UNIVERSITY OF OSLO
Department of Informatics

Inclusive identity management

A case study investigating the accessibility of user registration

Master thesis

Øyvind Nordseth Pettersen

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Abstract

The emerging research field *inclusive identity management* (IIDM) addresses one of the most critical issues of the Internet today. The challenges related to the accessibility of user registration and identity management are many and in order to use the services provided by Facebook, users must first be registered and authenticated. These mechanisms must therefore be accessible for a broad range of users.

The primary objective of this thesis has been to contribute with valuable research on accessibility challenges in social media, and this thesis is a part of creating a pool of knowledge that addresses the challenges related to accessibility- and inclusion issues in identity management. The thesis has also had the objective of examining and comparing three evaluation methods and the outcome of these, as well as clearing up the relationship between usability and accessibility.

The first research question deals with exactly these two terms - usability and accessibility and the relation between them. A review and a comparison of three academic articles that discuss this problem has been made, and I argue that the most complete way to look at this relationship is to look at the terms and their respective fields' problems as two intersecting sets.

The second research question is focused on the challenges that visually impaired users experience when registering on Facebook. Challenges that this thesis unveils include great defects when it comes to *technical accessibility*, even though these technical flaws were observed to have less influence on the user experience than expected. In addition, I argue that use of newer and dynamic technology give assistive technology users problems, as well as CAPTCHA not being an accessible solution for the visually impaired.

The final and third research question is about different evaluation methods and their outcome and validity. The findings provide valuable insight on these evaluation types and how their outcome and validity varies. I argue that there is a big gap in the outcome of evaluation with and without users involved and a combination of evaluation methods is suggested, in order to get as valid results as possible.

These findings is interesting for the field of universal design and inclusive identity management, as registration processes such as this are seldom studied with an accessibility perspective. My research has also lead to thorough and extensive results on accessibility evaluation methods, which can be used in future universal design studies.

Keywords: Inclusive identity management, Universal design, Accessibility, Evaluation, Interaction design, Usability, Social media

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At last I want to dedicate this thesis to my dear mother, who passed away in March 2011. I will never forget you.

University of Oslo, *Øyvind Nordseth Pettersen*
May 2011

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Chapter 1

Introduction

We are currently experiencing the emergence of a new arena for social participation, namely social networking sites. Use of Facebook, Twitter and LinkedIn has already made a strong impact on the way we use the Internet, as well as on the society, and there are currently no signals that this impact and development will stop in the years to come. As the number of users grow by each minute, the usability and accessibility of user registration and identity management[1] are becoming increasingly important and essential.

While this development continues, many challenges emerge, and it is becoming clear that the use of these sites is not as easy for everyone. Even though research point out that low usability in identity management systems has been found to be a major problem source (Braz and Robert, 2006; Dhamija and Dusseault, 2008), the user-group that often experiences the most problems mainly contain users with different (dis)abilities. It is a well-known fact that people with disabilities often experience insurmountable obstacles when trying to use social networking sites such as Facebook. The quote below, which is extracted from a survey[2] that the research project Nettborger held in 2010 concerning disabled people and use of social media, gives an example of how essential the social aspects of social media can be for people with disabilities:

> "[...] Facebook, Twitter and other social media give me many opportunities: The ability to update on what other people I know are doing; the ability to communicate with others, even if I am not able to get out of the house, or am unable to talk on the phone; the ability to have social contact on hold, and answer when I am in good enough form; the ability to share information, events, news, etc. that I

[1] Refers to techniques for organizing the identity of a user in order to grant access or authorize execution of a given task. This is further explained in section 2.2.2.

[2] The survey is available on http://medialt.no/pub/info_pdf/status_social_media_2010_english.pdf

> find, and discuss in relation to this; to be introduced by friends to others who have similar interests as myself; the ability to differentiate regarding what I communicate to whom, through Friends lists, groups, locked status, etc. [...]
>
> Without social media and the Internet, I would not have managed to acquire knowledge about my own illness, and learned from the experiences of others so that I can manage myself, and receive advice on treatments and strategies that can make me better. The social aspect is very important for those who, like me, are housebound and sometimes bedbound and would have been at a minimum level without social media!" Person with ME in the survey held by Nettborger, (Tollefsen et al., 2010).

This thesis is associated with two independent research projects, named e-Me and the already mentioned Nettborger. I will provide a description of these two projects in chapter 4, which deals with the case in this thesis and the part of the real world I focus on. The overall objectives of this thesis are to provide new knowledge of the accessibility of user registration and identity management on Facebook, and to identify key accessibility challenges in the user registration process. The thesis also has the objective of examining and comparing various evaluation methods and the outcome of these. This is valuable, because more often than not, the first hurdles users with disabilities encounter when trying to use social networking sites are related to registration and identity management (Meiselwitz and Lazar, 2009).

In the next sections I will elaborate on my motivation for working with the field that I have, I will give an account of the research questions that my thesis deals with, as well as explaining the delimitations my work has had. Finally I provide an overview of the chapters that follow.

1.1 Motivation

I decided early that I wanted to write my thesis in the field of human-computer interaction (HCI). The fact that it combines the two entities "man" and "machine" through the interesting disciplines of informatics and psychology, has made it easy for me to be passionate about this field. I first discovered HCI when I attended the psychology-course "Human-Technology interaction" at the University of Oslo. In the middle of the swarm of mandatory reading was one specific book that really caught my eye, and this was Donald Norman's book "The Design of Everyday Things". As I read, I started to get more and more interested in usability, which really spurred my attention towards the field of HCI and interaction design.

I have been involved with two research projects, while writing this thesis. The e-Me project, which has the objective of studying the emerging research field of *inclusive identity management*

made me become aware of this research field, which suits my interests perfectly. In addition, the project Nettborger, and the company MediaLT has been really inspirational and we have had overlapping interests throughout the period. The privilege of being a part of advancing knowledge in this important field and to be a part of big projects such as e-Me and Nettborger has been a motivation in itself. The quote below is also extracted from the mentioned survey that Nettborger held. It gives some insight in how social media can provide great added value in relation to social participation in "real life".

> "I am severely hard of hearing (hearing aid user) and visually impaired. Facebook has become an extremely important arena for me to keep updated. The social aspects of visual or hearing impairments do not matter here. I use what I have learnt on Facebook when I later meet people face to face, and this has made it much easier for me to follow and understand the context of conversations. It has also become much easier to keep in touch with people I otherwise would not have had the resources to keep in contact with. For me, Facebook provides the opportunity for a more active social life out in "real life"." (Tollefsen et al., 2010)

The phenomenon Facebook is in itself very fascinating, and what it offers and its growth in users has been close to extreme over the past five years. The position that the site holds in our society is unparalleled and the social power that comes with being a user on these sites can be said to be quite large. Unfortunately, the powerlessness that users who are unable to take use of sites such as Facebook, feel, is strong. They are excluded from the digital society in a way, which at the least is unjust and very unnecessary. I find this imbalance in power quite provoking and also interesting, and therefore the notion of having a remote possibility to shed some light on this injustice is also motivating. E-inclusion prevents this exclusion and can to the utmost be seen as a precondition for democracy and participation in social and working life. Following in the next sections are the research questions that I have focused on in this thesis.

1.2 Research questions

The following research questions help me to achieve an understanding of the problem area and to provide new knowledge of the accessibility of user registration and identity management on Facebook. A case study will be done and several methods will be applied in order to gain knowledge about the domain. The research questions stated below will be answered and thus lead to advanced knowledge. The relationship between usability and accessibility will be thrown light on through the first question, which concerns the theory angle in this thesis, while the other two concerns empirical studies of accessibility challenges, as well as the validity of the

different evaluation methods used.

1.2.1 Research question 1

This thesis has its focus both on theory as well as on empirical studies. The terms usability and accessibility are often used concepts in interaction design literature. These can be difficult to understand as separate entities, but maybe more confusing is how the relationship between the two concepts works. As these concepts are used thoroughly in my thesis, I find it relevant to try to advance knowledge on this by asking and answering the first research question: ***What is the relationship between usability and accessibility? How do the one affect the other?***

1.2.2 Research question 2

An essential part of interaction design is evaluation. Among other things, this is used as a process in order to gather information about the quality of a system, such as its usability and accessibility, as well as how users experience using the system. By performing different types of evaluation methods, I will gain knowledge about the accessibility of Facebook. To put these findings in order, I will answer the following research question: ***What are the accessibility challenges with actual practices used on Facebook as of today, when it comes to user registration and identity management?***

1.2.3 Research question 3

There are different ways of measuring and evaluating accessibility. With accessibility evaluation methods I mean procedures that are aimed at finding accessibility problems, and I will try to shed light on the value and validity of some of these methods through answering the third and last research question: ***What are the main differences regarding the accessibility problems revealed by the different types of evaluation methods?***

I will discuss and answer these research questions in chapters 6 and 7. In order to focus on the aspects that the research questions above require in a satisfactory way, I have tried to delimit the scope of the thesis. Following is an explanation of the delimitations that I have made.

1.3 Delimitations

I have focused on the accessibility aspects of user registration and identity management of the social networking site Facebook. Emphasis has been placed on evaluating actual practices and identifying the challenges that currently exist. The choice I made of focusing on Facebook, is purposefully based on popularity, functionality, and my own experience with the chosen site. As of November 2010, Facebook had over 2.5 million users in Norway and 564 million users globally (Halogen, 2011), which really speaks for itself. LinkedIn, Twitter and MySpace are also very popular sites for people who want to participate in the social, digital community, but because of its majestic position, Facebook was the most interesting site for me to study.

I have considered different types of disabilities that I could have focused on in this thesis. There are many different groups that are interesting to follow, however, I have chosen to focus on users with visual impairments. These are users that need supporting accessories in order to use computers and the Internet. In order for these accessories to fully do their job, websites should be rightly prepared and accessible for these users. The fact that this is often not the fact, makes it very interesting to look at the challenges that visually impaired users face today. This choice is also made on the basis of several other factors, most importantly access to test users and informants, in addition to my own interest in the problem-space.

It is worth mentioning that Facebook has also developed a full HTML version of their site[3]. This site was primarily planned to be a site for the mobile platform, but it now seems as if some visually impaired users in Norway prefer this version. As I focus on the accessibility challenges on Facebook's original site, this site is outside the scope of my thesis. It is nevertheless very interesting to look at and compare with as this site can be argued to solve many of the problems that especially visually impaired users experience on the original site.

