

Other

- Notify NSD about our database containing personal information such as e-mail and names. (http://www.nsd.uib.no/)

3 Project organization

To achieve good work flow throughout the project, group members will have predetermined roles, routines and rules to prevent confusion. Collaboration tools will also be used to easily work together on different computers.

3.1 Roles

Project:

Ole Martin Ibsen: Main Frontend & Documentation
Henrik Reff Snilsberg: Frontend & Backend
Fredrik Paulsen: Frontend & Backend

Supervisor: Carlos Vicient-Monllaó
Product owner: Marius Pedersen

Throughout the project all group members will be flexible and help each other.

Group Leader: Henrik Snilsberg

Interviews and user tests:

Interviewer: Henrik Reff Snilsberg
Note-taker: Ole Martin Ibsen
Main-Observer: Fredrik Paulsen (Usability.gov, No date)

3.2 Routines

Each week the group will have meetings with the employer 10:00 on wednesdays, and with our supervisor on fridays 14:00. However if a meeting is not needed that week we can cancel these guidance meetings.

We have planned to work on mondays, wednesdays after meeting and fridays before and after meetings, however if needed we can set up more or move days. About 5 hours each day.

A minimum of 15 hours of work each week is required, but all members plan to be flexible with our time, meaning that some weeks the group will spend more than the required amount depending on the workload in other subjects.

3.3 Group rules

- Obligatory to attend all meetings with client and supervisor.
- Notify members if you can't attend planned activities.
- All group members have to be responsible for their task.
- Be available online when working from home.
- All major decisions and changes must be discussed with all members.
- When there is disagreement, the majority vote decides.
- The group leader has to make sure goals are met.

3.4 Collaboration tools

To help collaboration between group members GitHub will be used as a version control system. This will allow different members to code on different parts of the system at the same time, thus maximizing efficiency, while also allowing us to do rollbacks if something were to happen.

Google Drive will allow the group to sync documents and other files across different computers easily throughout the process. Google Drive also allows the use Google Docs/Sheets to collaborate on writing and documenting throughout the project.

Messenger and Discord will be our main tools for planning, communicating and scheduling meetings, - allowing us to plan meetings ahead or be spontaneous.

The initial plan was to use Trello to organize the tasks and see backlog in the sprints, because it is something that all group members have already used. However research on ZenHub will be done before the first sprint, which is a plugin for GitHub similar to Trello to combine systems rather than using seperate ones.

4. Planning

To ensure efficient workflow and results good planning is necessary. The group will have to figure out which technologies works best for this project, - and what methods we can use to reach our final goal of a user friendly and functional system.

4.1 SCRUM

For solving the issue at hand the group will be utilizing an agile method called SCRUM, by dividing the work into sprints the tasks will be easier to manage and deploy.

4.2 Iterativ process and user testing

Towards the end of each sprint user testing will be done if there are any new functions added to our system. After user testing evaluating the feedback provided will help make necessary changes. Throughout the development the group will be working in an iterative process while working closely with the employer.

Early in the process there will be made sketches for the design, and layout of the application. To easily create solutions and ideas for the user experience. We will also create personas & scenarios (Kumar, 2013) that will work as our target audience, and such they can be used to perform user cases to see how the solution will work.

From the sketches there will be created a lo-fi (low fidelity) prototype (Visual Hierarchy, No date), that the group can use to test the most basics of layouts and functionality of the application early on. The personas and scenarios will be used on this as well.

Sketches of the database will be done using an EER model (Hansen and Mallaug 2014) and normalized to create a easily structured and modern relational database. A relational database which is correctly implemented is critical when deleting or updating some information, so you do not have to do this multiple places, - or risk being unable to delete a table/row.

The group will create a design template containing the interface/layout and color scheme of the application. The color scheme will be the same or similar to the colors of NTNU, as the application is supposed to be used at campus. The Colorlab's own web page uses these colors as well (Norwegian Colour and Visual Computing Laboratory, 2018).

4.3 Technologies

To implement the solution the group will utilize web technologies and create a web-application. The benefits of using web is that it is ubiquitous (everyone has browsers on all devices), easier to develop (you do not need to develop and test for each platform/device, as well as you can develop on any operating system), easier to install and maintain (when you update the code on the server, the users gets the update instantly and do not have to download anything) and that it is not overly complicated (Magic Web Solutions, No date). This will make it easier for someone who might want to expand the work with the Colorlabs solution at a later point to understand the code.

The group will research what frameworks, technologies and programming languages to develop a functional and easy to understand code/system.

For backend, one of the best frameworks is Laravel PHP (Malhotra, 2018). This framework allows us to write the backend and PHP code more fluently and improve workflow. It also allows more compact and clean code, which will make people working on this project after us have an easier time understanding. There will also be done research on how to create PHP API's and how it can be implemented so it is easier for others to take over the project at a later date.

For front-end we will look into the advantages of different web technologies such as jQuery, jQuery UI, JavaScript frameworks (Angular 4, React, Vue), Bootstrap if they are prove to be useful for the project.

4.4 Constraints

The main focus on the project is to complete the core and main functionalities for the systems, as well as creating a easy and user friendly interface. When this is completed the remaining time available will be spent on implementing the extra functionality the employer wants if the research on these topics has proved that it is possible to implement.

If the system is going to use NFC, users will have to register their users with a NFC capable device to link their card to their account.

We will research information about how to implement NFC-reader (student-/employee card), calendar/mail booking and mirroring time table. If we happen to find out it is not possible or takes too much time to implement, we will drop these functionalities.
The group has been in contact with the responsible department at NTNU, but so far it seems to be a security issue they will have to examine further. Therefore we cannot conclude yet if we can use NFC for our system.

In an interview with the employer we asked what he wanted the NFC-functionality to do.
He answered: “Easy and quick solution is most important, either a drop-down menu or NFC.(...) Do not want to login with email and password every time as it takes a lot of time.(...) Functionality for the system over prioritising NFC” (Pedersen, 2018).

4.5 Milestones

- Lo-fi Prototype/Preparations
- Login/Registration
- Admin-Dashboard
- Booking room
- Booking equipment
- Report

4.6 Gantt

Sprint 1 - Preparations / Lo-fi prototype
Sprint 2 - Login/Registration
Sprint 3 - Booking room/equipment
Sprint 4 - More functionality

5 References

Hansen,K.J. Mallaug,T. (2014) *Databaser*. 2.utg. Polen: Gyldendal Norsk Forlag

Kumar, V. (2013) *101 Design Methods*. New Jersey: John Wiley & Sons, Inc.

Malhotra, M (2018) *Why Laravel is the best PHP framework in 2018.* Available at: https://www.valuecoders.com/blog/technology-and-apps/laravel-best-php-framework-2017/ (Last access: 25.01.2018)

Magic Web Solutions (No Date) *The benefits of web-based applications.* Available at: https://www.magicwebsolutions.co.uk/blog/the-benefits-of-web-based-applications.htm (Last access: 25.01.2018)

Norwegian Colour and Visual Computing Laboratory Available at: https://www.ntnu.edu/colourlab#/view/about (Last access: 25.01.2018)

Pedersen, M (2018) *Interview (Interview done: 12.1.2018)*

Schwaber, K., Sutherland, J. (2017) *The Scrum Guide - The Definite Guide to Scrum: The rules of the game.* Available at: http://www.scrumguides.org/docs/Scrumguide/v2017/2017-Scrum-Guide-US.pdf#zoom=100 (Last access: 25.01.2018)

Usability.gov (No date) *Planning a Usability Test*. Available at: https://www.usability.gov/how-to-and-tools/methods/planning-usability-testing.html (Last access: 31.01.2018)

Visual Hierarchy (No date) *High and Low fidelity prototypes.* Avalible at: https://visualhierarchy.co/blog/the-continuum-of-high-and-low-fidelity-prototypes/ (Last access: 31.01.2018)

A.4 User test 21.02

, Prototype brukertest 21.02.2018

I denne brukertesten vil vi gjennomføre en test av skissene i form av en papirprototype som ble laget under sprint 1.

Hva opplevde du som vanskelig med appen?

Egentlig ikke, det meste var lett å forstå.

Var det noe som manglet?

Log view fremvisning

navigasjon

Hva opplevde du som enkelt?

Alt virket egentlig ganske enkelt

Har du noen tilbakemeldinger for forbedring?

Kanskje ha egne view for rom og utstyr

Ellers ser detmeste bra ut

A.5 User test 15.03

Prototype brukertest 15.03.2018

I denne brukertesten vil vi gjennomføre en test av admin dashboard og booking systemet. Vi vil at du skal teste forskjellige administrative funksjoner som bytting av roller på registrerte brukere og godkjenning av nye brukere. Videre vil vi at du skal legge til nye rom og utstyr og redigere disse. Vi vil også teste booking funksjonen.

Hva opplevde du som vanskelig med appen?

Problemer med å endre rolle, hake vs redigeringsting. Forskjell fra adminpanel til user panel. Mulig for at show toast ikke var tydelig nok eller lenge nok synlig (samme farge som footer, og ligger rett over)

Var det noe som manglet?

Ønsker favoritter i utstyrsliste, da det er utstyr som blir brukt om igjen flere ganger, ofte ved besøk av lab'n.

Hva opplevde du som enkelt?

Registrering var rett frem. Navigasjonen virket klar.

Har du noen tilbakemeldinger for forbedring?

Bedre å kalle brukere inaktiv enn deleted, da Colourlab'n ønsker å ta vare på alle brukerne for logging.

Ønsker å kunne søke på brukere i user-list.

Merket ikke helt at menyen endret seg da man byttet til administrator-panel

Endre på rolle og status, bekrefte valg. Vanskelig å vite om endringen er gjort før eller etter man har valgt ny rolle og trykket bekreft.

Skrivefeil i navnet på siden (skal være britisk)

Hva syns du om at navigasjonsbaren endret seg når du gikk for å gjøre admin funksjoner?

Det fungerer greit, iom at det ikke er så mange som skal bruke admin-funksjonen så lærer man det ganske fort forskjellen.

Andre interessante punkter

Description som tekstfelt. Navn og lokasjon er det viktigste.

Beste valg er at man kan huke av å bruke rom alene når man booker rom

Standardvalg er ingenting, slik at man må bevisst velge.

Rom uten utstyr skjer,

3-4-5 ting om gangen.

Mest brukte utstyr

Generelt 8 ting

Noen andre rom 100+

Søkefelt

Tidligere booket?

A.6 User test 06.04

,

Prototype brukertest 06.04.2018

I denne brukertesten vil vi gjennomføre en test av booking-systemet. Vi vil at du skal booke et rom med utstyr, og et rom uten utstyr. Vi vil også at du skal gjennomføre en booking og bekrefte når denne bookingen er.

Test 1

Hva opplevde du som vanskelig med appen?

Ingen feedback når man valgte rom før man trykket book så man måtte “gamble”

Vanskelig å finne riktig tid da det var litt mange valg.

Var det noe som manglet?

Nei, det virker ganske ålreit.

Har du noen tilbakemeldinger for forbedring?

Mulighet for å sjekke om rom er booket i tidsrommet man velger før man booker.

Andre interessante punkter

Valg av bruk var allerede fylt inn, så bruker hoppet over dette valget.

Bruker mottar ikke e-mail for å fullføre registreringen.

Test 2

Hva opplevde du som vanskelig med appen?

Nei, synes den virket veldig grei. Litt mange valg av tid, så måtte lete endel.

Var det noe som manglet?

Nei, det virker ganske ålreit.

Har du noen tilbakemeldinger for forbedring?

Kanskje mulighet for å se andre valgmuligheter hvis et tidsrom er booket.

Andre interessante punkter

Snakket om mangel på MDL-styling av selector(drop-down), var ikke noe problem - ønsket funksjon over design.

A.7 User test 30.04

, Prototype brukertest 30.04.2018

I denne brukertesten vil vi gjennomføre en test av loggingen. Du skal samle all data om bookings som har blitt samlet om utstyr så langt i systemet. Videre vil vi at du skal sjekke hvor mange bookings det har vært av rom A008 den siste måneden. Du skal også sjekke hvor mange timer kamera Canon 50D har blitt brukt.

Hva opplevde du som vanskelig med appen?

Virket ganske rett frem. Enkel og logisk oppbygging av tekst/elementer

Var det noe som manglet?

Ønsket pie charts med all time bookings i admin dashboard inkludert total antall timer. VIl ha statistikk for siste 30 dager i log siden.

Har du noen tilbakemeldinger for forbedring?

Samme som sagt i forrige spørsmål. Er kjent med bruk av CSV filer så foretrekker nesten å kunne laste ned CSV fil . Liker det vi har gjort men er ikke en hovedprioritet å lage noe grafisk.

Andre interessante punkter

CSV var litt gjemt.

A.8 First interview with product owner 15.01.2018

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Intervju Marius 15.01

Eksisterende løsning

Hva funker dårlig med løsningen dere har i dag?
Analogt system, ett rom - rom spredt rundt omkring, brukes ikke pga dette. Ingen brukere, ingen løsning.

Er det noe fra den som fungerer bra i dag du vil ha med videre?
Intensjonen, hvem som har brukt forskjellige ting. Logg for å se hvis det har skjedd noe osv.

Utstyr og rom

Kan man booke rom og utstyr uavhengig av hverandre?
Ja og nei.

Er utstyr knyttet til et rom, rommene, eller kan de tas med ut?
Er det unntak?

Det er noe utstyr som kun kan brukes i ett rom fordi det ikke er mobilt. Noe utstyr som ligger i ett rom fordi det er en fast plassering på det, men kan tas med ut. Noen rom har fast utstyr.

Har utstyr satte plasser på visse rom?
Ja

Kan flere folk booke utstyr fra samme rom?
Ja, dette skal være mulig.

Kan utstyr bookes selv om noen har booket et rom?
Ja, men fargemålinger kan forhindre noen å gå inn i et rom når dette pågår.

Er det noen spesielle rom hvor dette går/ikke går?

Gjelder alle rom. Utstyret for fargemåling er mobilt så kan brukes i alle rom.

Skal det være en maksimal grense for mye utstyr du kan låne?
Skal ikke være noe problem.

Skal det være en grense på hvor lenge man kan booke rom, eller hvor mange dager på rad?
Bør være tidsbegrensning. Lengre bookinger kan måtte godkjennes av en admin. Roller kan også påvirke (student, forsker, lærer)

Skal det være noe prioritering på booking, om en lærer skal booke et rom eller utstyr, kan det overstige en students booking på noe vis?
First come first served. Ansatte bør få en slags prioritering men eventuelt kan ta dette utenom våres løsning.

Eller hvis det er en forsker som kommer og trenger et spesifikt rom, får han prioritet over andre om rom alt er booket?
Samme svar som forrige spørsmål.

Registrere rom NFC

Generelle tanker om NFC:

Registrere bruk av rom og utstyr (enten via mobil, pc, nettbrettet i laboratoriet eller via student-/ansattkort)
Mulighet for å ta kortet forran tablet, velge rom, utstyr og confirmer dette. Utregistrering for å kunne logge.

Registrere bruk av rom og utstyr ved bruk av student-/ansattkort hva menes med dette?

Er tanken at man skal bekrefte en registrering med kortet?

Skal man kunne logge inn med kortet i stedet for tradisjonelt brukernavn/passord?
Enkel og rask løsning er det viktigste, drop-down meny eller NFC. Vil unngå å logge inn med epost og passord.

Hvilke funksjonaliteter vil du at kortet skal gi systemet?

Er det en høyt prioritert egenskap/mulighet?
Funksjonalitet for systemet ovenfor prioriteten på NFC.

Kort uten kode. Booking av rom, muligens ikke utstyr.

Rapport om bruk

Rapportene om bruk av rom og utstyr skal det være en grafisk visning på nett som sier **hvor mye rom og utstyr har blitt brukt, eller vil du at dette skal være informasjon som kan printes?**

Ja takk begge deler. Ikke høy prioritet, gjerne få data ut i tabell hvis vi ikke får til grafisk.

Er rapporten noe alle skal ha tilgang til å se?

Gjelder kun admin

Adminsystem

Hvor mange adminstratorer mener du vil bruke systemet?

Usikkert, i utgangspunktet har det vært kun meg tidligere.

Hvilke platformer ville du gjort dette på?
Hovedsaklig PC, da jeg bruker PC som oftest.

Tror du administratorer kommer til å bruke systemet borte fra pc'en, f.eks med mobil?
Nei, det tror jeg ikke. Kommer nok til å brukes kun på PC.

Design

Når det gjelder design, har du noen tanker på hvordan du vil det skal se ut?

Står fritt. Bruke noe folk er kjent med.

Er det noe førsteinntrykk du vil brukerene skal ha?

Skal vi holde oss til NTNU-fargene med tanke på at det er en NTNU-booking app?

Innlogging

Tanken er at innlogging er via Feide som ellers?
Trenger ikke være så sikkert. Kan være helt separat fra feide (høre med Orakel på skolen) Eget passord og bruker.