This research is focused on a social networking site, but another area that I could have chosen to focus on is public services such as online banking in Storebrand or AltInn. These services also use different registration and authentication mechanisms for users. Some of these services currently undergo a transformation into integrated services on social networks, which amplifies the importance of the usability-, accessibility- and security-issues.

From an academic perspective, I have focused on key principles from interaction design literature, as well as on evaluation methods such as use of an automated accessibility evaluation tool, heuristic evaluation and user testing.

[3] http://m.facebook.com

1.4 Chapter Overview

The structure of this thesis is as follows: Chapter 2 explains the theory that is relevant. It examines concepts that are used throughout the thesis, and the section concerning HCI and interaction design explains the terms *users*, *usability*, *accessibility* and *evaluation*. The section concerning inclusive identity management goes through the concepts *inclusive design*, *social design*, *identity management* and *single sign-on*.

The research methodology and methods used in this thesis are described in chapter 3, Method. These include use of an automated accessibility evaluation tool, heuristic evaluation, and performing manual user tests. The findings that emerge from use of the mentioned methods are then presented in chapter 5, Findings.

The fourth chapter, Case, sets the stage for my study and gives a description of the case in this thesis. The two research projects that I have been involved with are described, and the chapter provides an overview of visual impairments, assistive technology and Facebook.

The findings that are presented in chapter 5 are taken further into discussion in chapter 6, Discussion. In this chapter I consider the theory accounted for in the theory chapter, in order to answer the research questions. With a basis on this discussion, chapter 7 presents the conclusions made based on the results.

Finally, the appendices can be found on page 103. These include an overview of the terminology and concepts used throughout the thesis, as well as the complete and raw sets of findings from the automated and heuristic evaluations. In addition, I have included the licence that I acquired for the Privacy Ombudsman for Research in Norway (NSD), and the letter of information and consent that I handed out to the participants in the user tests. At last, the user testing task sheet is included in order to show how the user tests were implemented.

"When those who benefit are not those who do the work, then the technology is likely to fail, or at least be subverted."

Grudin's law, Jonathan Grudin
Norman (1994)

Chapter 2

Theory

This chapter explores the main theoretical fields of interest that has been helpful in this thesis. This involves an explanation of concepts within HCI and Interaction design, as well as examining the field of Inclusive identity management. The two first fields that I will present have had central roles in how I decided to carry out with the evaluations, namely HCI and Interaction design.

2.1 HCI and Interaction design

Human-computer interaction (HCI) and interaction design are two closely related fields, and are both concerned with building and designing interfaces that help and satisfy their users. The philosophy of these fields is based on a user-centred design and on the needs and interests of the user, with an emphasis on making interfaces usable and understandable. As Norman (2002) states, proper design can make a difference in our quality of life.

HCI emerged in the early 1980s as an area of research and practice, initially as a speciality area in computer science (Carroll, 2009). Since then HCI has evolved at great speed, adopting many other disciplines and developed into a multidisciplinary field. Carroll (ibid.) looks at HCI as an aggregate of several fields of research and practice in human-centred informatics.

Interaction design is meant by designing interactive products or systems that support the way people communicate and interact in their everyday and working lives (Sharp, Rogers and Preece, 2007, p. 8). Löwgren and Stolterman (2004) make an assumption that sees interaction design as a complex and advanced task, and as a unique process that cannot easily be described.

They define it, however, as "the shaping of use-oriented qualities of a digital artefact for one or more clients".

A goal in interaction design is to involve the users in the design process, and develop usable products. The best way to ensure that the development takes the users' needs and activities into account is to involve the users throughout the whole design process. This will provide the designer with a better understanding about the user's goals, and create a usable product (Sharp, Rogers and Preece, 2007).

There are two main design-approaches within interaction design; a participatory approach (PD) or a user-centred approach. The main difference between these approaches is that the level of involvement and participation of the users in PD is of a higher degree than in the user-centred approach. The user-centred approach also invites users to participate in the process, but in a more limited way than the participatory-design approach, that emerged from Scandinavia in the late 1960s (ibid., p. 567). Both approaches are based on early focus on users and tasks. Real users and their goals should be a driving force, not just technology.

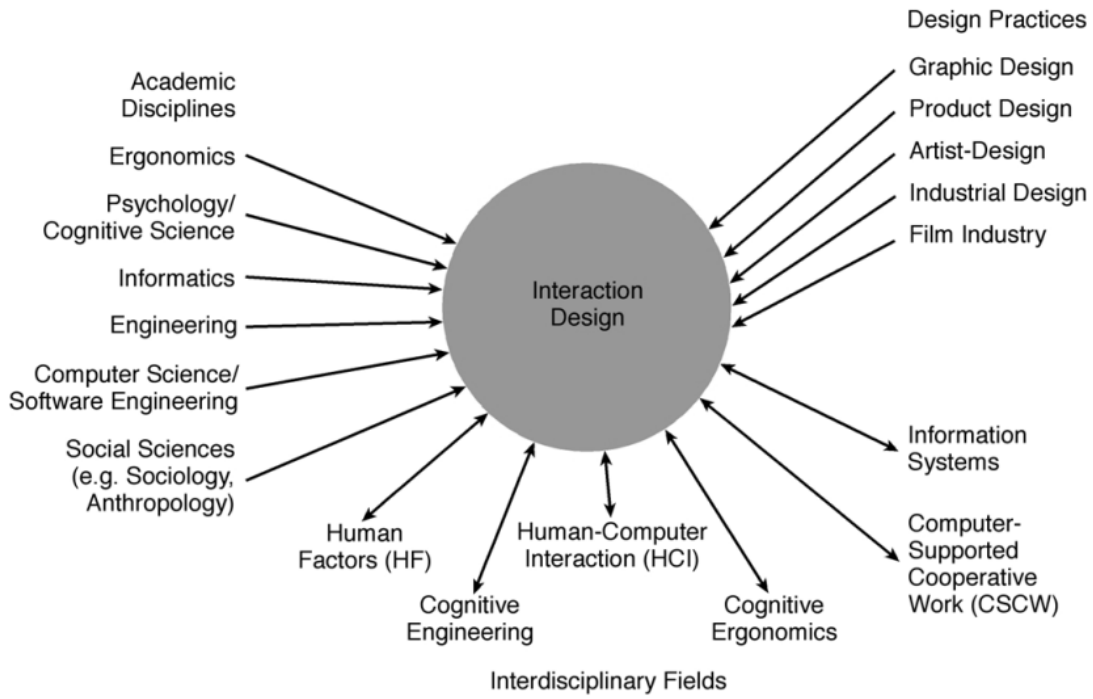

Figure 2.1: Interaction design as an umbrella term (ibid.)

Sharp, Rogers and Preece (ibid.) state that they see the main difference between interaction design and HCI as being one of scope. They mean that interaction design revolves around a wider field, and that HCI has a more narrow focus. Sharp, Rogers and Preece (ibid.) therefore see interaction design as the umbrella term, when talking about the relationship between the research fields and practices. Their thoughts are carefully illustrated in figure 2.1, and in this

thesis I will follow this way of looking at that relationship.

Sharp, Rogers and Preece (ibid.) argue further that the process of interaction design involves four basic activities. The figure 2.2 shows a model that incorporates iteration and encourages a user focus.

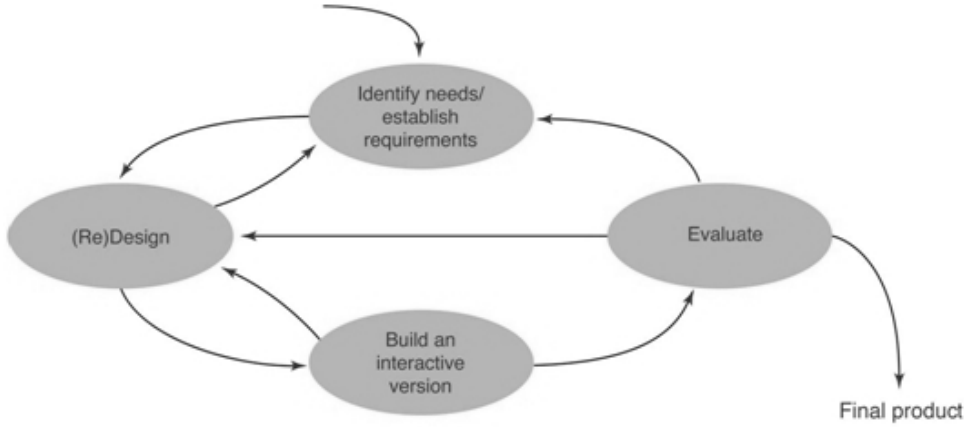

Figure 2.2: A simple interaction design life cycle model (ibid., p. 448)

These are the four basic activities involved in the process:

1. Identifying needs and establish requirements (understanding the users).
2. Designing potential solutions.
3. Building interactive versions of the design (prototyping).
4. Evaluating the design.

This is meant to be a cyclic process of activities that inform one another and is iterated upon (ibid.). The focus of this thesis will be on the last, but not the least important activity - evaluation. Integral parts of this activity are methods and techniques, as well as the users, which I focus on in the next section.

2.1.1 Users

In interaction design literature there is a distinctive focus and emphasis on users, and it could be argued that the term user forms a great portion of the basis of design. But who are these users? What characterizes a user, and which qualities do they possess? A discussion with this in focus is relevant because of the comprehensive use of the term, and because these questions

must be answered in order to be do interaction design the way the literature prescribe (Sharp, Rogers and Preece, 2007, p. 430).

One can gain valuable insight by looking at a word's etymology. More precisely this means to study the history of words, their origin, and how their form and meaning have changed over time. The word *use* is *oeti* in old Latin and has its origin in the mid 13th century. The word can be said to mean to make something serve one's purpose, thus making it possible to say that the word *user* means someone or something that makes something serve one's purpose. *User* also has its origin in the mid 13th century, and is *usere* in old Latin. This can be related to a person using an information system on a computer as a means to an end.

Users are often put into different categories and there are many interpretations of who the users are. Sharp, Rogers and Preece (ibid.) mention that "[...] users are people who interact directly with the product to achieve a task". This can be said to be a generally accepted definition in the field, but also mentioned is three categories of users identified by Eason (1987): primary, secondary, and tertiary. Users fall into these categories based on the frequency of use. There are also a group that is called *stakeholders* (Sharp, Rogers and Preece, 2007). These are people or organizations that are affected by a system in some manner.

In my thesis there is a comprehensive focus on one specific category of users. There are many ways to look at this type of classification, but it is no secret that the area of accessibility primarily refers to the degree to which an interactive product is usable by people with disabilities. By doing this classification, users are categorized by their marked properties, such as visual impairments or other mental or physical impairments. It can be argued that this is a questionable way of classifying people in general, but on the other hand it can also be argued that this classification is important to make, so that specific needs can be satisfied. This is nevertheless quite common, and people with disabilities have become a well-known user-group, with its own needs and requirements. That being said, it is important for designers and practitioners to remember that people with disabilities also have many of the same needs and requirements as people without disabilities have.

Grudin's law can be seen as quite relevant in this discussion. His law states that "When those who benefit are not those who do the work, then the technology is likely to fail, or at least be subverted" (Norman, 1994). I believe that this principle is great. If, for instance, you are designing a system that involves talking tactile maps as orientation tools for the visually impaired, you should make sure using it first and foremost is easy for the visually impaired. It should be of secondary interest whether a sighted user understands how to use it. Grudin is also an advocate of the design method personas. "Personas are an interaction design technique with considerable potential for software product development" (Pruitt and Grudin, 2003). A persona is a description of a person that defines the target user for the design. The personas

provide important details about the users, and get the designer to focus on the specific user groups' needs. I have, however, not chosen personas as one of my methods in this thesis, as my focus has been on the evaluation part. I see personas as a method that is better suited for other stages in the interaction design process.

The following section will give an account for the term usability, which unquestionably is an integral part of interaction design, and therefore also of my thesis.

2.1.2 Usability

Usability is often seen as a quality attribute that ensures that interactive products are easy to learn, effective to use, and are enjoyable to use from the user's perspective (Nielsen, 2010; Sharp, Rogers and Preece, 2007). To define a term such as usability can be said to be a challenging exercise. In fact usability can be said to be invisible, when it is at its purest, because it is often the case that only when something is not usable, we pay attention to it. The ISO 9241-11 defines usability as "[...] the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 1998).

In other words usability means ensuring that interactive products and systems that are not only intuitive, but also easily learned and matches the user needs and requirements. More specifically, usability is divided into these goals (Sharp, Rogers and Preece, 2007):

- Effective to use (effectiveness)
- Efficient to use (efficiency)
- Safe to use (safety)
- Having good utility (utility)
- Easy to learn (learnability)
- Easy to remember (memorability)

To make a clear distinction between what is and what is not usable, it can be helpful to operationalize these usability goals as questions. By doing this we can assess interactive products by answering these questions, and designers and evaluators can, early on in the process, determine whether there are design problems or not (ibid.).

History

For a long time, there was made a distinction between the areas of human-computer interaction (HCI) and product usability. While there has been some antecedents, interest in HCI began in a meeting in Virginia, USA in 1982 titled "Human Factors in Computing Systems" (Dumas, 2007). Throughout the rest of the 80s, a group of psychologists, cognitive scientists and human factors researchers did work on and published studies on HCI.

Out of these studies a new approach to product design and evaluation made its appearance. Instead of stressing the research experiment, researchers and designers advocated a quantitative, but practical engineering approach to product design. This approach emphasized early setting of objectives, prototyping, and iterative evaluation, which can be seen as the foundations of the usability methods used today. The terms *usable* and *usability engineering* then became the words of choice to describe products that were well-designed and the process by which they should be designed (ibid.).

To summarize, the concept of usability comes from the field of human factors. Dumas (ibid.) mentions that human factors (also known as *ergonomics*) has its roots in psychology, and its methods and practices originated within the US military during World War 2. Sophisticated weaponry had to be usable. If it could not be used, military objectives could not be met and if it was used incorrectly, it could kill the forces using it rather than the enemy.

User experience

Another central concept in interaction design is the user experience. Sharp, Rogers and Preece (2007, p. 15) explains this concept as "how a product behaves and is used by people in the real world." Every product that someone uses has qualities that form a user experience, and it can be explained further by looking at it as how people feel about a product and their pleasure and satisfaction when using it (ibid.).

Designers cannot design a user experience, although they can design *for* a specific user experience, and create a design that aims at bringing forward a specific experience. In figure 2.3 Peter Morville's user experience honeycomb is illustrated. This illustration shows the different properties that a product should hold, for shaping and designing for a pleasant user experience. Aspects of the user experience, such as how a product feels and looks, are entangled with how usable it is.

As there are usability goals, there are also a number of user experience goals. These can

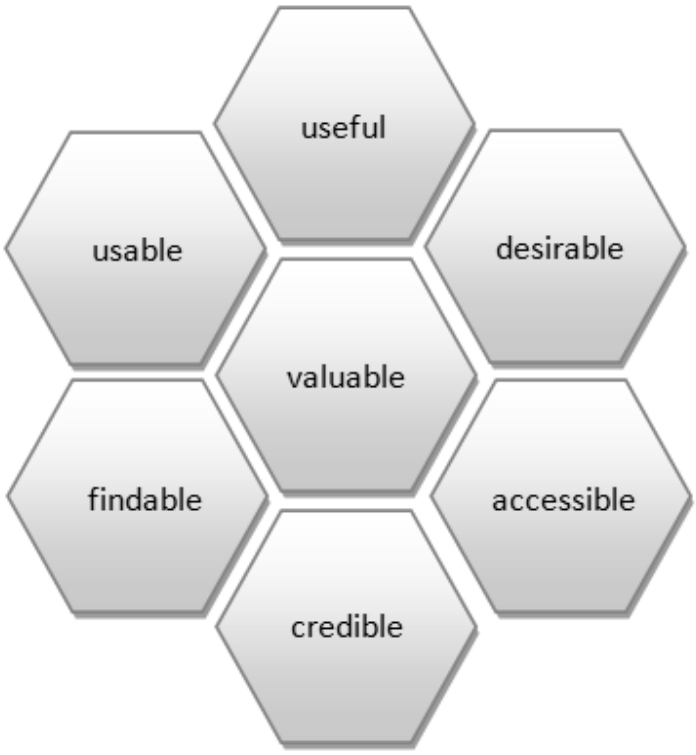

Figure 2.3: Peter Morville's User Experience Honeycomb (Morville, 2011)

be both positive and negative goals, and many of these subjective qualities relate to how an application or website feels to use. As Sharp, Rogers and Preece (ibid.) point out, these goals differ from the more objective usability goals, which are more concerned with how useful a system is from its own perspective.

In addition to user experience goals, designers often take use of design principles. These are useful rules for analysing and evaluating aspects of an interactive product, and they are often used by interaction designers as valuable tools for designing for pleasant user experiences. They also function as reminders of what to provide and what to avoid when designing (ibid.).

Design principles

There are a number of design principles that more or less are widely accepted by the community. Norman (2002) goes through the following principles in an extensive way.

- **Visibility** If the functions are visible, the more likely it is that the users will be able to know what to do.

- **Feedback** Sending information back to the user that something has been done is called feedback.
- **Constraints** With constraints the design are restricting the possible actions that can be done, which helps the user not to select incorrect options. It is important to think about this when designing, because it is not always optimal to have access to all options at once.
- **Consistency** This means that you design interfaces that have similar operations and uses similar elements for similar tasks
- **Affordance** This means that you give a clue to the user, so that they know how to use it.

In the next section I will go through the term *accessibility*, which can be seen as a key aspect in interaction design that has much focus in this thesis.

2.1.3 Accessibility

As written in the previous section, usability is well defined, but as far as accessibility is concerned there are numerous approaches. The Web Accessibility Initiative (WAI) was founded in 1997 by the World Wide Web Consortium (W3C), in order to promote the accessibility-aspect on the web. The initiative has formulated a definition of web accessibility, which is generally accepted (Petrie and Kheir, 2007, p. 1):

> "Web accessibility means that people with disabilities can use the web. More specifically, web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the web, and that they can contribute to the web. Web accessibility also benefits others, including older people with changing abilities due to ageing." (W3C, 2010b)

As Petrie and Kheir (2007, p. 1) suggest in their article, this definition focuses very much on the user, and it can be seen as a version of usability, only for people with disabilities, or even *usable accessibility*[1] In addition, as Lazar et al. (2010, p.70) specify, an accessible web site means that any user, using any type of assistive technology[2] can successfully access the content.

[1] This approach is further discussed in the section 2.1.5.

[2] Assistive technology, such as screen readers, alternative pointing devices or alternative keyboards are examined under the section 4.3.1.

History

The concept of accessibility is not only relevant in Information and communications technology (ICT), as it can be said to have its origin from other areas, such as housing, commercial and public facilities, outdoor environments and other products. Accessibility is often mixed with concepts like *universal design*, *inclusive design* and *design for all*. The two last-mentioned terms are examined further in the section 2.2.1. In general, these concepts deal with the same, but it can be said that *universal design* and *design for all* encompass around a larger group of people, disabled and non-disabled, where a key concept is *all*. There are those who argue that while *accessibility* only seeks temporary solutions, *universal design* is about everyone being able to use the building/website/product without necessary workarounds being made (Universal Design, 2011).

There are more and more countries that are starting to take universal design seriously. Fritsch, Fuglerud and Solheim (2008) mention that legislative actions are put in place in the US, Australia, Japan and in the European Union, in order to require public bodies and companies to make sure that their products and services are accessible and usable by as many users as possible, including elderly people and people with disabilities. As a result of this, there is an increasing number of laws that are referring to, and requiring conformity to standards and guidelines related to universal design.

Accessibility as a design concept has a long history, but legislation such as *Americans with Disabilities Act of 1990* and the *Federal Rehabilitation Act (Section 508)*, has given it a more general focus. The *Act June 20 2008 No 42 relating to a prohibition against discrimination on the basis of disability (the Anti-Discrimination and Accessibility Act)*, was passed in 2008 in Norway, with Section 11 regarding the *Requirement of universal design of information and communication technology (ICT)* being the most relevant regarding this thesis. Below is an excerpt from Section 11:

> "[...] New ICT solutions that support the undertaking's normal functions and which are the main solution aimed at or made available to the general public are to be universally designed as from 1 July 2011, but nonetheless at the earliest 12 months after standards or guidelines relating to the content of this obligation have been established. For existing ICT solutions, the obligation applies as from 1 January 2021. The obligation does not apply to ICT solutions whose design is regulated by other legislation. [...]" (The Anti-Discrimination and Accessibility Act §11)[3]

An important question that needs to be raised in the wake of this act being passed is who

[3]Unofficial translation found on http://www.ub.uio.no/ujur/ulovdata/lov-20080620-042-eng.pdf

decides what is accessible and universally designed, and what is not? There are guidelines, such as the Web Content Accessibility Guidelines (WCAG), which are described in the next section. The need for standardization becomes increasingly vital, when it comes to this area, and WCAG is one attempt of providing principals for web accessibility.