Ymse annet:

- Ønsker en oversikt over kalender som hovedskjerm?
- Rom bør ta prioritering ovenfor utstyr ved kalenderfunksjon.
- Microsoft Exchange
- Administrator-grensesnitt, vil legge inn utstyr selv, fjerne utstyr osv.
- Møtes gjerne ofte gjennom arbeidsprosessen.
-

A.9 Second interview with product owner 14.02.2018

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Notater fra møte med Marius

Brukere

- Hvem som bruker Colourlab mest.
    - Bachelor-grupper
    - Interne forskere
    - Ansatte NTNU
    - Masterstudenter.
- Må systemet skal holdes ryddig / om brukere skal slettes regelmessig
    - Gamle brukere skal i utgangspunktet ikke slettes.
- Ikke alle har behov for å bruke lab'n jevnlig. Ca 20 som bruker.
- Rundt 30 nye brukere hvert semester.

Språkvalg

- Engelsk

Logging

- Forskjellige views
- Lister / tables eller bare tall/statistikk
- Kakediagram
- Rapportere hvor mye det har blitt brukt lag i ett spesifikt prosjekt. Få ut alle som har gjort arbeid på 1 prosjekt. (alle mennesker og tid, totalt tid brukt)
- Fordeling mellom alle rom, prosent, antall timer. Hvilket rom er brukt mest. Utstyr som er mest brukt.
- Tabulert, kunne presentere data for instituttleder
- Skal være enkelt å formidle videre.

Booking

- Book igjen funksjon.
- Norwegian er noe NTNU-ansatte er oppfordret til å bruke så alle skal ha et visst kjennskap til dette systemet.
- Foretrekker visuell timeplan over liste.
- Dato for utstyr når det er kjøpt. Pga kalibrering osv, service historikk
- Tag for utstyr.
- Kun studenter skal approves

- Tekstfelt for beskrivelse, produktnavn.
- Tagge utstyr med labels og gjøre labels søkbare. Istedenfor kategori.Kunne dobbeltsjekke om utstyr er i riktig rom gjennom booking.
- Booker helst rom ovenfor utstyr.
- Forskningsprosjekt
- Undervisning/forskning

A.10 Quantitative interviews

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Kvalitativ brukerintervju målgruppe

Personlig informasjon:

Alder 55 år
Utdanning: Grafisk ingeniør, fagbrev i reproduksjons fotograf, master i color science, ph.d i color science

Hva er din holdning til teknologi?
Kjent med teknologi

Hvor mye bruker du PC/mobil/nettbrett daglig?
Jobbsammenheng bruker PC. Nettbrett aldri. Mobil brukes også, mer lesing enn å skrive.

Hva bruker du mest av PC/mobil/nettbrett?
PC helt klart, mobil etter dette. Aldri nettbrett

Arbeidsoppgaver o.l:

Hvilke stilling har du?
Førsteamanuensis.

Hva er dine generelle arbeidsoppgaver i en typisk arbeidsdag?
Blanding mellom undervisning og forskning.

Hvilke fag underviser du i?
Fargestyring, farger i interaksjonsdesign. Medical-imageing. Medisinsk avbildning. Farge bildereproduskjon som gjelder.

Hvor lang er din typiske arbeidsdag?
Svinger, kommer an på innlevering osv (deadlines for konferasegreier) Avhengig av hva som skjer.

Hvor ofte har du undervisning i lab'n?
Alle emner bruker lab. 60% undervisning, 40% lab.

Labrelatert:

Hvor ofte bruker du laben?
Avhengig av aktivitet syklusen. Høst ingen undervisning, kun lab aktivitet, våren har han 2 emner tilknyttet lab'n. 25% av total arbeid er i laben.

Hva bruker du laben til?
Forskning og undervisning. 60% undervisning 40% forskning.

Hvilken lab bruker du oftest?
A012, A011, A009, A010.

Hvor lenge bruker du laben?
Varierer, undervisningssammenheng/gruppeoppgave faste tider, adhoc med tanke på forskning. Et eksperiment som går over tid, må ha forskjellig observatører, oppsett som står nede i laben i et par uker, får beskjed om å ikke røre, kan gå over flere uker. Noen ganger i bare en halvtime, aktivitetsrelatert.

Hvilke problemer er typisk å møte på laben?
Aktivitetsnivå varierer voldsomt, 15 masterstudenter i fjor, ikke vite hvilket rom som er ledig. Kamp om plassen. Om våren er det mer rolig. Praktisk utfordring, flere som må ha samme utstyr på samme tidspunkt. Skjer innimellom. Laben ikke har lab assistent, som tar seg av oppgraderinger. Ting som ikke er gjort fordi Adobe CS pakke har gått ut, osv.

Har det vært problemer når det kommer til booking? Konflikter med rom?

Må forhøre seg med mange forskjellig. Kommunikasjon er et problem. Ikke lov å ta ut utstyr, men hender at noen gjør dette. Noen ganger er utstyr borte, som kan være et problem.

Har du noen gang opplevd at utstyr er ødelagt?
Ødelagt sjeldent, service og vedlikehold er et større problem. A008 fotostudio, kan brukes av mange studenter, hender at folk har revet ned bakgrunns-lerret. 10 år, 2-3 ganger. Ingen backup så det kan være problematisk. Service kan være mer interessant enn å rapportere feil.

Er det ofte at laben har vært opptatt når du trengte den?
Ja, det hender. Pleier å booke på forhånd

Når du booker rom, booker du utstyr og rom uavhengig?

Rom først, siden utstyr er der. Individuelt ansvar.

Personlig informasjon:

Alder 34 år
Utdanning: bachelor i ingeniørfag, master i teknologi, medieteknikk, PhD i fargebilde teknologi

Hva er din holdning til teknologi?
Kjent med teknologi

Hvor mye bruker du PC/mobil/nettbrett daglig?
Jobbsammenheng bruker PC. Mobil og nettbrett brukes også.

Hva bruker du mest av PC/mobil/nettbrett?
PC.

Hvor ofte bruker du laben?
Varierer gjennomsnittlig 1 gang i uka, noen ganger hver dag.

Hva bruker du laben til?
Eksperimenter med observatører, personer innom som gjør eksperimenter

Hvilken lab bruker du oftest?
A011 - dedikert til psykometriske forsøk

Hvor lenge bruker du lab'n?
30 min -1 time

Hvilke problemer er typisk å møte på laben?m
Utstyr ikke er der det skal være

Hvilke problemer har du opplevd i laben?

Har det vært problemer når det kommer til booking?
lapper, på ting, vet ikke når, vansklig å vite om lappene har hengt der lenge

Konflikter med rom?
Dårlig ordning førte til flere konflikter, master studenter opplevde en del konflikter, de prøvde å sette opp tabell system der noen ikke gadd å følge

Har du noen gang opplevd at utstyr er ødelagt?
Ikke ødelagt.

Er det ofte at lab'n har vært opptatt når du trengte den?
Ja det har skjedd, spesielt i høstsemesteret.

A.11 Sketches

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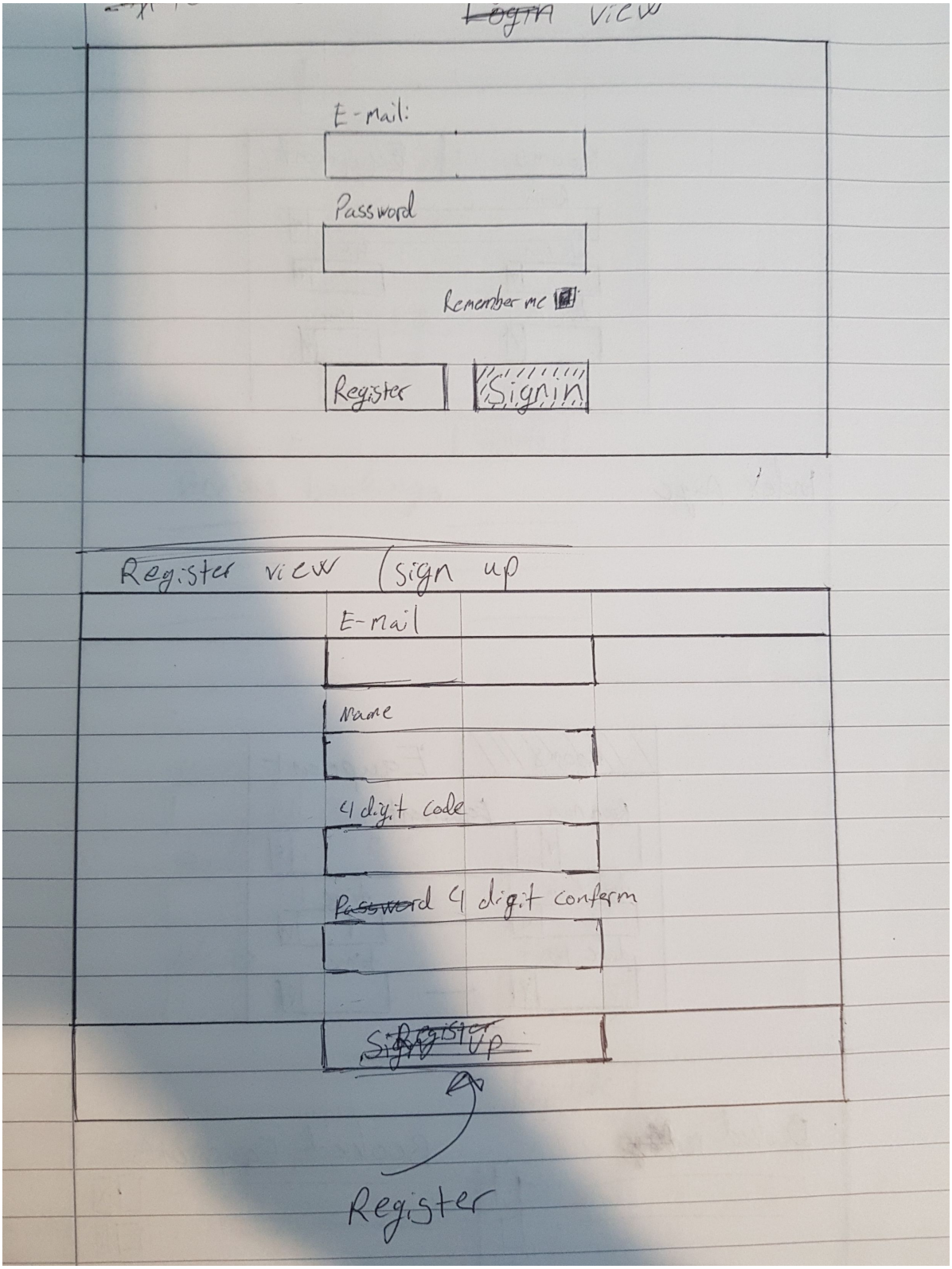

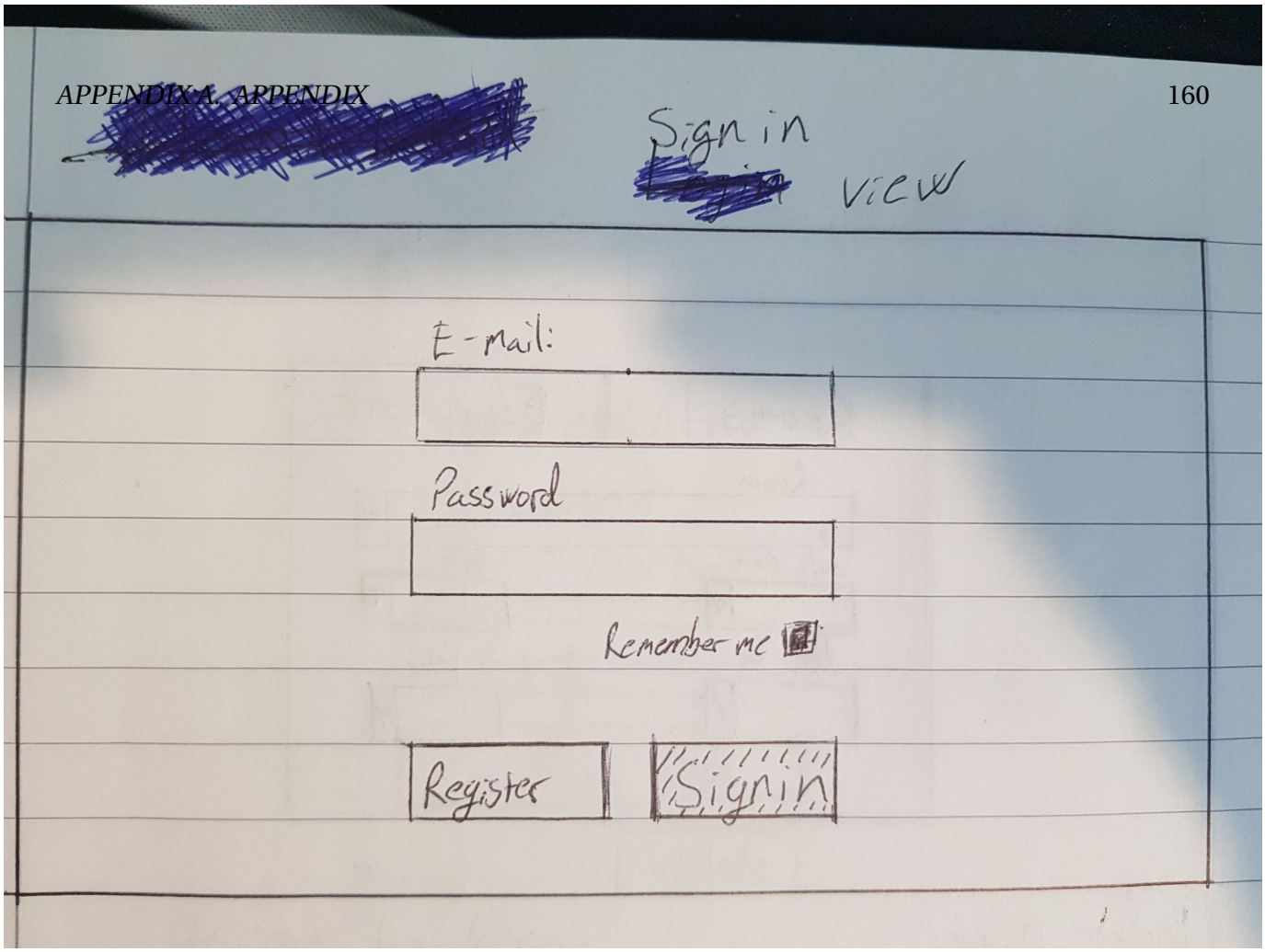
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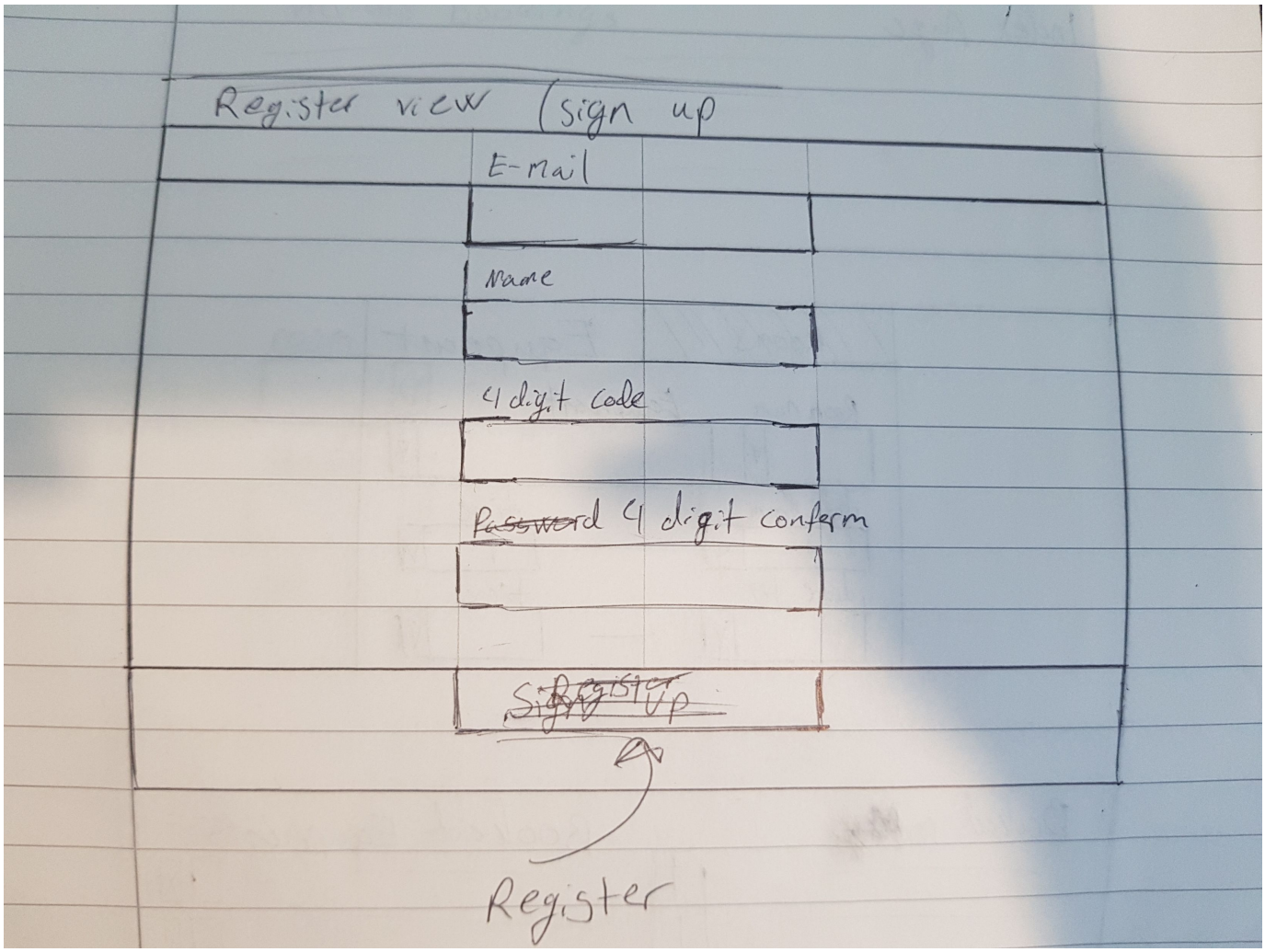
E-mail:
Password
Remember me
Register
Signin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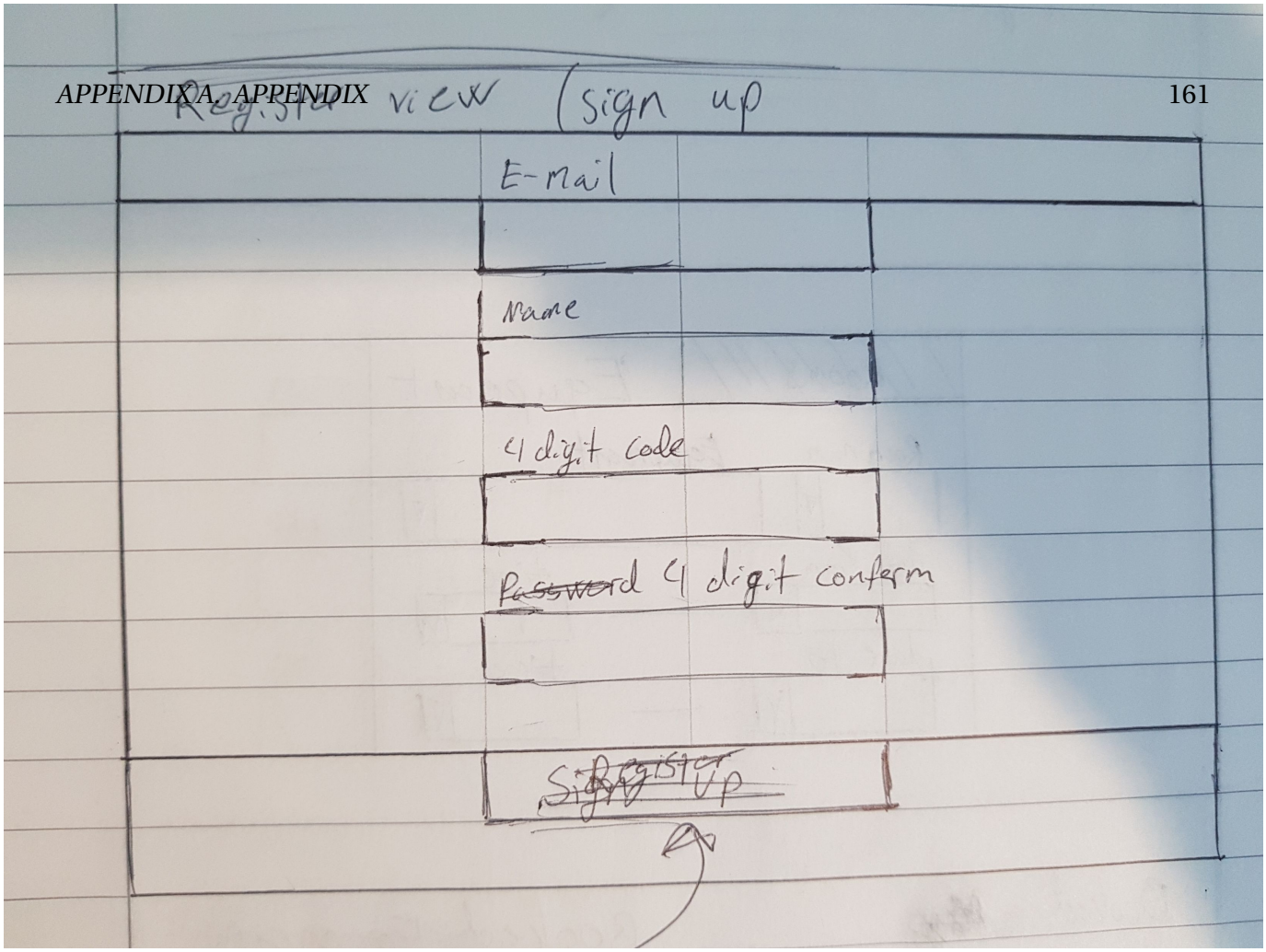
E-mail
Name
4 digit code
Password 4 digit confirm
Sign Register up
Register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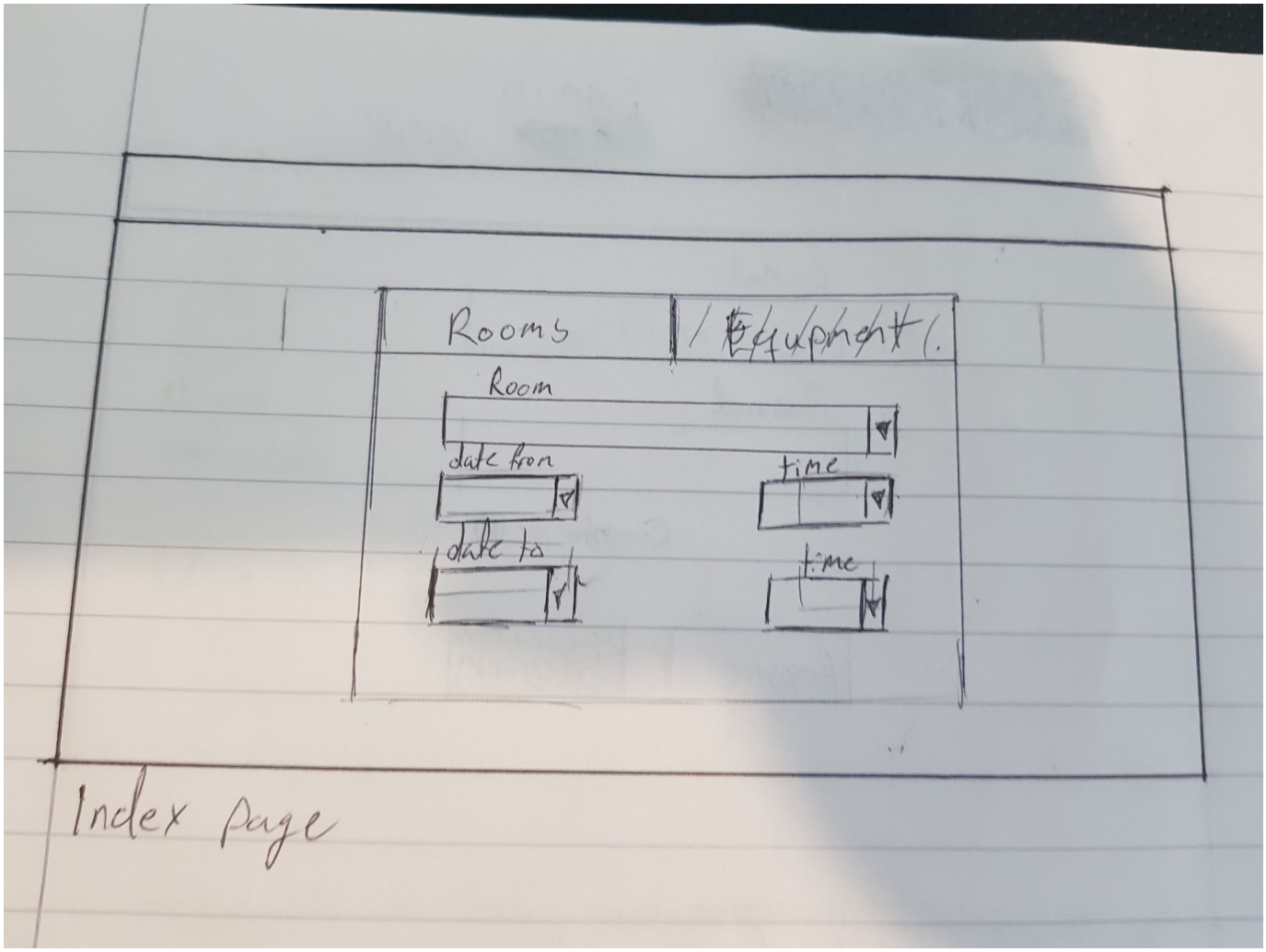
Sign up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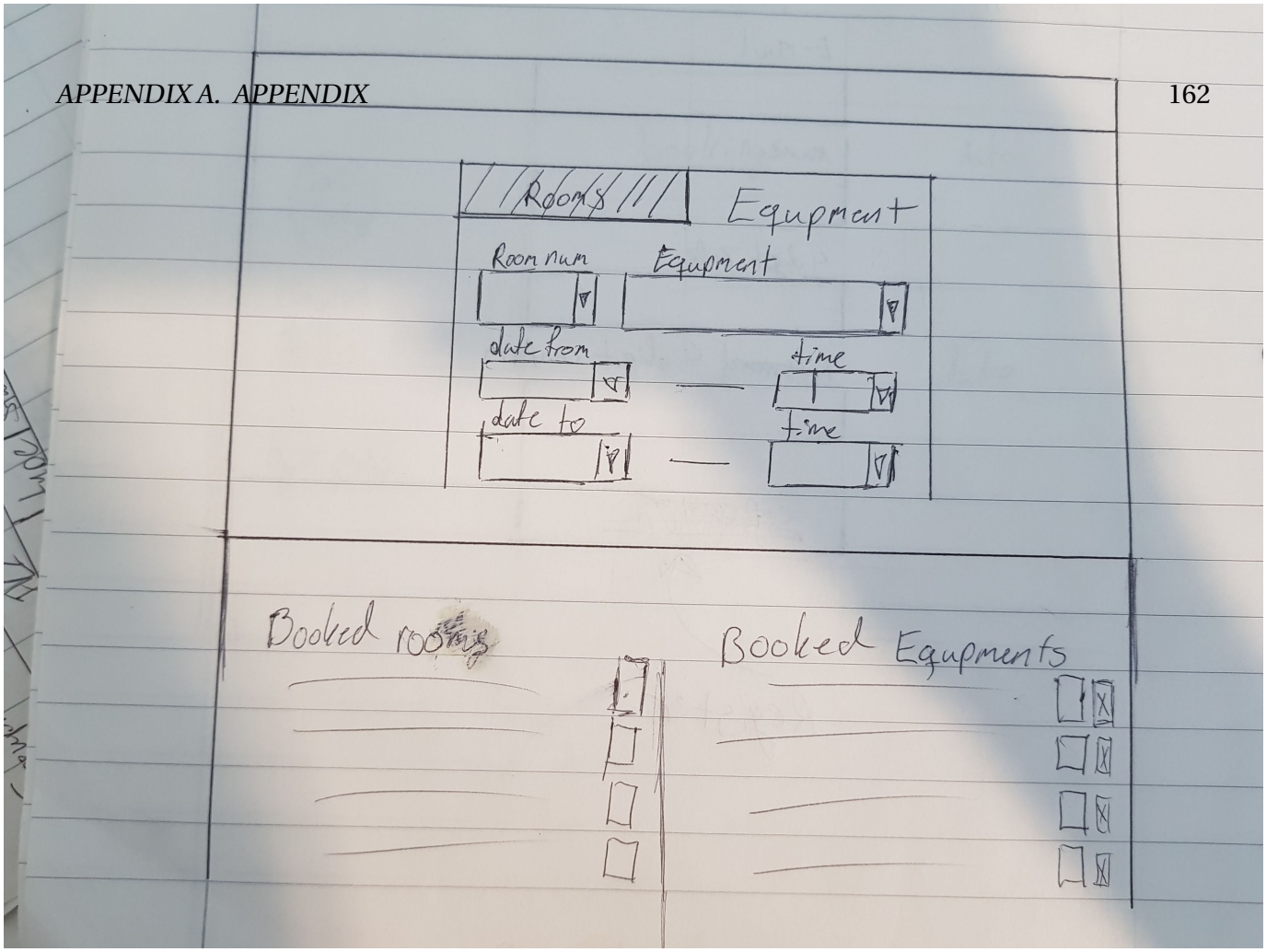
Equipment
Room
date from
time
date to
time
Index page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time
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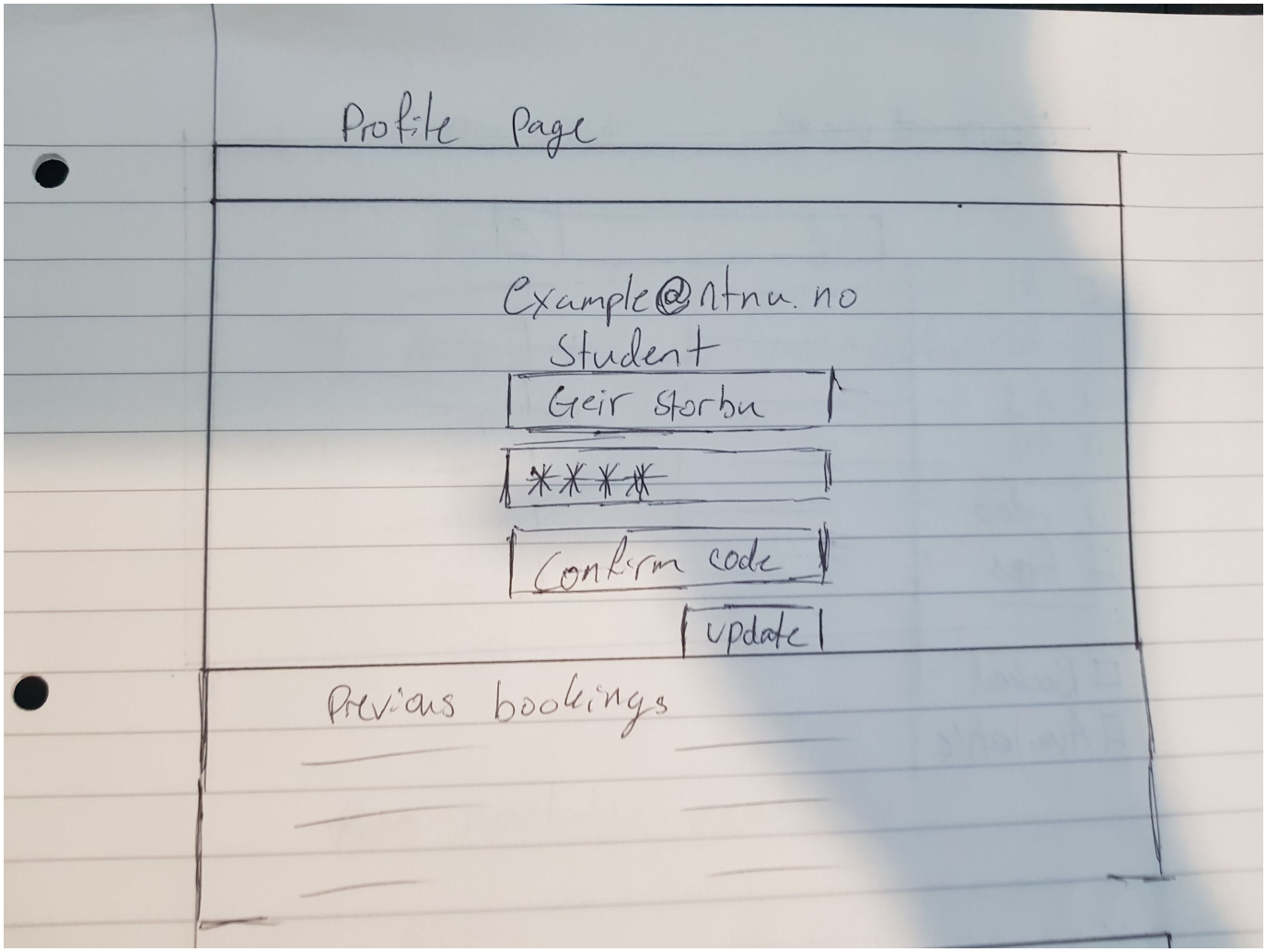
time
Booked rooms
Booked Equipments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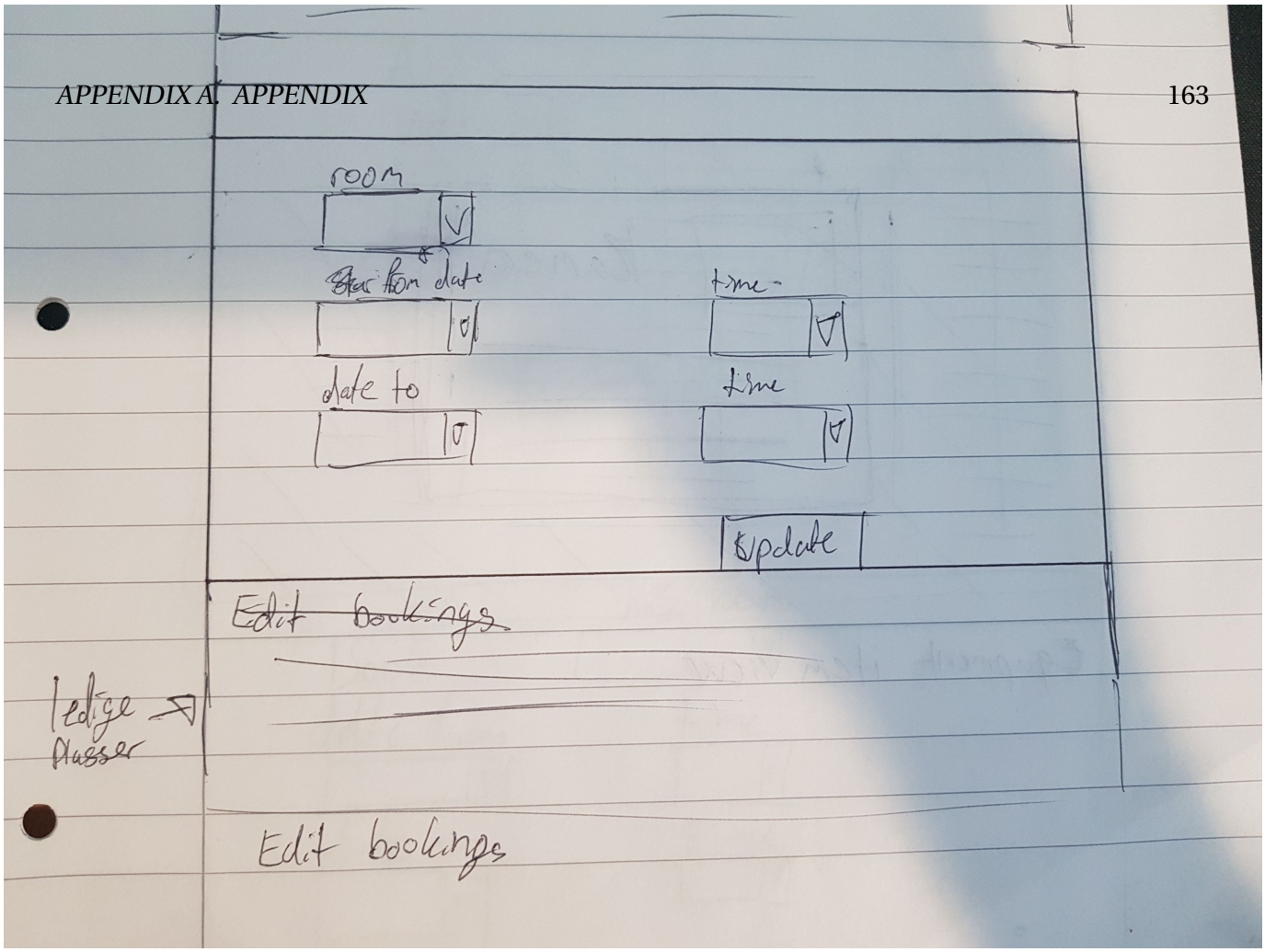
Student
Geir Storbu
****
Confirm code
update
Previous bookings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date from
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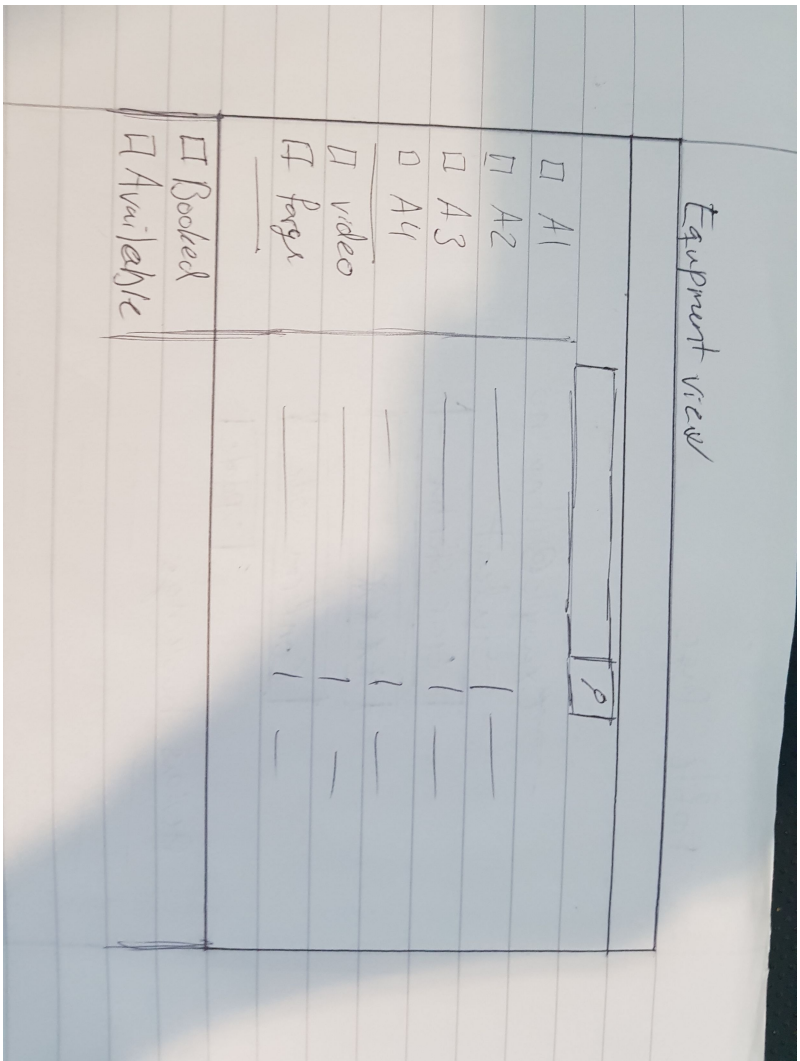
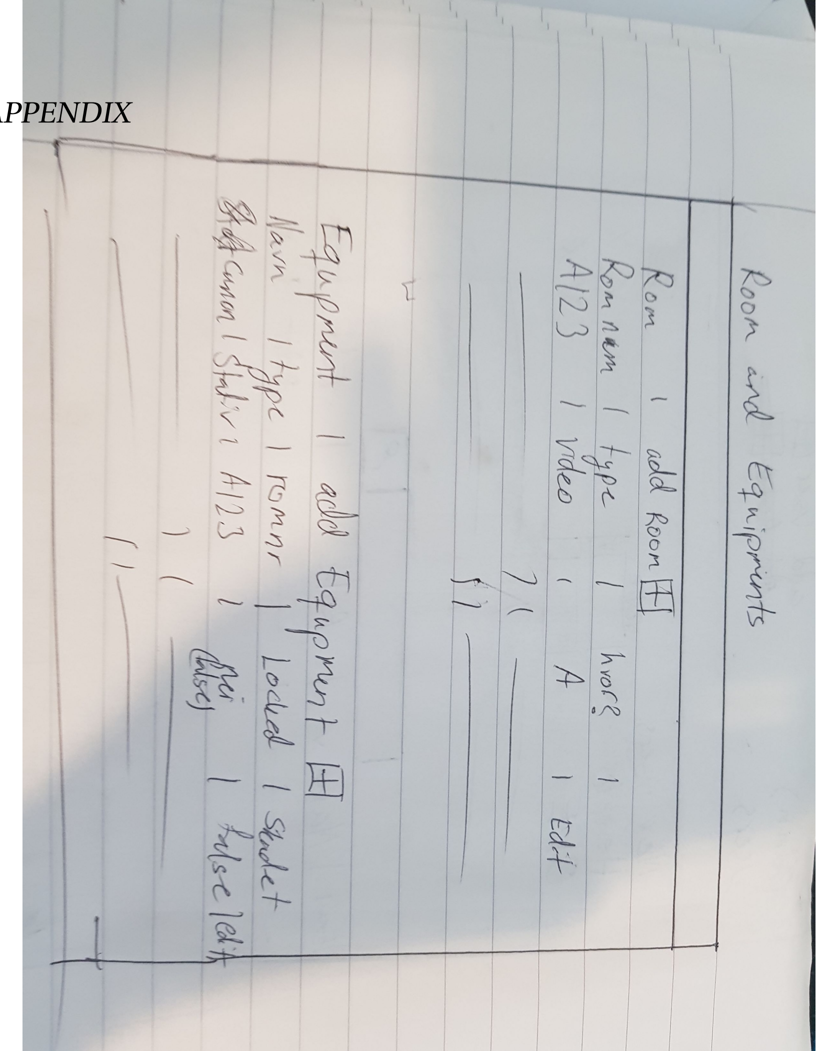