Web Content Accessibility Guidelines (WCAG)

WCAG 2.0 is a set of guidelines, published by W3C through WAI. These give criteria for measurement and achievement of accessibility on the web. The purpose of these guidelines is to help make the web more accessible for all users. WCAG 2.0 is different from WCAG 1.0 in that they are not dependent on technology, as well as formulated as statements that are easy to test. Petrie and Kheir (2007) mean that these criteria address the more technical sides of accessibility, as they revolve more around code-specific terms, than user-specific aspects.

The WCAG 2.0 is built in a hierarchic structure, in layers of guidance. First of all, four fundamental principals provide the basis for web accessibility. According to W3C's website (W3C, 2010a), anyone who wants to use the web must have content that is:

1. Perceivable - Information and user interface components must be presentable to users in ways they can perceive. This means that users must be able to perceive the information being presented (it can't be invisible to all of their senses)

2. Operable - User interface components and navigation must be operable. This means that users must be able to operate the interface (the interface cannot require interaction that a user cannot perform)

3. Understandable - Information and the operation of user interface must be understandable. This means that users must be able to understand the information as well as the operation of the user interface (the content or operation cannot be beyond their understanding)

4. Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. This means that users must be able to access the content as technologies advance (as technologies and user agents evolve, the content should remain accessible)

W3C further states that if any of these are untrue, users with disabilities will not be able to use the website. For each of these principles there are also one or more guidelines, twelve in total (ibid.):

1. Perceivable
    - Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, Braille, speech, symbols or simpler language.
    - Provide alternatives for time-based media.
    - Create content that can be presented in different ways (for example simpler layout) without losing information or structure.
    - Make it easier for users to see and hear content including separating foreground from background.
2. Operable
    - Make all functionality available from a keyboard.
    - Provide users enough time to read and use content.
    - Do not design content in a way that is known to cause seizures.
    - Provide ways to help users navigate, find content, and determine where they are.
3. Understandable
    - Make text content readable and understandable.
    - Make web pages appear and operate in predictable ways.
    - Help users avoid and correct mistakes.
4. Robust
    - Maximize compatibility with current and future user agents, including assistive technologies.

These guidelines are yet again divided into the success criteria for testing-purposes, distributed to the levels A, AA and AAA. To be in conformance with WCAG 2.0 the minimum requirement is that all the success criteria on level A is achieved, while in order to conform with levels AA and AAA, all the success criteria on the particular level have to be achieved as well as the ones on the preceding level.

It is worth mentioning that WCAG 2.0 also has been the subject of some criticism, in which it has been argued that these guidelines are not suited to identify all current accessibility challenges. As an example of one way of looking at guidelines, such as WCAG 2.0, Milne et al. (2005) stated that "Accessibility guidelines and tools focus on the basic level of accessibility and do not cover higher-level problems such as navigational structure, functionality, and inexperience with user interface conventions."

Rømen and Svanæs (2010) identified 80 different violations in two public websites through usability tests. 47 of the found violations were closely related to accessibility. They then examined both WCAG 1.0 and 2.0 in order to determine how many of the found accessibility violations that could have been identified by heuristic evaluation using the success criteria in WCAG as heuristics. Their study shows that only 27% of the accessibility violations could have been identified through WCAG 1.0, 32% through WCAG 2.0, and 38% through a combination of the two.

Rømen and Svanæs (ibid.) conclude with that while evaluation with focus on WCAG is a good start, and a minimum requirement for accessible websites, a user-centred approach is necessary in order to better the accessibility of websites. I will give a closer account of evaluation, and some of the approaches one could take while evaluating in the following section.

2.1.4 Evaluation

As mentioned, evaluation is an integral part of the design-process. It is needed to ensure that users are able to use a product and that they have an enjoyable experience when using it. Sharp, Rogers and Preece (2007, p. 620) define evaluation "as a process for collecting information about users' or potential users' experiences when interacting with a prototype, computer system [...] in order to improve its design". This process has many approaches, and one can use several evaluation methods and techniques in order to collect the information needed, each with their own set of values and terms of how to conduct the evaluation.

Sharp, Rogers and Preece (ibid., p. 591) state that there are three main evaluation approaches, which are *usability testing*, *field studies* and *analytical evaluation*. The two former both involve observing users doing tasks, but the latter has a key feature that is that users do not need to be a part of the evaluation.

In this thesis I have evaluated the adaptation for accessibility in user registration on Facebook by employing three independent evaluation methods - evaluation using an automated accessibility evaluation tool and heuristic evaluation, which are part of the analytical evaluation approach. I have also conducted what I in this thesis refer to as *user tests*.

User testing is a central component of usability testing, and often includes observation of user satisfaction and task completion. The relationship between usability and accessibility is something that comes up for discussion when talking about usability testing in an accessibility context, and because I have performed the tests in the participants' natural environment, there are similarities with the field studies approach as well.

More on the evaluation methods and my application of them, can be found in section 3.4 on evaluation methods, but following next is a review of academic articles that discuss the mentioned relationship between usability and accessibility.

2.1.5 The relationship between usability and accessibility

As part of my thesis and as a tool that helps me answer the research question concerning the relationship between usability and accessibility, I have done a review and a comparison of three academic publications. Through doing this I have explored how the authors of the respective articles deal with the two key terms in question. In order to review these publications in the best way, as well as answering my research question, I have produced a simple summary of the sources. Then, later on, in the discussion chapter, I have tried to combine this summary with my own reflections.

Wolfram Huber and Peter Vitouch - Usability and Accessibility on the Internet: Effects of Accessible Web Design on Usability

As the title of the article states, this study deals with the effects that accessible design have on usability. The authors early express that definitions of usability and accessibility on the web can be characterized by looking at respectively "problems in using the web and barriers in accessing the web" (Huber and Vitouch, 2008). More than once, it is mentioned that the relationship between these two terms are unclear and that there currently exist few empirical studies that deal with the matter. One that is mentioned, although, is Petrie and Kheir's (2007) study, which also is the same article that I review in this chapter.

Huber and Vitouch's (2008) study consisted of an online test-environment that the researchers had designed. This was done in order to break down and analyse the unclear relationship between usability and accessibility on the web. In this environment there were implemented three test portals, all given different levels of accessibility. These levels of accessibility spanned from no consideration of it to compliance with The Web Accessibility Initiative's (WAI) Web Content Accessibility Guidelines (WCAG) 1.0 levels A and AA.

To test these portals there were 131 test users that were to rate the portal's usability by using a reduced version of the Web Usability Index (WUI). The value of this index is a percentage of usability problems experienced on a site. The higher percentage, the more usability problems. By examining these ratings the researchers tried to distinguish whether there were clear differences in the ratings of usability in the three portals that had different

levels of accessibility. Another goal was to find out whether there were differences in usability ratings given by people with and without disabilities for the three test portals. Hypotheses in the study were that the usability rating of non-accessible sites were lower than on sites with an extended level of accessibility, and that usability ratings of participants with disabilities differ from those given by non-disabled users, related to the amount of consideration that was given to accessibility.

The findings in this study are stated by the authors to clearly show significant differences in the usability ratings of the three portals. The study shows that web sites with more consideration to accessibility are more usable. In addition, the study concludes with that the results express that accessibility is equally important and relevant for all users, no matter if they have disabilities or not.

Helen Petrie and Omar Kheir - The Relationship between Accessibility and Usability of Websites

The authors early state that although both accessibility and usability are well established concepts, and that usability is precisely defined, there are many different approaches to accessibility. They also introductorily express that there are little empirical data that have been gathered regarding the possible relationships that could exist between problems encountered by disabled and non-disabled users. (Petrie and Kheir, 2007)

Further on in the article, some clarification is made regarding definitions of usability and accessibility. As earlier mentioned in the usability section, the generally accepted definition of usability provided by ISO 9241 leaves limited room for interpretation:

> "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (ISO, 1998)

There is then made a point out of the lack of a clear equivalent definition of accessibility. At least one that is as precise as the one provided for usability by ISO 9241. WAI is mentioned as a promoter of accessibility of the web, which also gives a general definition of the concept. This specifies accessibility as a requirement so that people with disabilities can use the web. Further on, conformance to the criteria in WAI's accessibility guidelines (WCAG) is promoted as another specification of what accessibility on the web requires.

The authors also give their own version; a two-sided explanation of the unclear definitions of

accessibility. The general definition of accessibility by WAI is looked at as *usable accessibility*, as it approaches the situation from the users perspective and focuses on disabled users' ability to perceive, understand, navigate, and interact with the web, much similar to the usability definition mentioned earlier (Petrie and Kheir, 2007).

On the other side, they coin WCAG's criteria for achieving and measuring accessibility as *technical accessibility* (ibid.). They explain this by pointing out that these criteria are mostly focused on meeting requirements regarding the underlying code of websites, not necessarily on user-experience itself. Another vital point that is made is the fact that there are very little empirical data that show that websites that achieve higher conformance to WCAG also are more usable by disabled users. Petrie and Kheir (ibid., p. 397) believe that "the ultimate criteria should be user-based" and provide the reader with their own definition of accessibility:

> "The extent to which a product/website can be used by specified users with specified disabilities to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (ibid., p. 397)

The article then goes on to compare different propositions to how the relationship between accessibility and usability and accessibility- and usability-problems can be analysed. The authors mention that it is possible to claim that the most common way to look at usability- and accessibility problems are as two different and independent entities. This means that problems can be seen as two distinct, non-intersecting sets, which again means that there are no problems that disabled users experience that also are experienced by non-disabled users and vice versa. Figure 2.4 illustrates this.

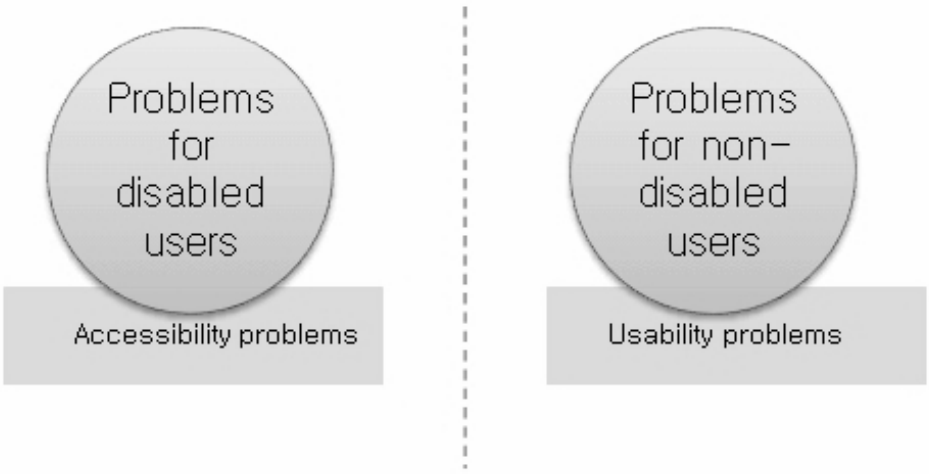

Figure 2.4: Usability and accessibility as two independent entities (ibid.)

They go on to mention that this, in fact, is the way accessibility and usability often are dealt

with in the development of most websites today. They say that the processes for conceptualizing, assessing and removing problems experienced by each user-group are completely distinct, most likely dealt with by different individuals within an organization, at different times in the development process (Petrie and Kheir, 2007).

A study that is referred to in the article is that of Thatcher and Waddell (2003). They define usability problems as problems that affect both disabled and non-disabled users, while accessibility problems affect only disabled users (ibid.). This is illustrated by figure 2.5.

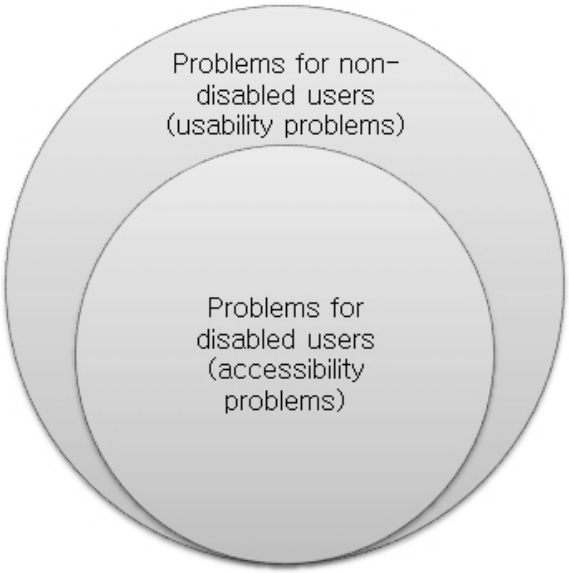

Figure 2.5: Accessibility problems as a subset of usability problems (ibid.)

One can also turn this relationship around and say that usability problems can function as a subset of accessibility problems, which basically means that non-disabled users experience all of the problems that disabled users do. Figure 2.6 illustrates this formulation.

Another possible relationship between usability and accessibility and usability- and accessibility problems mentioned in Petrie and Kheir's (2007) study, is that there are two overlapping sets, which includes three different categories. This is also illustrated by figure 2.7:

- Problems that only affect disabled users - these can be named *pure accessibility* problems
- Problems that only affect non-disabled users - these can be named *pure usability* problems
- Problems that affect both disabled and non-disabled users - these can be named *universal usability* problems.

Petrie and Kheir's (2007) study consisted of two sets of users evaluating two different web-

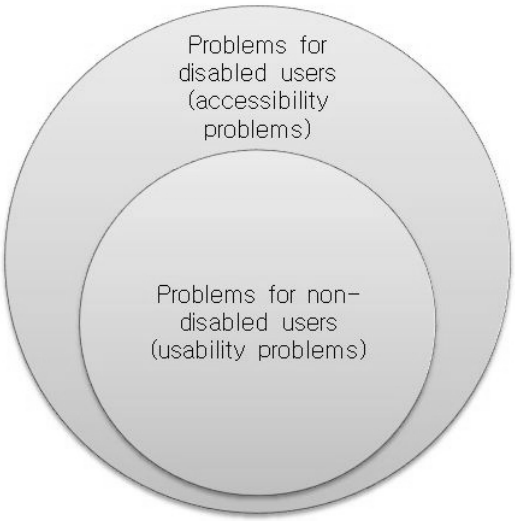

Figure 2.6: Usability problems as a subset of accessibility problems (Petrie and Kheir, 2007)

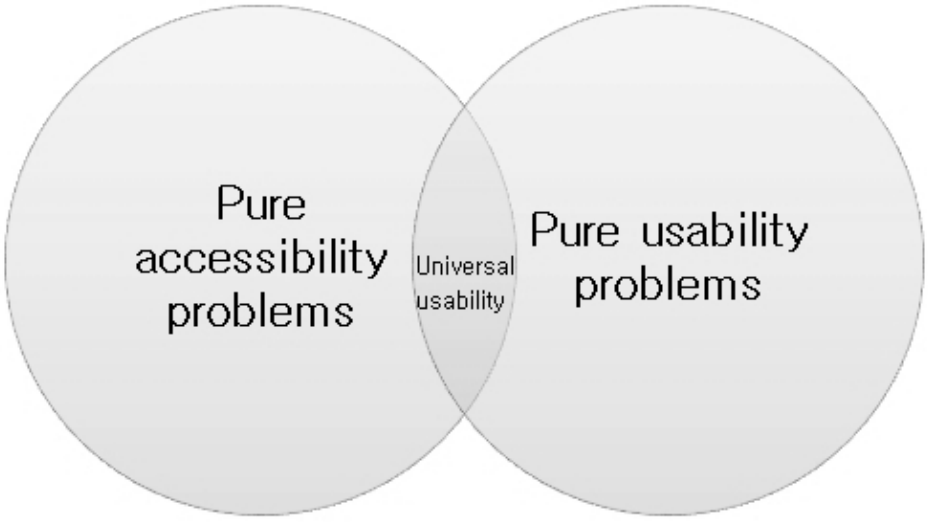

Figure 2.7: Usability and accessibility problems as two overlapping sets (Petrie and Kheir, 2007)

sites, in order to explore the nature of the relationship of the problems encountered by non-disabled and disabled participants. The first set of users therefore consisted of six disabled participants, with visual impairments. The other set consisted of six non-disabled participants. The findings that arose from the two sets of informants are quite interesting. These indicate that disabled and non-disabled users experience many of the same problems. Some problems were only discovered only by the disabled users, some problems were only discovered by the non-disabled users. 14% of the problems were discovered by both groups of users. The authors admit that this is not a large overlap, but they state that it shows that there is some mutuality in accessibility and usability problems.

Another interesting finding is that the degree of impact that the problems experienced have, varies between the two user-groups, as problems for non-disabled users is intensified for disabled users. According to Petrie and Kheir (2007), this can mean that usability problems can be more easily found when having disabled users as informants in evaluations.

Ross Yates - Web site accessibility and usability: towards more functional sites for all

Yates' (2005) article explores both accessibility and usability and examines what lies beneath these terms. In addition to this focus point, it also explores different design techniques for improving user experience and access, as well as different evaluation methods. As I see the latter aspects as being outside of the scope of my research questions, no further attention will be paid to them. More specifically Yates' (2005) article examines what is important to consider when designing web sites with relevance to disabled users and accessibility.

The approach that Yates (2005) has in this study is that of assessing various web sites for both accessibility and usability and getting an overview of the close relationship between the two terms. A much referred to article in Yates' (2005) text is that of Webdale (2003), which was published in New Media Age. In that article Webdale suggests that accessibility could be a driver for overall site usability, as the need for pursuit of more accessible sites can be accelerated by threat of legal action (Yates, 2005).

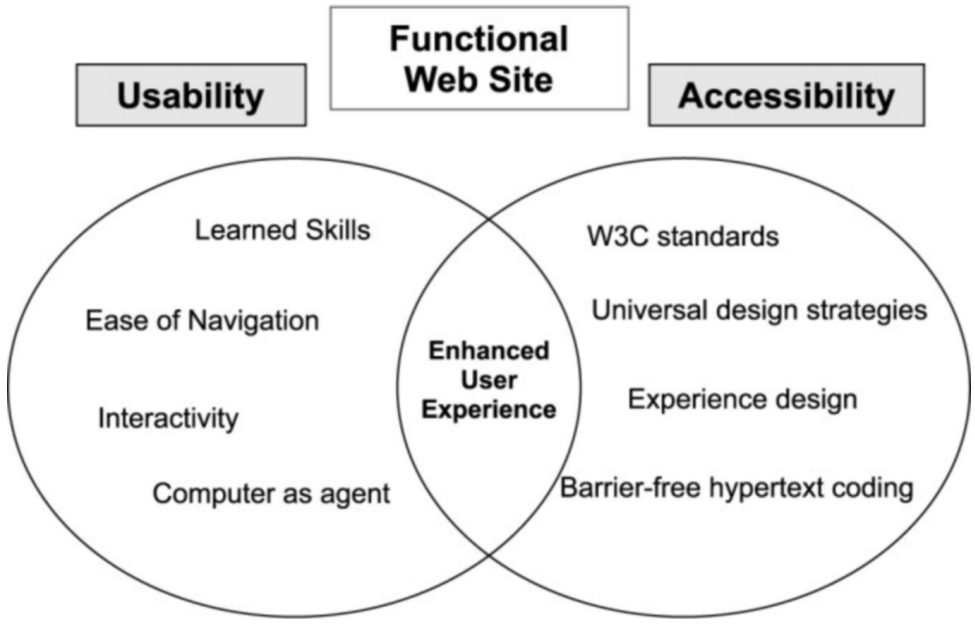

Figure 2.8: The proposed relationship between accessibility and usability (ibid.)

Yates (ibid.) further mentions the close relationship between accessibility and usability as

a system of two distinct entities, but also as being interlinked with each other and difficult to apply or view in isolation from each other. He further expresses that sites that are developed to meet accessibility standards generally are more usable. Possible reasons for this that are mentioned are the sharing of concepts and requirements that the two entities are supposed to fulfil. Another vital point that is made is that although there are clear and general similarities and relations, it cannot be definitively stated that all accessible sites will be usable. If a site conforms to an accessibility standard, it can still be constructed in a non-intuitive way, and therefore fail usability tests (ibid.).