Equipment view
A1
A2
A3
A4
video
pages
Booked
Available

Equipment item view
Camera
Room view
type

Room timetable view
A123
Videolab
Book
date from
date to
time
time
book
Admin view
Quick
Handle
Rooms
Equipments
Categories
Log

(Admin)
Users
add user
New users
Henrik
OLE
role
Email | Name
Role
Edit
Edit
Approve
Approve Student bookings
Henrik | A123
Approve Student Equipment
Henrik | Kostativ | Filma | tid/dato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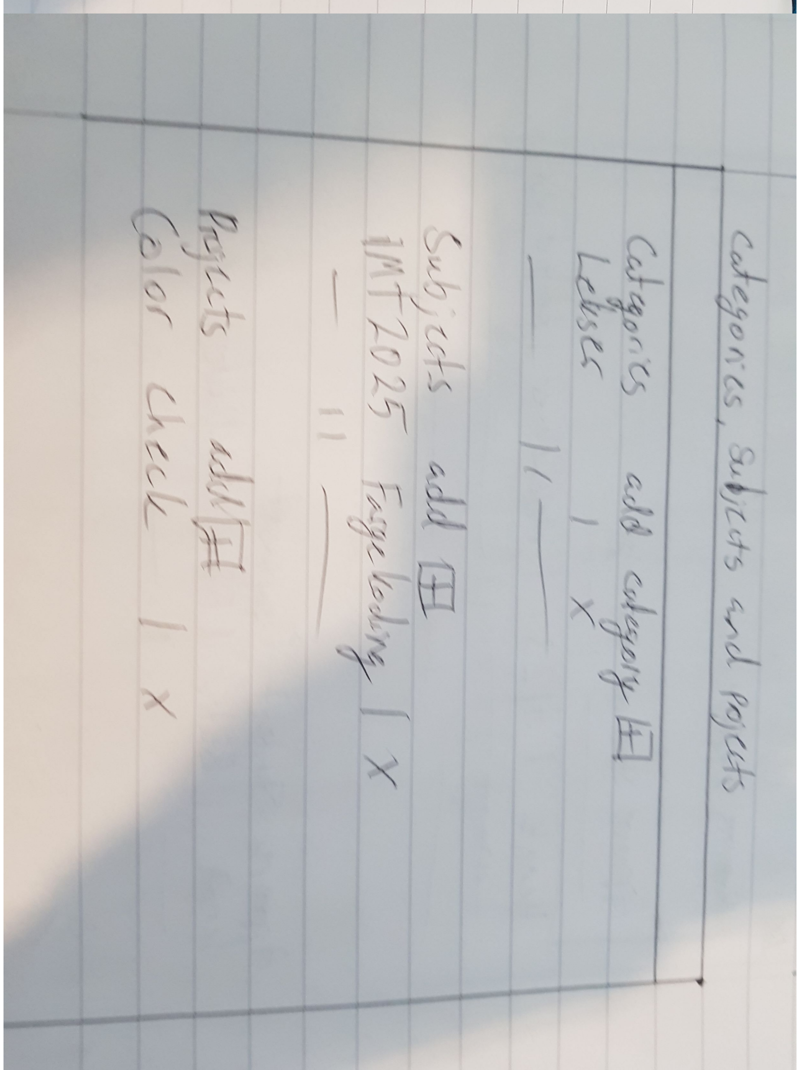
Edit
add Equipment


Categories, Subjects and Projects
Categories add category
Subjects add
Projects add
Color check

Categories, Subjects and Projects
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Labels 1 x
Subjects add ⊞
IMT2025 Focus looking [x
Projects add ⊞
Color check [x

A.12 Wireframes

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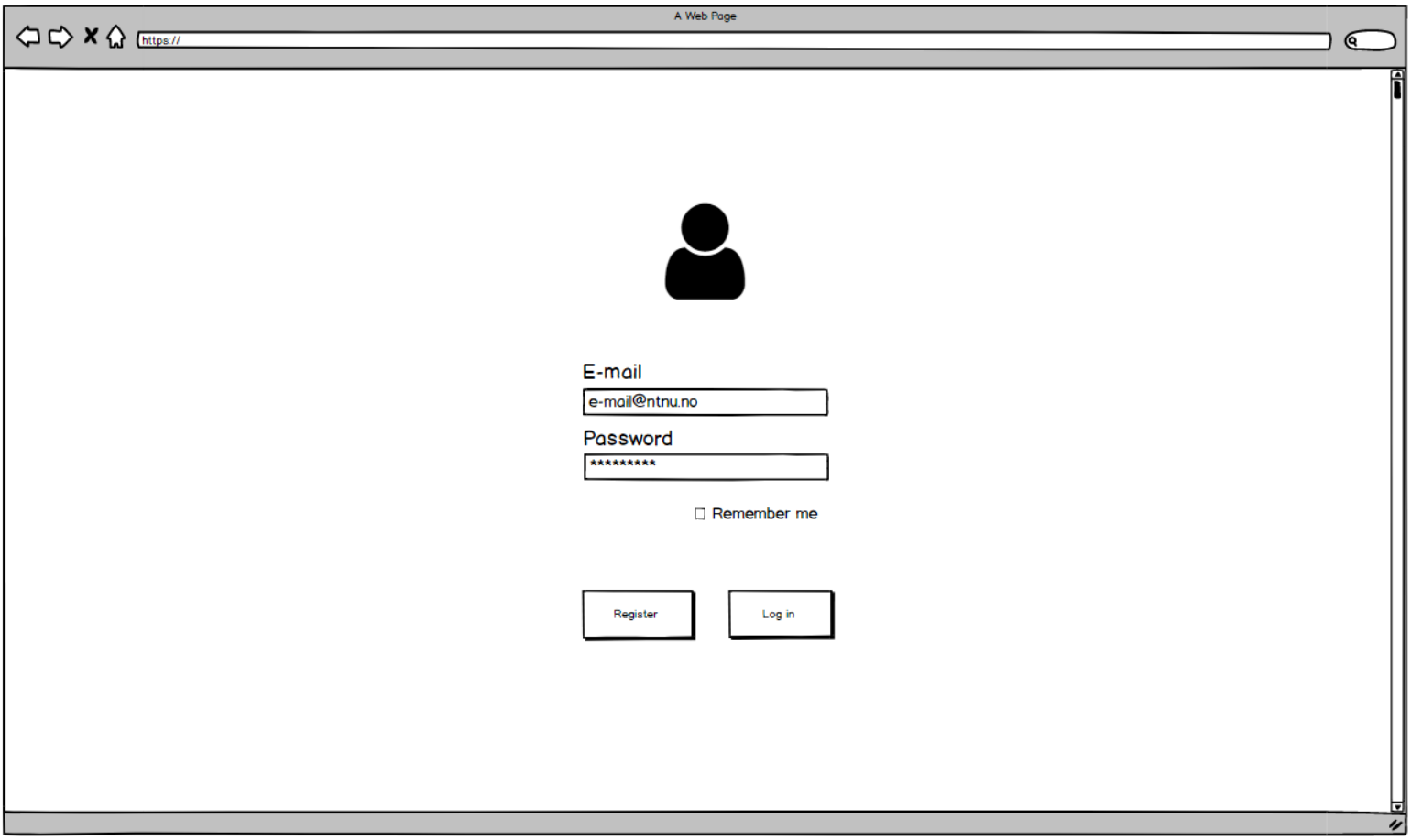