Further on, the article refers to the proposition in Webdale's (2003) article, that it is impossible to separate the two interrelated elements of usability and accessibility as they effectively complement each other (ibid.). This is further illustrated by figure 2.8.

Yates' (2005) study concludes with a suggestion that a combination of focus on accessibility and usability, due to their close relationship, can enhance efficiency of websites and also justify implementation of methods that better both the accessibility and the usability of web-design in organizations.

2.2 Inclusive identity management

It is a known problem that security solutions online often have shortcomings regarding usability and accessibility. Fritsch, Fuglerud and Solheim (2008) mention that it may be that defects in these areas can lead users to compensate in ways that compromise the security and the personal information protection, such as receiving assistance of a third party to register or to log in to services, use of simple passwords or other things.

Fritsch, Fuglerud and Solheim (2010) mention that security mechanisms in general have been found to be a major barrier for visually impaired ICT users. They go on to mention that this probably is because most of the current recommendations about usable security are based on visual representations and cues, with no indication of non-visual alternatives.

The relatively new field of inclusive identity management addresses challenges regarding accessibility and identity management. It sheds light on the need for accessible and inclusive security mechanisms, and is focused on inclusive design of identity management solutions. In the next section, I will elaborate more on the terms *inclusive design* and *social design*. Thereafter, I will explain what is meant by *identity management*, as well as giving an account for one method of authentication, which is becoming more popular by the minute, *single sign-on*.

2.2.1 Inclusive design

As Fritsch, Fuglerud and Solheim (2008, p. 1) state, there are some design approaches that all go under the term inclusive design. *Universal design* and *Design for All* are examples of approaches that aim to design products and services accessible and usable for "as broad a range of users as possible, including older people and people with accessibilities" (ibid.). This means that a priority in an inclusive design-approach should be to attempt to meet the needs of those who generally are excluded from product use.

An approach from Zimmermann and Vanderheiden (2008) proposes a 4-step process for accessible design in software application development, that is similar to practices of software engineering. This is shown by figure 2.9.

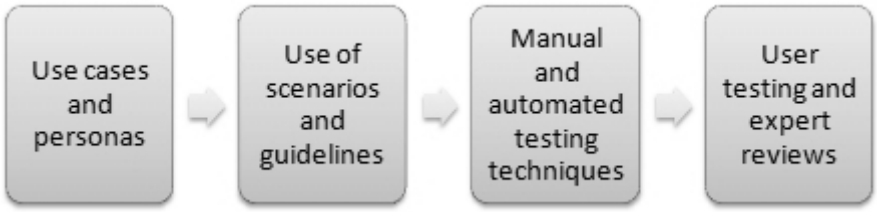

Figure 2.9: A 4-step process for accessible design (ibid.)

As seen above these steps include (ibid.):

1. Using use cases and personas[4] as methods to capture accessibility requirements and make them real and comprehensible

2. Making user requirements real concrete through the use of scenarios and guidelines

3. Using manual and automated testing techniques based on test cases and checkpoints

4. User testing and expert review

The Engineering Design Centre at the University of Cambridge claims that simply put, inclusive design is better design (*Inclusive Design Toolkit* 2010). In the following section I will give an account of another emerging term that is relevant in this field, which is called *social design*.

[4] A persona is a description of a person that defines the target user for the design.

Social design

Social design is defined by Porter (2008, p. 5) as "[...] the conception, planning, and production of web sites and applications that support social interaction." Social design is important to take into account because of the scope of this thesis. Use of the term implies focus on opposing known design issues in social networking sites and other systems that support interaction between people.

If the interface is too confined and has very rigid borders, people won't use it. On the other side if the interface is experienced as too flexible, people won't understand how to use it. The golden mean can therefore be software that supports the person and the personality of the user, in addition to the social environment and the groups that one is a part of. This can at least be seen as very relevant in order to know how to produce usable and accessible social networking sites.

> "The interface is the environment in which people work and play on the web. [...] Our behaviour is determined by the interface we use." (ibid., p. 8)

Hurdles that make registration on social networking sites hard can often be irritating and frustrating for users. Usually there are registration forms, verification and authentication of new users in addition to construction of passwords and user names. All of these steps are standard operations for the regular user, but not all people find these identity management methods usable or accessible enough.

A basic requirement for accessible systems is that the IDM-methods can be used by a broad range of users, with different skills, ages, and different (dis)abilities. The sign-up hurdles can therefore cause so much friction that some people relinquish trying to register. Porter brings the web service Netvibes[5] into this as an example that sign-up hurdles can be reduced. Netvibes is a solution that can be compared to iGoogle[6], where users can customize a panel on a website with lots of smaller applications, widgets, such as GMail[7] and Facebook.

The thing about Netvibes is that there is nothing that the users have to do before they can start using the service. Registration and authentication is therefore reduced to no more than an operation of saving. This leads to circumventing and scaling down the hurdles and friction that so often arise when having to register or log in before any action can be done. Porter (ibid., p. 93) mentions Luke Wroblewski, an Interface-designer, who coins this technique *progressive*

[5] http://www.netvibes.com/
[6] http://www.google.no/ig
[7] https://mail.google.com/

engagement.

2.2.2 Identity management

As Jøsang, Zomai and Suriadi (2007) state, an identity is a representation of an entity in a specific domain. Identity management (IDM), consists of processes and technology equipped for use and management of digital versions of identities. There are usually three parties in a typical identity management structure: The user, the identity provider and the relying party (Alpár, Hoepman and Siljee, 2011). As seen in figure 2.10, the user asks for service from the relying party (Facebook), which is dependant of an identity provider to get the correct information about the user. Identity management is commonly used in organizations and enterprises to administrate individuals and control their access to resources (Jaferian et al., 2009) and IDM systems are implementations of IDM routines. One IDM example is use of the user profiles on Facebook (Fuglerud and Røssvoll, 2010).

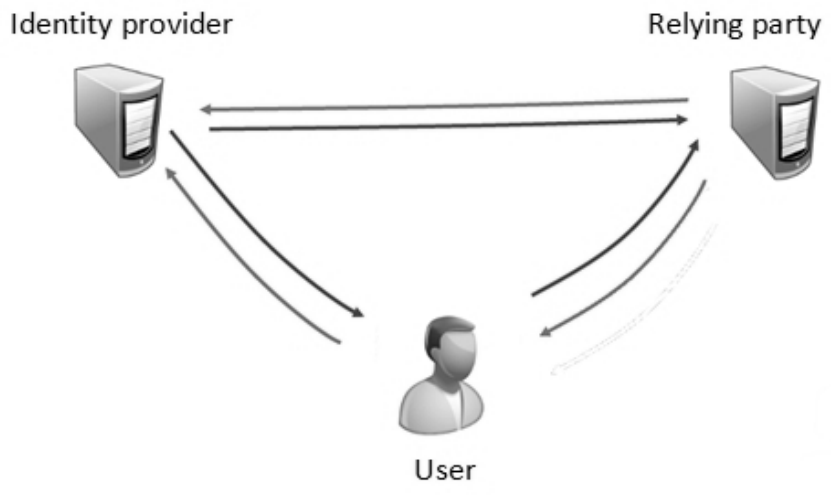

Figure 2.10: Model of an identity management system

There is currently a lot of research on information system security, but very few researchers focus on the usability and accessibility issues of security mechanisms and techniques. Security, usability and accessibility are important factors in the process of authentication. Braz and Robert (2006) argue that even though these factors are essential, the requirements for a high level of security while maintaining adequate usability, and accessibility, frequently are in conflict with each other. A suitable balance between these priorities must therefore be found. Further on, they also argue for the use of heuristic evaluation as a method for minimizing the mentioned conflicts.

Fritsch, Fuglerud and Solheim (2008) state that in order to be able to use a large number of

public services, such as Facebook, and private services such as online banking or government-services, the user must be authenticated. A fundamental requirement that exists for universal design is therefore that the authentication methods that are provided can be used by as broad a range of users as possible (ibid., p. 5). Different methods used for authentication include passwords and PINs, tokens, biometry, certificates and smart cards as well as 3rd party solutions such as one-time codes from code generators.

The mentioned methods can be challenging at best or more often impossible to use for user with different (dis)abilities. Another method of authentication, which may be suited for users with special needs is single sign-on, which I will explain in the following section.

Single sign-on

Single sign-on (SSO) is a property of access control of multiple, related, but independent software systems. It enables users to log in only once and then be automatically authenticated when they attempt access to other resources. SSO uses centralized authentication servers that all other applications and systems utilize for authentication purposes, and combines this with techniques to ensure that users do not actively have to enter their credentials more than once. The figure 2.11 illustrates how single sign-on works.

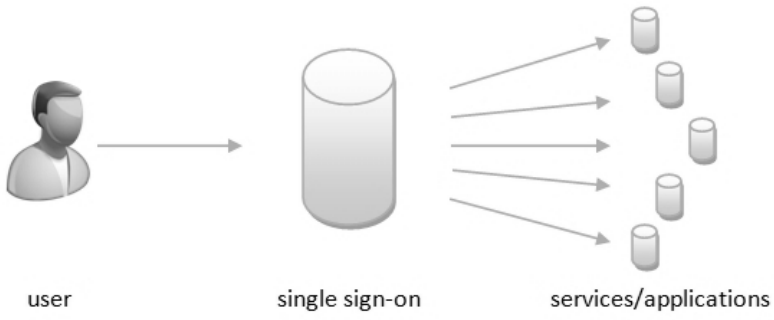

Figure 2.11: How single sign-on works

Imagine a world in which as you browse the web, sites automatically know who you are. They know who your friends are, and you can make comments and post stories and interact with your true identity. In this world, your identity provider is your only provider - log in once, and you are automatically logged in everywhere. Log out once, and you are automatically logged out everywhere. No need to keep clicking “log-in” buttons. It has a kind of poetic beauty and simplicity to it.

The situation today is that most people have a growing number of identities to manage,

with an account set up on each system where access is needed. This leads to an increasing burden to keep all of this information current. Having to remember a multitude of passwords adds to the user's workload and often leads to security risks such as passwords being written down and never being changed.

SSO has been developed to help with this issue. There are a number of technical solutions to this problem, each with their own advantages and disadvantages, including OpenID[8], OneLogin[9], Novell Access Manager[10] and now also Facebook.

Facebook enables developers to remove the registration process for their sites by enabling users to log in to a given site with their Facebook account. Once a user logs in to a site with his or her Facebook account, developers can access the user's account information from Facebook, and the user is logged in to the site as long as he or she is logged in to Facebook.

For the end-users there are some clear advantages with using single sign-on techniques, because single sign-on:

- reduces phishing[11] success, because users are not trained to enter password everywhere without thinking.
- reduces password fatigue from different user name and password combinations
- reduces time spent re-entering passwords for the same identity

As written above, the benefits of SSO are clear from the user's perspective. Users being automatically logged into sites, means lower friction and less hurdles for commenting, posting, rating, and doing other activities on social networking sites that require an account.

[8] http://openid.net/
[9] http://www.onelogin.com/
[10] http://www.novell.com/products/accessmanager/
[11] Phishing is a way of attempting to steal sensitive information such as user names, passwords and credit card details by pretending to be a trustworthy entity in communication over the web.

"What people say they do and what they do is not the same."

Blomberg et al. (1993, p. 123)

Chapter 3

Method

In this chapter I present the research methodology and the methods that I have chosen for the data gathering in my study, their theoretical background and my application of them. The presentation of the different evaluation methods are tightly coupled with the corresponding sections in chapter 5, Findings. To start with I present the research methodology that I have adopted in this thesis.

3.1 Research methodology

The overall methodology of a study can be defined as a general approach to the study of research topics (Silverman, 2005). The most natural methodology out of several research methodologies in qualitative information systems research can be said to be case studies. A case study draws epistemological[1] attention to the question of what specifically can be learned about a single case (Stake, 1995). It is an empirical research strategy in which you study a phenomenon in a "real-life"-context (Myers, 2010).

A case study can take one of three different approaches: intrinsic, instrumental or collective (Denzin and Lincoln, 2005). With an intrinsic approach, there is usually a case already identified and interesting in itself. The study is undertaken because of an inherent interest in, and a desire to better understand, the particular case (ibid.). Within an instrumental approach, the specific case usually has to be chosen. The case selected is meant to provide insight into an issue or to draw some sense of generalization. A collective approach is, in general, a set of cases with instrumental approaches (ibid.).

[1]Epistemology is a philosophical branch concerned with the nature and scope of knowledge.

An instrumental case study is carried out in this thesis, in order to get an insight in how visually impaired users experience the registration process on Facebook, and to advance knowledge in the current accessibility challenges in the identity management on Facebook. I concentrate on gaining knowledge and insight into a phenomenon and the use of it, but also with the purpose of wanting to say something general about the accessibility of user registration and identity management on Facebook today. My research goes under the interpretive paradigm. The reason for this is that in this study I am trying to understand a phenomenon and gain knowledge about it, through looking at the current situation. User testing, which normally is not included in case studies, will be used in this one, as this is a prominent feature of interaction design and will help discovering accessibility challenges and areas that are problematic.

I could have chosen to base my studies on the methodologies action research or grounded theory. Action Research is an iterative process, that involves researcher and participant co-operating together in an activity-cycle that includes diagnosis of the problem-area and reflexive learning (Avison et al., 1999, p. 94). In comparison with case studies, action research is more focused on what the participants in the research actually do, than what they say they do (ibid., p. 96). In my research it has primarily been important to gain knowledge of how users experience Facebook, and this is one of the reasons that I voted action research out. As the main focus in action research is improving current practices, rather than gaining knowledge (Elliot, 1991), case study seems more fitting.

Grounded theory is both a theory and a methodology, discovered by Glaser and Strauss (1968). As a theory it is the result of when ones empirical material is analysed and structured by grounded theory's procedures and techniques. As a methodology it is the mentioned procedures and the techniques that help one to generate grounded theory from one's data. In my research it has never been my goal to develop any form of theory on the basis of my studies, and case study is in my opinion better suited as a methodology in my thesis. In the next section I give an account of how I have looked at ethics in relation to observation and research.

3.2 Ethics

Ethical issues play a prominent role in qualitative methods. In research in which it is direct contact between researcher and the people that are studied, there are drawn up distinct ethical guidelines that the researcher(s) are to follow that prescribe the researchers relationship to the informants (Thagaard, 2003).

When it comes to ethics the primary question is basically about what is right and wrong for scientists to do to reach their goals. Thagaard (ibid.) mention a principle that can be seen as

the foundation for all scientific integrity, which is to avoid plagiarism. She also mentions that an ethical reference practice can contribute to preventing plagiarism because accurate references makes it more feasible to control and re-examine references (ibid.).

In this project I have had direct contact with informants, and I have gathered data that can be tied to the informants. As the project assumes treatment of personal information, it falls under the Personal Data Act of 2001. This means that my project has been notifiable to the Privacy Ombudsman for Research in Norway (NSD) and I have attached the licence that I required from NSD in appendix D. In addition to this, I obtained consent from informants by sending out letters of information and consent. The letter that I sent can be seen in appendix E.

3.3 Observation

"What people say they do and what they do is not the same" (Blomberg et al., 1993, p. 123). This is in many ways the basic idea in the method of observation. This method is a way to generate empirical data from natural settings. By observing, one can make more realistic findings than for example by interviews.

A very important tool that researchers can use when doing observation is note-taking. This, in addition to filming, sound recording and photographs, can help ensuring that one will get more out of the observation in the form of more accurate and rich empirical material. One can exercise passive observation or in a more participatory way. The chosen way depends on what kind of results one looks for. In addition to this, ethical and practical aspects can limit your choice.

The degree of participation can also vary, where on one side the observer can be an "insider", the observer can on the other side be an "outsider". If one approaches the former, one can say that there is participant observation. This means that one tries to act as a full member of the community or the group that is studied. This can be said to be challenging in the way that you usually should try to distance yourself from the group, to study as exactly as possible. On the other side it is important to also try to blend into the environment without bothering anyone. At last one should always try to be as objective as possible.

If one chooses the "outsider"-role, one can say that one practices passive observation. By having this approach, one takes no part in the environment being studied at all, but observe from the outside, without interfering in the ongoing activities. Those who are observed may feel uncomfortable and under surveillance as someone watches everything they do and then note

this down. If they are bothered by the surveillance, one must stop doing it (Sharp, Rogers and Preece, 2007).

While working with this thesis, I have observed visually impaired users while performing user tests. I recorded these tests on film throughout the observation, in addition to taking notes. By filming while observing one can make sure of not missing any important material or events. In the next section I will focus on the different methods of evaluation that I have used while working with this thesis.

3.4 Evaluation methods

Accessibility evaluation methods are procedures that are aimed at finding problems regarding the accessibility of a website or an information system (Brajnik, 2008). Nielsen and Mack (1994) say that evaluations can be done in four basic ways: automatically, empirically, formally or informally. Throughout the period I have defined my own fields that are examined. These are fields that I believe are very relevant to the key themes of the thesis, and that I also find very interesting. I have based the empirical study in my thesis on evaluation of the accessibility of the registration process and identity management in the social networking site Facebook.

While working with this thesis, I have adopted three of the mentioned ways of doing evaluation. This is often called *triangulation* or even *methodological triangulation* in literature, and is a well-known way of doing qualitative evaluation methods. There are many examples of researches that have chosen to do evaluation in this way, such as Murphy et al. (2008) and Leitner and Strauss (2008). To use multiple methods in order to study a single problem can be seen as an ideal and powerful, but expensive, solution to the problem of relying too much on any single data source or method (Denzin, 2009; Patton, 1987). I have employed automated evaluation by using an accessibility evaluation tool and an informal technique has been used in doing inspection-based heuristic evaluation. At last, I have performed user-based and empirical evaluation by conducting user-tests with a focus on accessibility together with visually impaired users.

I have:

- Taken use of an automatic evaluation tool to evaluate conformance with WCAG 2.0 requirements
- Performed a heuristic evaluation of conformance to relevant accessibility guidelines
- Conducted user tests together with visually impaired users

- Done a comparison of the findings from the different methods
- Provided an overview of accessibility challenges that currently exist in the domain.

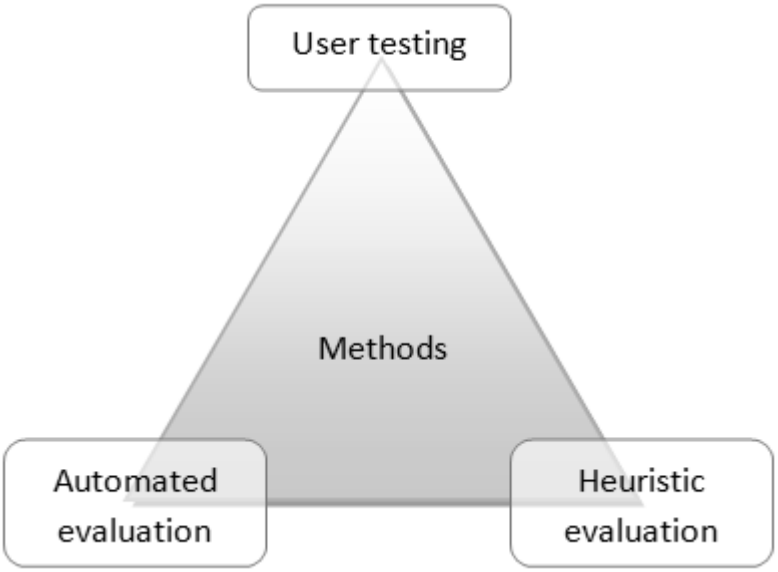

Figure 3.1: The triangulation of evaluation methods used for this thesis, as proposed by Patton (1987)

In addition to these elements, another relevant item on the agenda has been to review and compare three academic publications that all discuss the nature of the relationship between the often used terms accessibility and usability. A review such as this is relevant because of the importance of distinguishing between these terms, when using them actively. To begin with, I will describe the automated accessibility evaluation tool that I used and how I used it.

3.4.1 Use of an automated accessibility evaluation tool

Currently, there are several tools for testing the accessibility of web sites. These are tools that can examine web sites using different accessibility guidelines, and identify where in the web pages' code there are accessibility violations (Lazar et al., 2010). Some of these tools are fully automated, and some demand a more manual approach. Brajnik (2004) states that before you choose which tool to use, the effectiveness of automated tools for evaluating web site accessibility should itself be evaluated. This is because of the increasingly important role that these accessibility evaluation tools play.

Because of the lack of time, I, on the other hand, chose to use Deque's tool Worldspace FireEyes[2] in my research, without performing an exhaustive evaluation of its effectiveness.