A Web Page
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E-mail
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Name
Marius Pedersen
4-digit code
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4-digit code confirm
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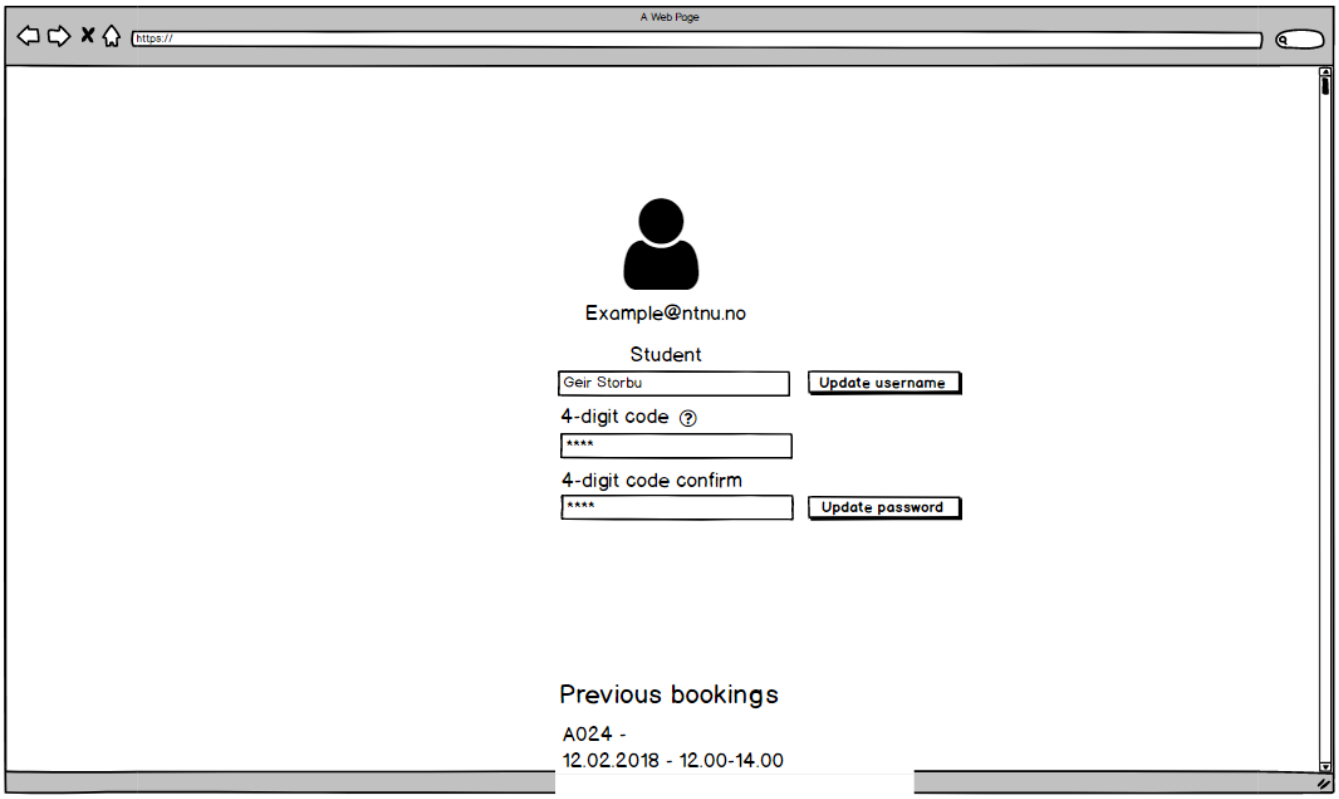
Register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https://
Example@ntnu.no
Student
Geir Storbu
Update username
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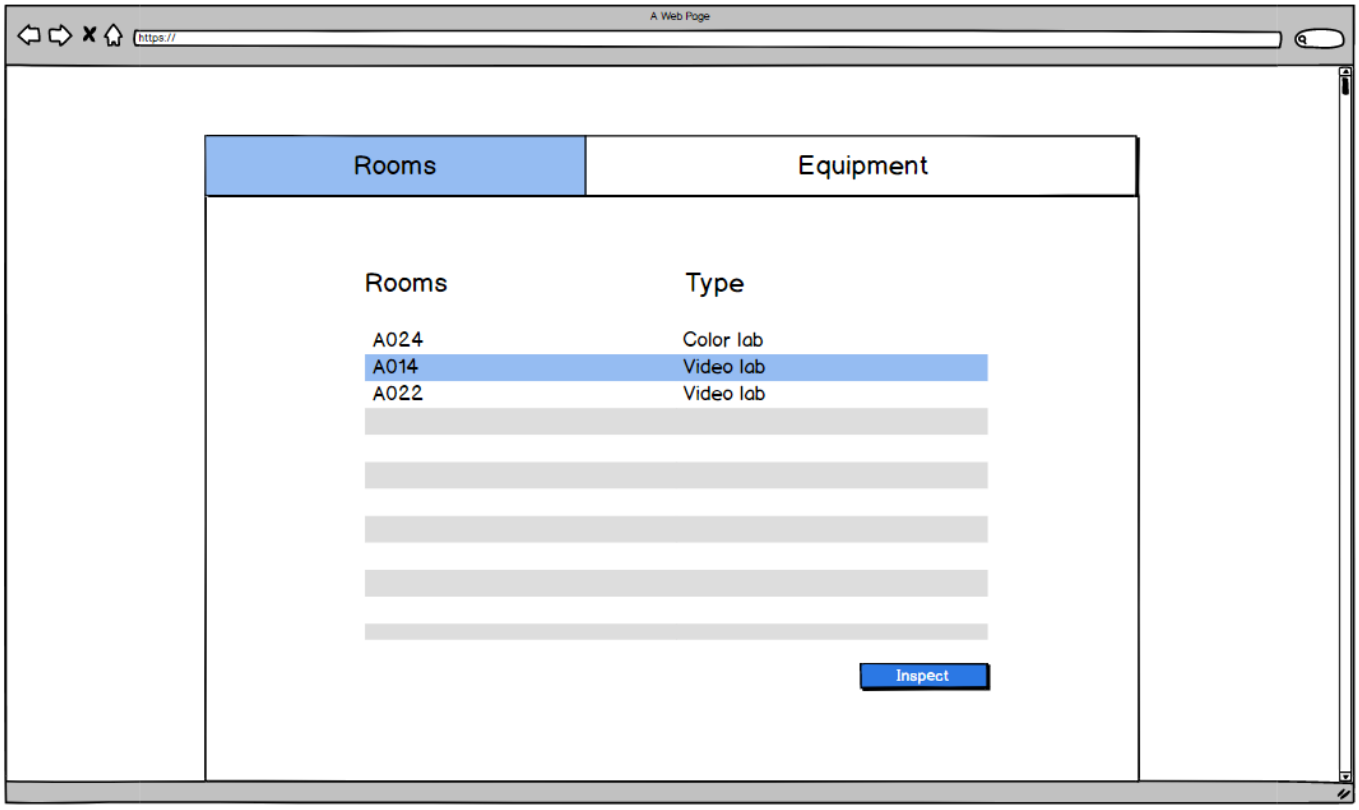
****
4-digit code confirm
****
Update password
Previous bookings
A024 -
12.02.2018 - 12.00-14.00
A014 -
14.02.2018 - 08.00-14.00
A022 -
29.03.2018 - 13.00-14.00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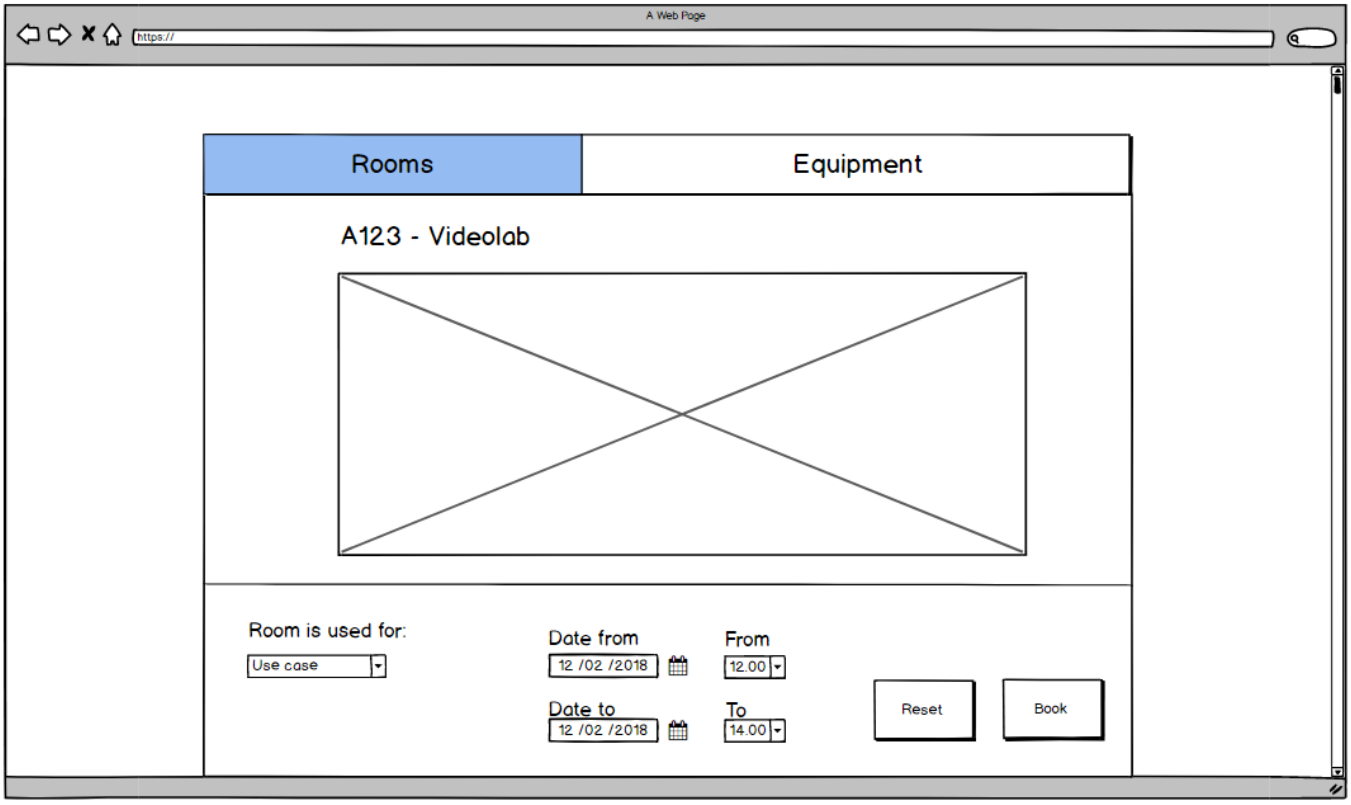
Video lab
A022
Video lab
Inspect


A Web Page
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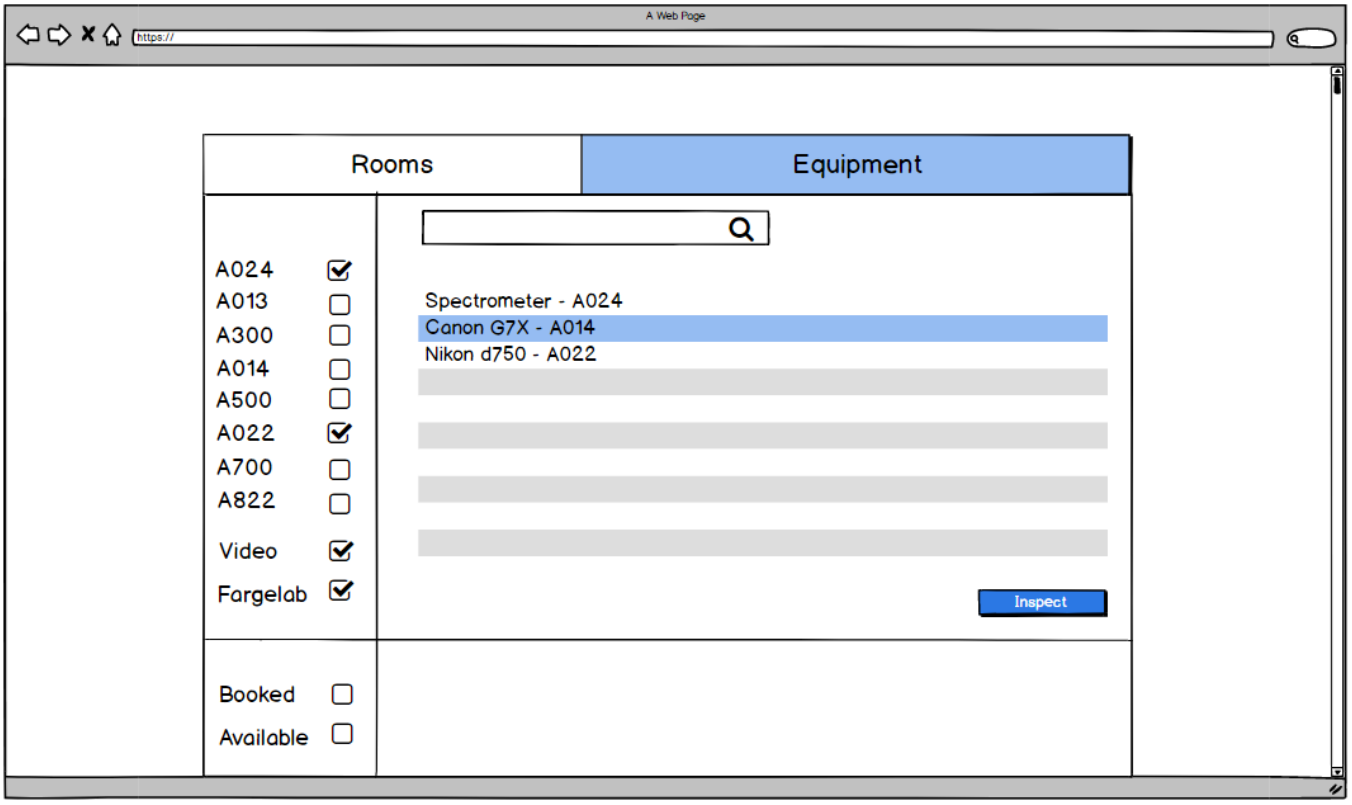
Rooms
Equipment
A123 - Videolab
Room is used for:
Use case
Date from
12 /02 /2018
From
12.00
Date to
12 /02 /2018
To
14.00
Reset
Book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Spectrometer - A024
Canon G7X - A014
Nikon d750 - A022
Inspect
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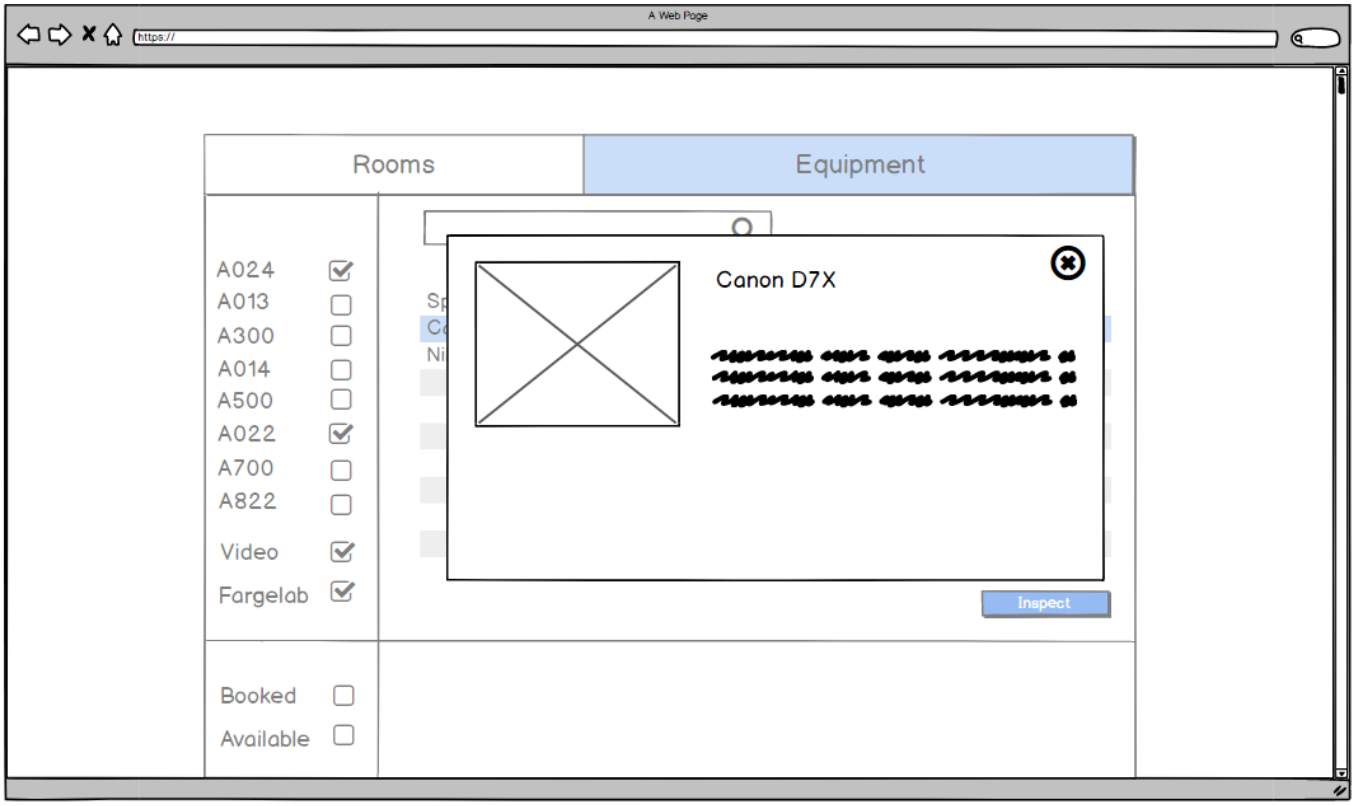
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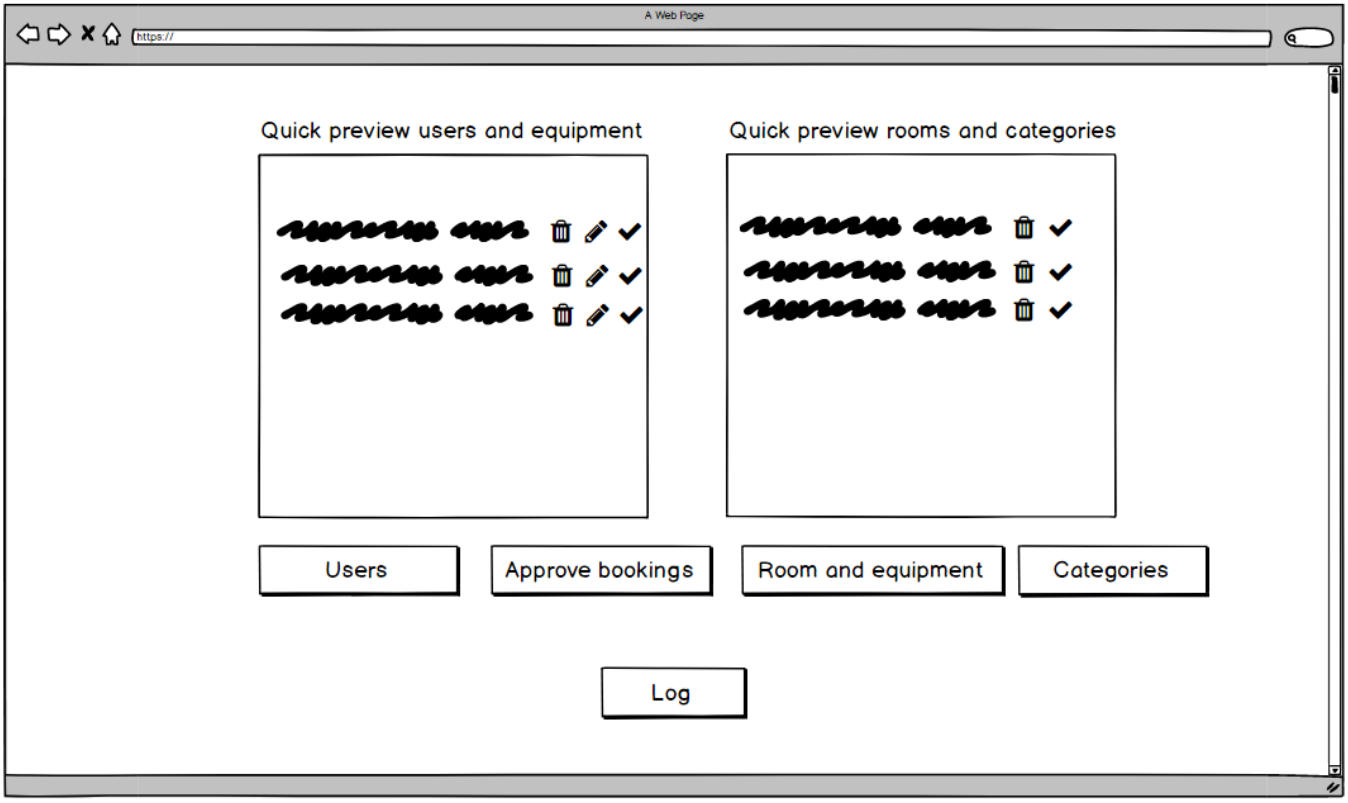
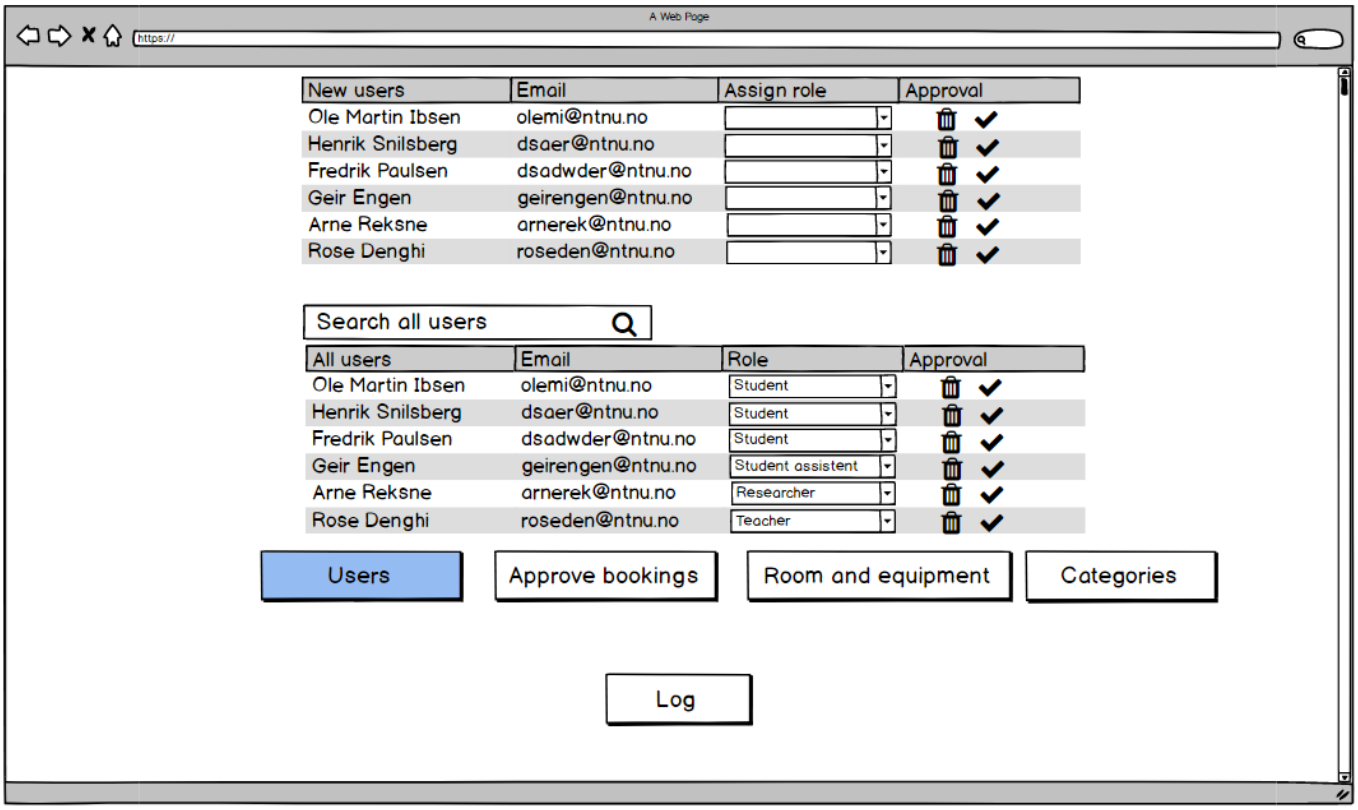

A Web Page
https://
Quick preview users and equipment
Quick preview rooms and categories
Users
Approve bookings
Room and equipment
Categories
Log


A Web Page
https://
New users
Email
Assign role
Approval
Ole Martin Ibsen olemi@ntnu.no
Henrik Snilsberg dsaer@ntnu.no
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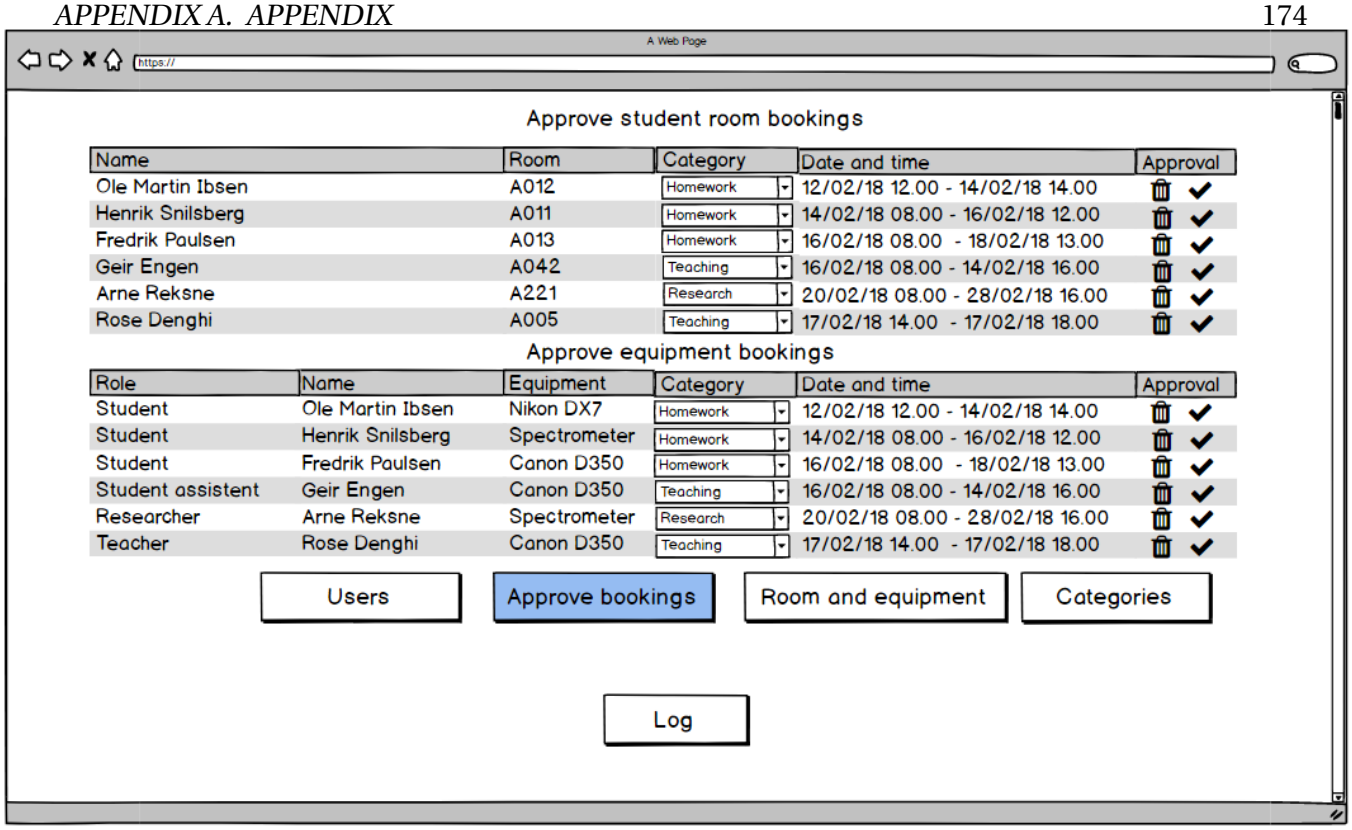
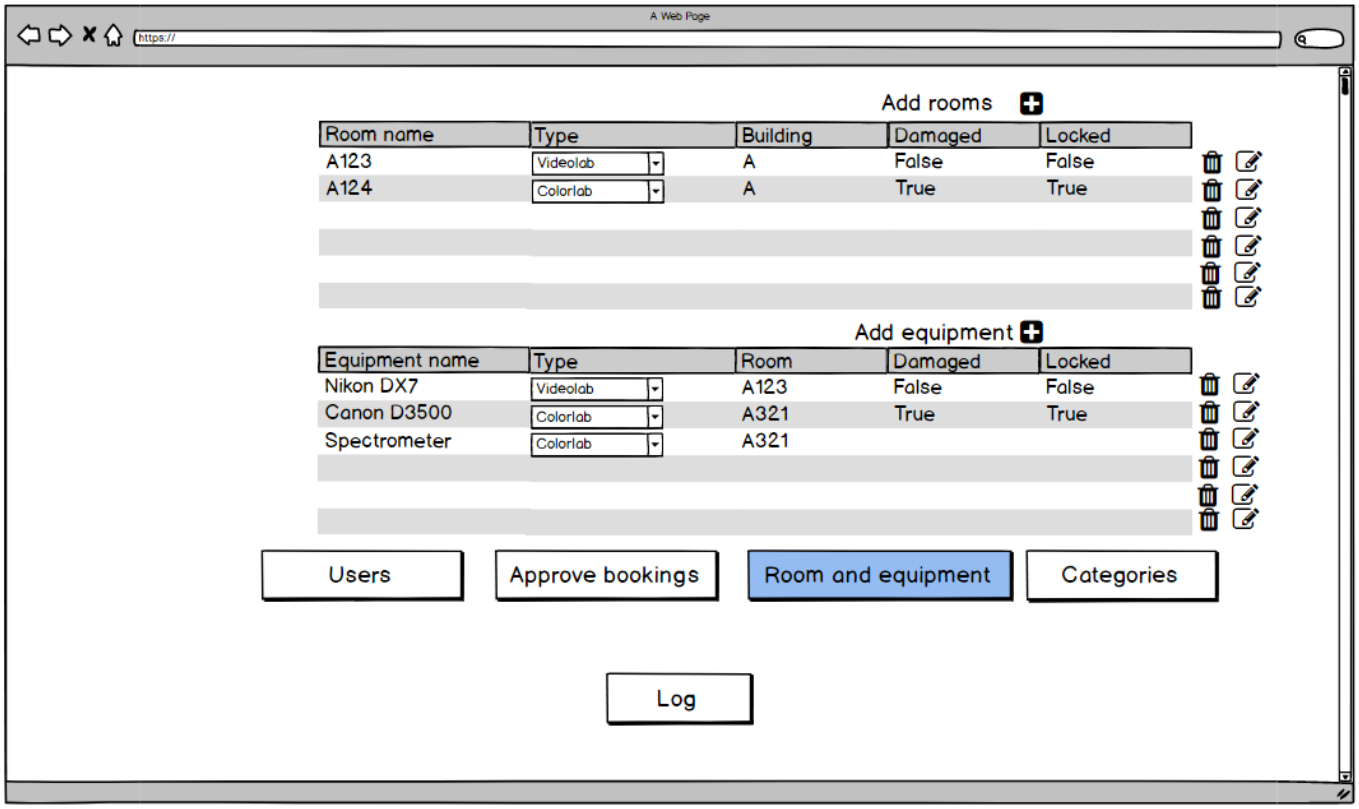
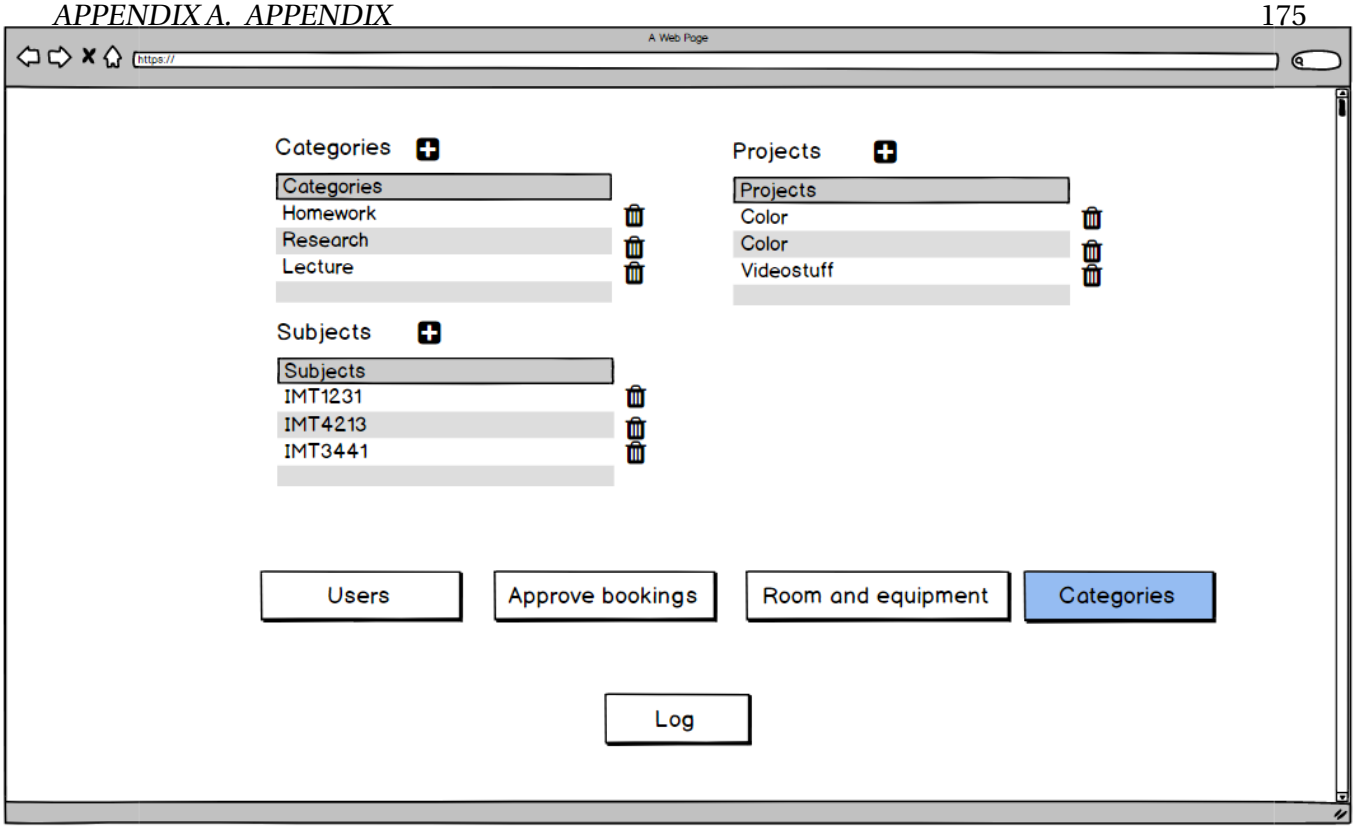
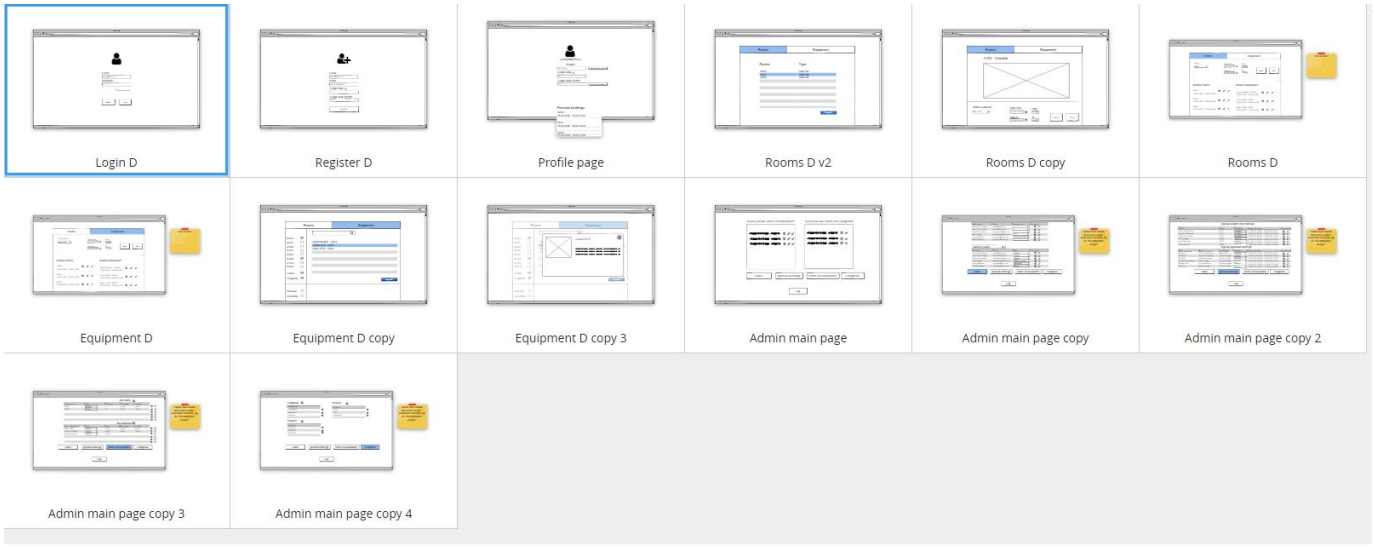
Geir Engen geirengen@ntnu.no
Arne Reksne arnerek@ntnu.no
Rose Denghi roseden@ntnu.no
Search all users
All users
Email
Role
Approval
Ole Martin Ibsen olemi@ntnu.no Student
Henrik Snilsberg dsaer@ntnu.no Student
Fredrik Paulsen dsadwder@ntnu.no Student
Geir Engen geirengen@ntnu.no Student assistent
Arne Reksne arnerek@ntnu.no Researcher
Rose Denghi roseden@ntnu.no Teacher
Users
Approve bookings
Room and equipment
Categories
Log


A Web Page
https://
Approve student room bookings
Name
Room
Category
Date and time
Approval
Ole Martin Ibsen
A012
Homework
12/02/18 12.00 - 14/02/18 14.00
Henrik Snilsberg
A011
Homework
14/02/18 08.00 - 16/02/18 12.00
Fredrik Paulsen
A013
Homework
16/02/18 08.00 - 18/02/18 13.00
Geir Engen
A042
Teaching
16/02/18 08.00 - 14/02/18 16.00
Arne Reksne
A221
Research
20/02/18 08.00 - 28/02/18 16.00
Rose Denghi
A005
Teaching
17/02/18 14.00 - 17/02/18 18.00
Approve equipment bookings
Role
Name
Equipment
Category
Date and time
Approval
Student
Ole Martin Ibsen
Nikon DX7
Homework
12/02/18 12.00 - 14/02/18 14.00
Student
Henrik Snilsberg
Spectrometer
Homework
14/02/18 08.00 - 16/02/18 12.00
Student
Fredrik Paulsen
Canon D350
Homework
16/02/18 08.00 - 18/02/18 13.00
Student assistent
Geir Engen
Canon D350
Teaching
16/02/18 08.00 - 14/02/18 16.00
Researcher
Arne Reksne
Spectrometer
Research
20/02/18 08.00 - 28/02/18 16.00
Teacher
Rose Denghi
Canon D350
Teaching
17/02/18 14.00 - 17/02/18 18.00
Users
Approve bookings
Room and equipment
Categories
Log


A Web Page
https://
Add rooms
Room name
Type
Building
Damaged
Locked
A123
Videolab
A
False
False
A124
Colorlab
A
True
True
Add equipment
Equipment name
Type
Room
Damaged
Locked
Nikon DX7
Videolab
A123
False
False
Canon D3500
Colorlab
A321
True
True
Spectrometer
Colorlab
A321
Users
Approve bookings
Room and equipment
Categories
Log


A Web Page
https://
Categories
Categories
Homework
Research
Lecture
Projects
Projects
Color
Color
Videostuff
Subjects
Subjects
IMT1231
IMT4213
IMT3441
Users
Approve bookings
Room and equipment
Categories
Log


Login D
Register D
Profile page
Rooms D v2
Rooms D copy
Rooms D
Equipment D
Equipment D copy
Equipment D copy 3
Admin main page
Admin main page copy
Admin main page copy 2
Admin main page copy 3
Admin main page copy 4

A.13 Early prototype

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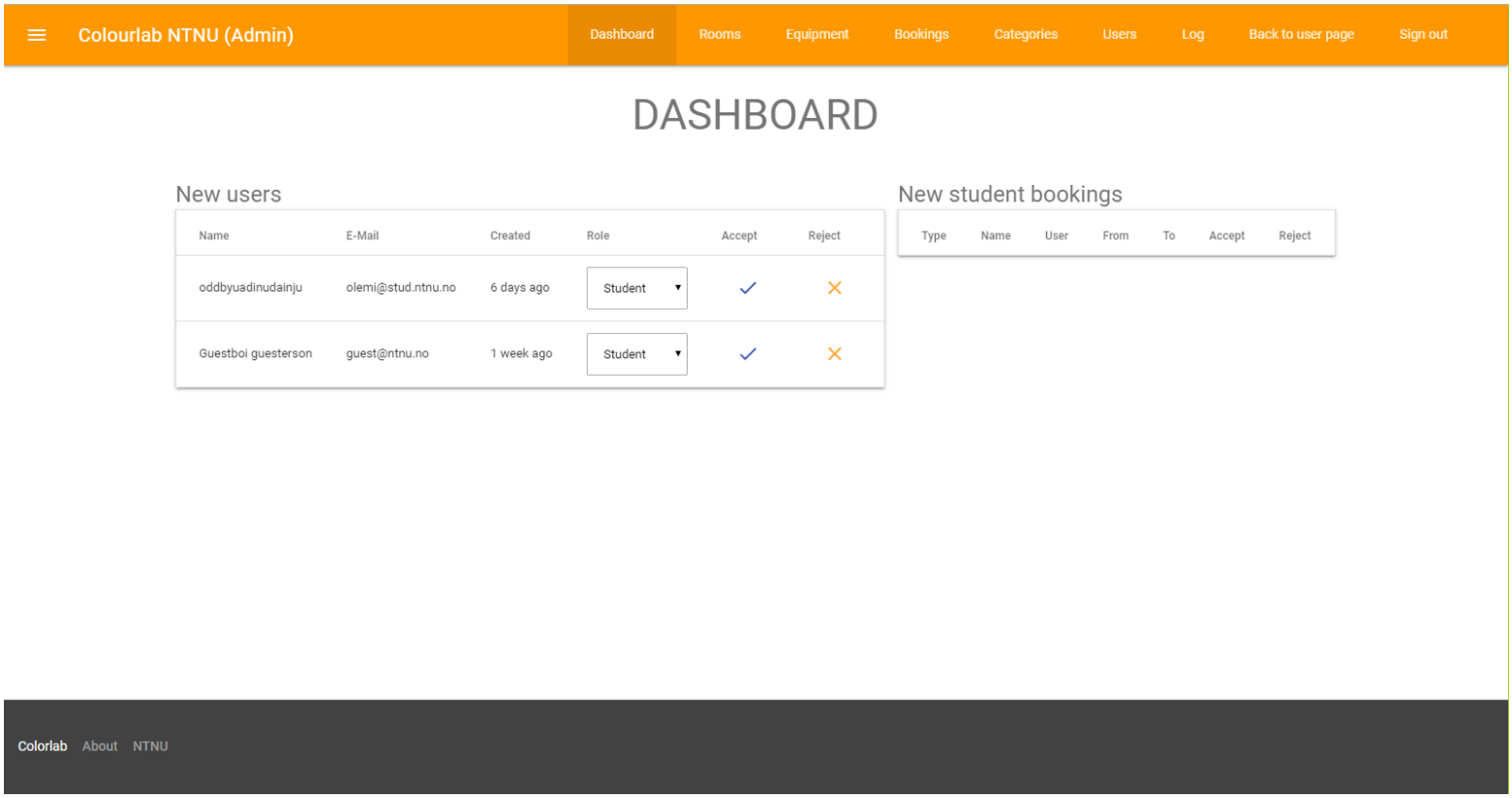
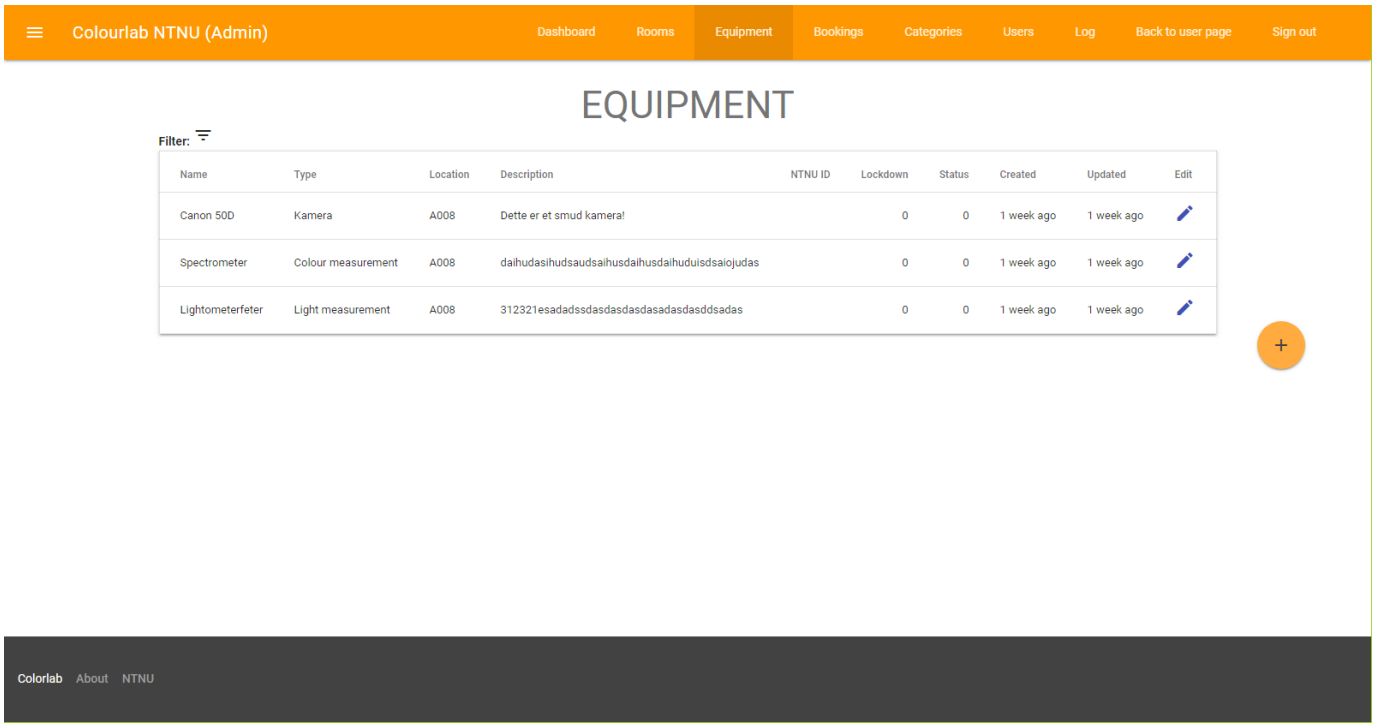
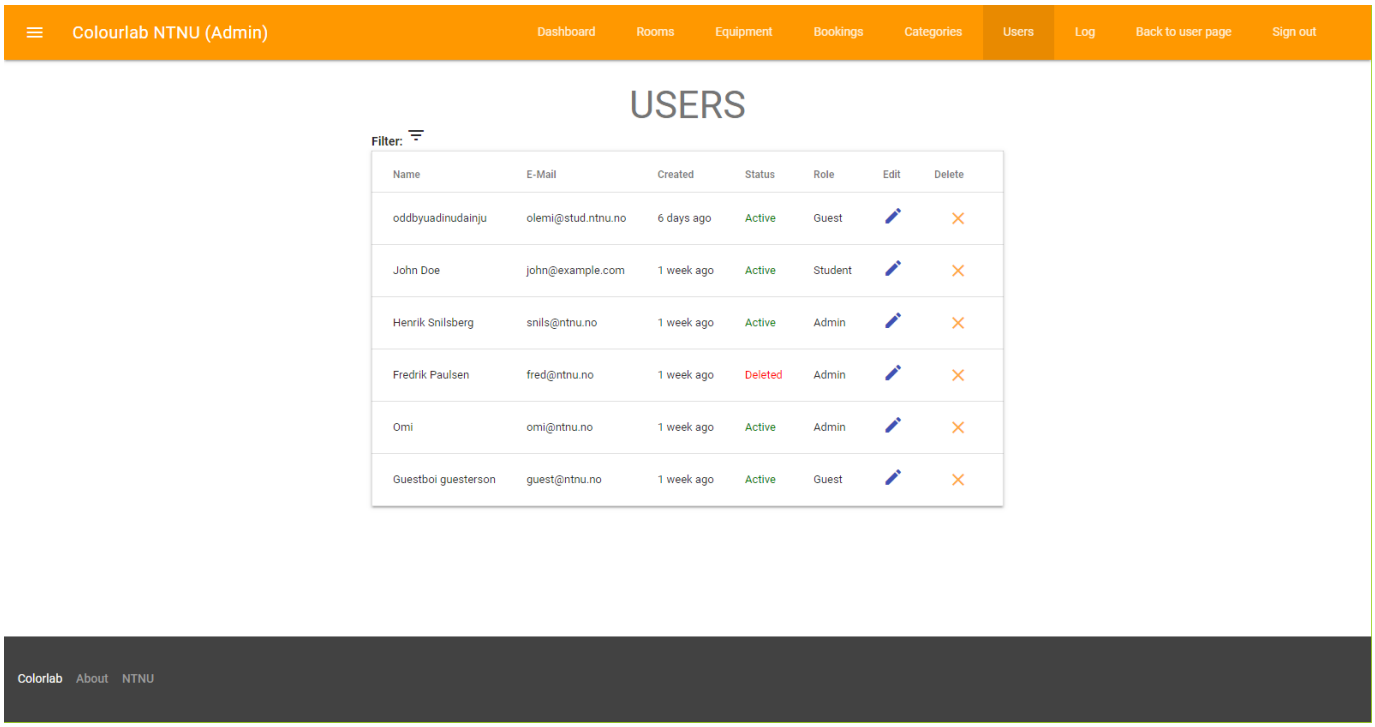
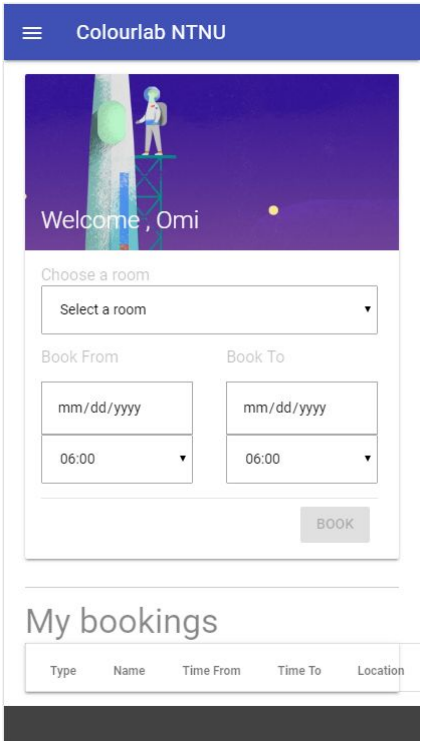
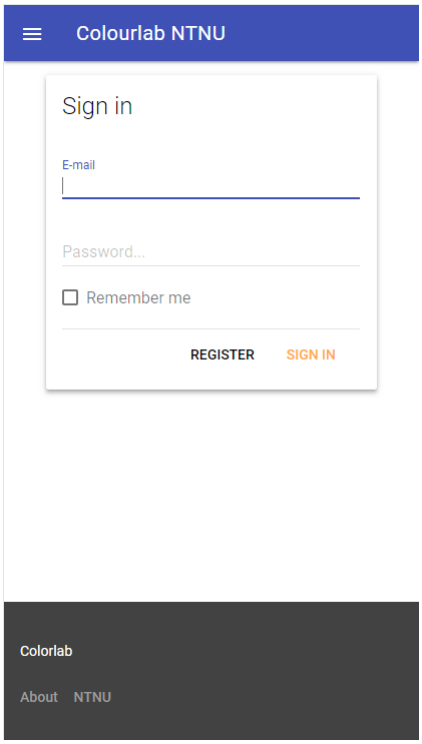
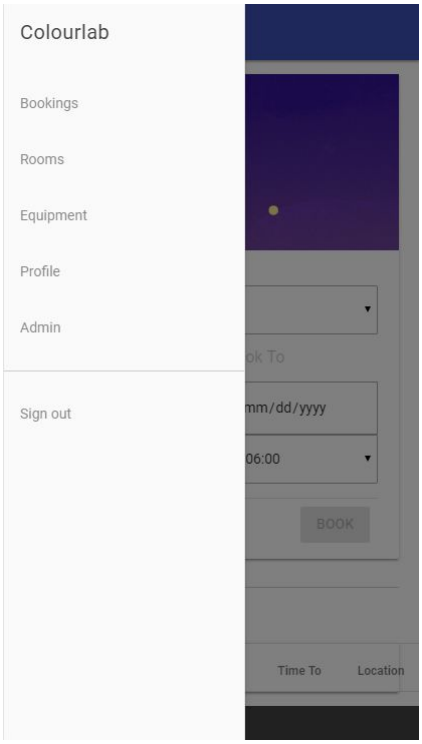


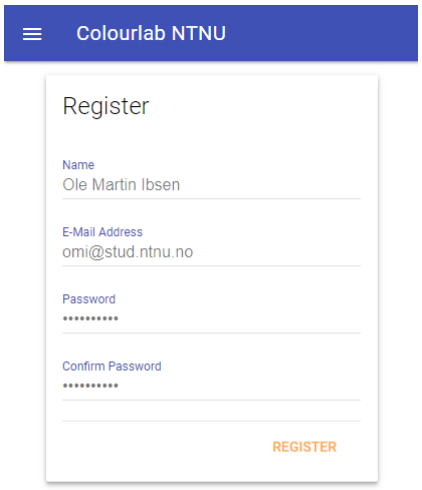

Colourlab NTNU (Admin)
Dashboard
Rooms
Equipment
Bookings
Categories
Users
Log
Back to user page
Sign out
EQUIPMENT
Filter:
Name
Type
Location
Description
NTNU ID
Lockdown
Status
Created
Updated
Edit
Canon 50D
Kamera
A008
Dette er et smud kamera!
0
0
1 week ago
1 week ago
Spectrometer
Colour measurement
A008
daihudasihudsaudsaihusdaihusdaihuduisdsaiojudas
0
0
1 week ago
1 week ago
Lightometerfeter
Light measurement
A008
312321esadadssdasdasdasdasadasdasddsadas
0
0
1 week ago
1 week ago
Colorlab
About
NTNU


Colourlab NTNU (Admin)
Dashboard
Rooms
Equipment
Bookings
Categories
Users
Log
Back to user page
Sign out
USERS
Filter:
Name
E-Mail
Created
Status
Role
Edit
Delete
oddbyuadinudainju
olemi@stud.ntnu.no
6 days ago
Active
Guest
John Doe
john@example.com
1 week ago
Active
Student
Henrik Snilsberg
snils@ntnu.no
1 week ago
Active
Admin
Fredrik Paulsen
fred@ntnu.no
1 week ago
Deleted
Admin
Omi
omi@ntnu.no
1 week ago
Active
Admin
Guestboi guesterson
guest@ntnu.no
1 week ago
Active
Guest
Colorlab
About
NTNU


Colourlab NTNU
Welcome , Omi
Choose a room
Select a room
Book From
Book To
mm/dd/yyyy
mm/dd/yyyy
06:00
06:00
BOOK
My bookings
Type
Name
Time From
Time To
Location


Colourlab NTNU
Sign in
E-mail
Password...
Remember me
REGISTER
SIGN IN
Colorlab
About
NTNU


Colourlab
Bookings
Rooms
Equipment
Profile
Admin
Sign out
mm/dd/yyyy
06:00
BOOK
Time To
Location


Colourlab NTNU
Register
Name
Ole Martin Ibsen
E-Mail Address
omi@stud.ntnu.no
Password
Confirm Password
REGISTER


Colorlab
About
NTNU

A.14 Time used

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Date	From	To	Hours	Description	Attendance	Number of people	Total time per day	Total time spent
10/1/2018	11:15	15:00	3:45:00	"Lynkurs" and discussion project plan start	All	3	11:15:00	824:14:00
12/1/2018	13:55	17:30	3:35:00	Meeting with Carlos (supervisor) , creating questions for employer-interview, Project plan work	All	3	10:45:00	
17/1/2018	9:30	15:00	5:30:00	Interview with Marius the "employer", discussion, and work on project proposal.	All	3	16:30:00	avg Time per pers
19/1/2018	14:00	15:30	1:30:00	Meeting with Carlos	All	3	4:30:00	274:44:40
22/1/2018	9:00	15:00	6:00:00	Project Proposal	All	3	18:00:00	
23/1/2018	10:00	13:15	3:15:00	Project Proposal, Gantt-chart	All	3	9:45:00	Work
24/1/2018	13:00	16:00	3:00:00	Project proposal work, feedback from Carlos	All	3	9:00:00	Supervisor meeting
25/1/2018	14:00	18:00	4:00:00	Project proposal work.	All	3	12:00:00	Employer meeting
29/1/2018	14:30	18:30	4:00:00	Perfect project proposal, updating GANTT-chart	All	3	12:00:00	Skiday
30/1/2018	13:00	14:00	1:00:00	A few minor changes to project proposal	All	3	3:00:00	
31/1/2018	9:30	10:00	0:30:00	Meeting with Marius (Project owner)	Fredrik	1	0:30:00	
31/1/2018	18:30	19:30	1:00:00	Finishing project proposal, and handing in	All	3	3:00:00	
2/2/2018	14:30	18:00	3:30:00	Research on existing/similar solutions	All	3	10:30:00	
5/2/2018	10:00	15:00	5:00:00	Sketches, discussion, wireframes	All	3	15:00:00	
6/2/2018	10:00	16:00	6:00:00	Wireframes and sitemap	All	3	18:00:00	
7/2/2018	10:00	12:00	2:00:00	EER model and relational model	All	3	6:00:00	
9/2/2018	12:30	16:30	4:00:00	Meeting with Carlos and other stuff	All	3	12:00:00	
12/2/2018	15:00	18:00	3:00:00	Research on plugins for calendar, mobile sketches, discussion	All	3	9:00:00	
13/2/2018	13:00	16:00	3:00:00	Research on material design, and how to implement, GetMDL.io	Henrik & Ole	2	6:00:00	
14/2/2018	9:00	13:00	4:00:00	Meeting with Marius (Project owner)	All	3	12:00:00	
19/2/2018	10:00	15:00	5:00:00	Affinity Diagramming and personas	All	3	15:00:00	
20/2/2018	10:30	14:30	4:00:00	Work on design template / moodboard	All	3	12:00:00	
21/2/2018	10:00	11:00	1:00:00	Meeting with Marius	All	3	3:00:00	
21/2/2018	11:00	15:00	4:00:00	Work on moodboard, and report writing seminar	All	3	12:00:00	
22/2/2018			0:00:00	Everyone was at Hafjell skiday :)	All		0:00:00	
27/2/2018	19:00	23:00	4:00:00	Setup Laravel	Henrik	1	4:00:00	
28/2/2018	10:30	15:00	4:30:00	Work on setting up, and getting the basic up and working	All	3	13:30:00	
2/3/2018	10:30	13:45	3:15:00	More coding, working on database	Henrik & Fredrik	2	6:30:00	
2/3/2018	14:00	15:00	1:00:00	Meeting with carlos	Henrik & Fredrik	2	2:00:00	
5/3/2018	10:00	17:30	7:30:00	More coding, working on database and making login etc	All	3	22:30:00	
7/3/2018	10:00	13:00	3:00:00	More coding, working on database and admin panel etc	Henrik & Fredrik	2	6:00:00	
7/3/2018	13:00	17:00	4:00:00	More coding, working on database and admin panel etc, pluss report	All	3	12:00:00	
9/3/2018	10:00	12:00	2:00:00	More doing work	All	3	6:00:00	
9/3/2018	14:00	15:00	1:00:00	Meeting with Carlos	All	3	3:00:00	
12/3/2018	10:00	16:00	6:00:00	Coding, working on admin page and mail verification	All	3	18:00:00	
14/3/2018	10:00	17:30	7:30:00	Coding, and style changes plus new bookings tables	All	3	22:30:00	
19/3/2018	10:00	16:00	6:00:00	Starting new sprint, and bookings	All	3	18:00:00	
22/3/2018	10:00	16:00	6:00:00	More booking and functionality	All	3	18:00:00	
26/3/2018	10:00	17:00	7:00:00	More booking and functionality, plus testing Materializecss	All	3	21:00:00	
27/3/2018	11:45	16:15	4:30:00	More booking work, and admin edit/create equipment	Henrik	1	4:30:00	
28/3/2018	10:00	16:00	6:00:00	Design, fixing stuff, more functionality and mail things	All	3	18:00:00	
28/3/2018	17:20	19:00	1:40:00	A few extra changes, and some GitHub/ZenHub work	Henrik	1	1:40:00	
4/4/2018	10:00	11:00	1:00:00	Meeting with Marius the employer	All	3	3:00:00	
9/4/2018	0:00	10:00	10:00:00	Finishing bookings to not allow overlaps	Henrik	1	10:00:00	
9/4/2018	11:00	17:45	6:45:00	Footer work, made site for categories and other fixes	Ole & Fredrik	2	13:30:00	
10/4/2018	3:30	6:00	2:30:00	Added categories to booking ++	Henrik	1	2:30:00	
13/4/2018	10:00	14:00	4:00:00	Filtering on tables ++	Henrik	1	4:00:00	
13/4/2018	14:00	15:00	1:00:00	Meeting with Carlos	All	3	3:00:00	
16/4/2018	10:00	16:30	6:30:00	Sorting on tables, visual feedback when selecting dates/time on booking, create/edit categories, report writing	All	3	19:30:00	
16/4/2018	16:30	18:00	1:30:00	Last touches on categories	Fredrik	1	1:30:00	
19/4/2018	14:30	16:00	1:30:00	Trying to make tables more responsive	Henrik	1	1:30:00	
20/4/2018	14:00	15:15	1:15:00	Meeting with Carlos about report	Henrik	1	1:15:00	
23/4/2018	11:00	15:00	4:00:00	Visual work for log (graph) and report	Ole & Fredrik	2	8:00:00	
23/4/2018	15:00	17:00	2:00:00	More graphs, starting base for fetching info for graphs	Fredrik	1	2:00:00	
23/4/2018	15:30	18:00	2:30:00	Several bug fixes and other QOL fixes	Henrik	1	2:30:00	
23/4/2018	22:30	23:59	1:29:00	Fixes to structure, and filling piecharts with real information	Henrik	1	1:29:00	
24/4/2018	2:00	9:20	7:20:00	Creating log pages	Henrik	1	7:20:00	
25/4/2018	10:00	11:15	1:15:00	Meeting with Marius, testing, final feedback, he liked everything	All	3	3:45:00	
27/4/2018	14:00	15:00	1:00:00	Meeting with Carlos about report and scheduling the writing	Ole & Fredrik	2	2:00:00	
27/4/2018	15:00	18:00	3:00:00	Finishing logs, fixing all booking bugs	Henrik	1	3:00:00	
27/4/2018	18:00	20:00	2:00:00	Report writing, rearranging structure, fixes to language/formulation	Ole	1	2:00:00	
28/4/2018	12:00	16:00	4:00:00	Report writing, sprint results, research/similar solutions, figures	Ole	1	4:00:00	
30/4/2018	8:15	14:00	5:45:00	Report writing chapter 1-3	Henrik & Fredrik	2	11:30:00	
30/4/2018	14:00	15:10	1:10:00	Report writing chapter 1-3	All	3	3:30:00	
30/4/2018	15:10	17:00	1:50:00	Report writing chapter 1-3	Ole & Fredrik	2	3:40:00	
7/5/2018	3:00	11:00	8:00:00	Web stuff	Henrik	1	8:00:00	
8/5/2018	18:00	22:00	4:00:00	Report writing	Fredrik	1	4:00:00	
9/5/2018	6:00	10:30	4:30:00	Report writing	Henrik	1	4:30:00	
9/5/2018	11:00	13:00	2:00:00	Meeting with supervisor Carlos	All	3	6:00:00	
9/5/2018	20:00	2:00	6:00:00	Report writing	Fredrik	1	6:00:00	
10/5/2018	10:00	18:30	8:30:00	Report writing	All	3	25:30:00	
10/5/2018	20:00	0:00	4:00:00	Report writing	Fredrik	1	4:00:00	
11/5/2018	11:00	13:30	2:30:00	Report writing	Henrik & Fredrik	2	5:00:00	
11/5/2018	13:30	15:20	1:50:00	Report writing	Henrik	1	1:50:00	
11/5/2018	15:30	0:00	8:30:00	Report writing	All	3	25:30:00	
11/5/2018	12:00	15:00	3:00:00	Report writing	Fredrik	1	3:00:00	
12/5/2018	15:00	0:00	9:00:00	Report writing	All	3	27:00:00	
13/5/2018	1:00	2:00	1:00:00	Report writing	Ole	1	1:00:00	
13/5/2018	11:00	14:00	3:00:00	Report writing	Fredrik	1	3:00:00	
13/5/2018	14:00	16:00	2:00:00	Report writing	Ole & Fredrik	2	4:00:00	
13/5/2018	16:00	24:00:00	8:00:00	Report writing	All	3	24:00:00	
14/5/2018	0:00	2:00	2:00:00	Report writing	Henrik & Fredrik	2	4:00:00	
14/5/2018	12:00	24:00:00	12:00:00	Report writing	All	3	36:00:00	
15/5/2018	0:00	2:00	2:00:00	Report writing	All	3	6:00:00	
15/5/2018	11:00	13:00	2:00:00	Meeting with Carlos last revisions	All	3	6:00:00	

15/5/2018	13:00	24:00:00	11:00:00	Report writing	All	3	33:00:00
16/5/2018	0:00	11:30	11:30:00	Report polish and delivery	All	3	34:30:00