[2] http://www.deque.com/products/worldspace-fireeyes

This was although an easy choice, because this tool was free to use, is accepted as adequate by W3C (2011b) and it includes complete sets of accessibility rules. It is also the natural successor of Deque's pioneer in accessibility testing tools RAMP, which, among others, Meiselwitz and Lazar (2009) used in their research of accessibility of registration in social networking sites. FireEyes does everything that RAMP did, and in addition it is the only tool that is fully aware of JavaScript.

FireEyes comes as a plug-in that is integrated with the Mozilla Firefox extension Firebug, a popular web development tool. The tool is said to work well with static sites and is also designed to address the challenges of dynamically updated content. This web accessibility tool helps ensuring that content within a website is compliant with accessibility standards such as Section 508, WCAG 1.0 and WCAG 2.0. As W3C emphasizes "Web accessibility evaluation tools [...] *help* determine if a Web site meets accessibility guidelines. While web accessibility evaluation tools can significantly reduce the time and effort to evaluate Web sites, no tool can automatically determine the accessibility of Web sites." (W3C, 2011b).

Lazar et al. (2010) mention that such tools often are preferred by developers because of its efficiency, but on the other hand, criticism of accessibility evaluation tools include that they are said to miss the common sense mistakes in accessibility. For example, most tools can identify whether a web page includes alternative text or does not include such `<alt>`-attributes, but generally cannot determine if the alternative text is useful (such as `<alt="picture here">`, which could be said to not be useful) or if the alternative text is not really needed (ibid.).

Procedure

When I conducted this evaluation, I started out by creating an account at Deque's Worldspace FireEyes website[3]. I then had to download the Firebug plug-in for Mozilla Firefox[4] as FireEyes is fully integrated with that extension. When this extension was installed I downloaded the FireEyes plug-in[5] and logged in to the plug-in with the credentials that previously were created. Once my new Facebook project was created and saved in the FireEyes extension I was ready to set the accessibility options that I wanted to apply to my evaluation. I chose to focus my analysis on testing for compliance with the WAI's WCAG 2.0 level A, as these guidelines are the newest and therefore the most up-to-date. This can therefore be seen as one way of testing conformance with WCAG 2.0.

I also checked the dynamic analysis options, that gave me the possibility to receive auto-

[3] http://worldspace.deque.com/FireEyes/
[4] http://getfirebug.com/downloads
[5] http://worldspace.deque.com/FireEyes/logEntry/download

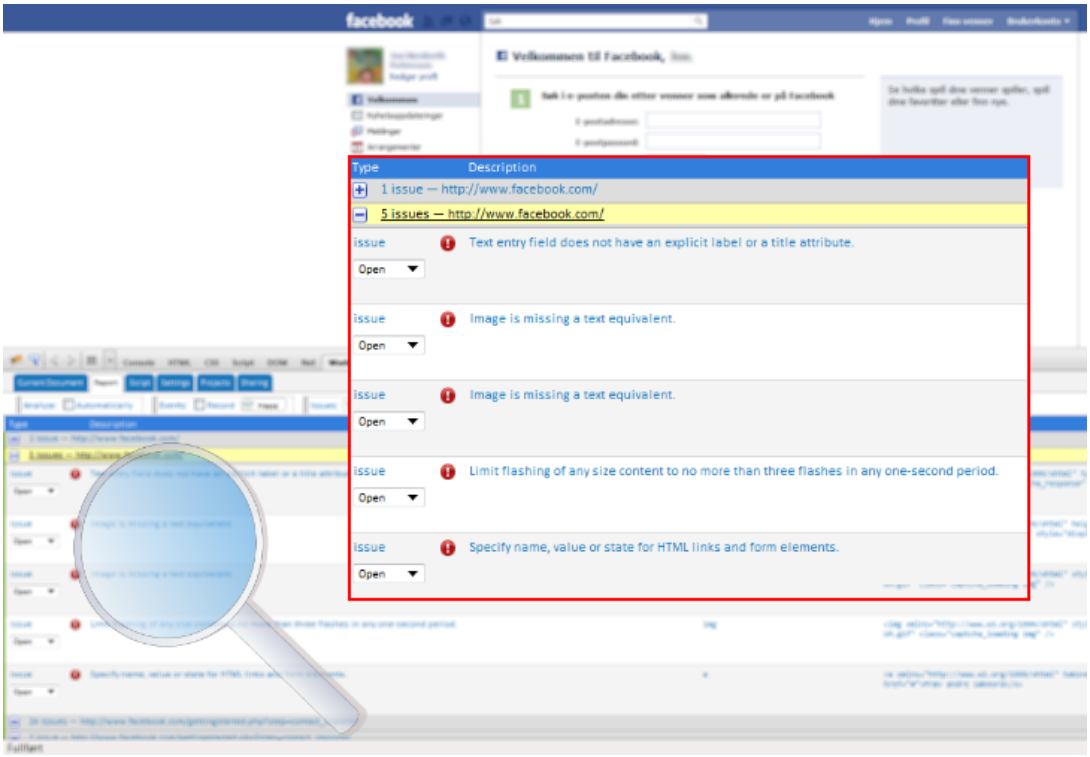

Figure 3.2: Illustration showing the Worldspace FireEyes plug-in under analysis Facebook.

matic analysis of advanced elements such as drag options, track focus on dynamical content manipulations, in addition to further analysis on dynamical content. Things that I did not focus on in this evaluation were accessibility challenges such as CAPTCHA[6]. This is although very relevant, and is thoroughly evaluated in the other evaluation methods.

As I went through the steps necessary to register and generate a profile on Facebook, the process was automatically analysed. When this was created, and the next step was customization of the profile, I decided to end the evaluation. This was mainly because the processes meant for examination were finished. The findings were then uploaded to the FireEyes-server, and exported into an excel-spreadsheet for further analysis. This can be found in appendix B.

3.4.2 Heuristic evaluation

Heuristic evaluation is an expert critique and inspection technique that aims at identifying major problems and opportunities for improvement on a system or a website. Nielsen and Mack (1994, p. 25) claim that heuristic evaluation is a simple, fast and cheap method for evaluating the usability of user-interfaces, as it does not involve users. It is often a benefit to have specialists

[6]Authentication method that is designed to ensure that the user is not a computer. Further explanation of CAPTCHA and an example of it can be seen in the section A.4 in the Appendix.

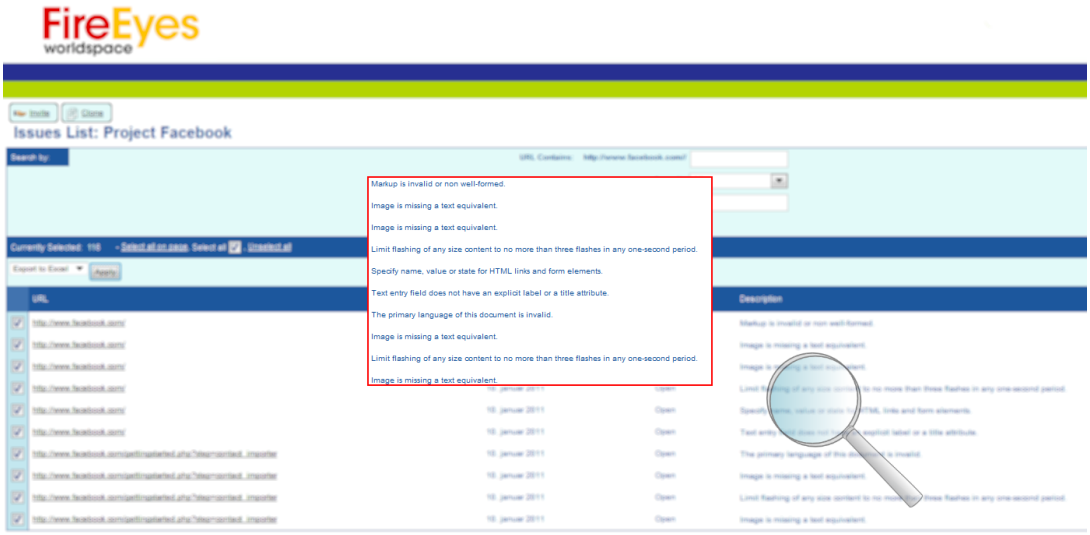

Figure 3.3: Illustration showing the Worldspace FireEyes server-side application after analysis.

within interaction design, or other experts, performing the evaluation. They can determine whether elements conform to well-known principles, such as the WCAG 2.0 guidelines. These principles are referred to as the heuristics, when used in evaluation.

One can also design the heuristic evaluation to focus on the accessibility of a system or a website. This is in many ways dependent on the heuristics that are to be evaluated. More specifically, this is easily adapted by carefully choosing principles that relate more to the accessibility-part of interaction design, to function as the heuristics. One should always try to tune the heuristics in a way that suits the domain and the purpose of the evaluation in the best way. I have also written about the distinction between usability- and accessibility-related problems in the discussion chapter 6.1 in this thesis.

As mentioned, the evaluation depends on the researchers ability to adapt and select the heuristics that are most relevant to the field that is to be studied (Jaferian et al., 2009). When exploring the accessibility of user registration and identity management system on Facebook, the focus of the selected heuristics should address various aspects, such as social-, accessibility- and usability-aspects.

To get the most out of heuristic evaluation, the inspection should contain more than only one evaluator. With only one evaluator, Nielsen and Mack (1994) state that it is less probable that one finds all the usability- or accessibility-problems. In a number of studies, mentioned by Nielsen and Mack (ibid., p. 26), it is established that more persons find different problems. Some problems are often very obvious, but some are so hard to find that only a few evaluators manage to find them. Nielsen and Mack (ibid.) recommend that an inspection-team has three to five evaluators performing the heuristic evaluation. The figure 3.4 illustrates this.

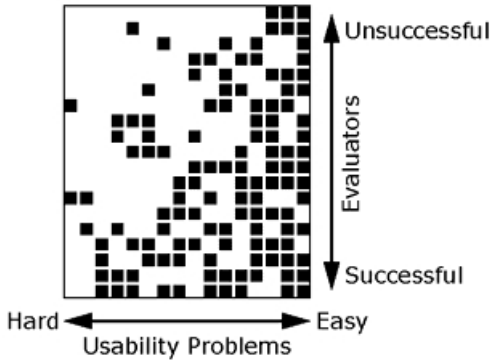

Figure 3.4: Evaluators and the found usability-problems (ibid., p. 27)

By having a team of three to five evaluators, the method is best executed by having each evaluator inspecting the interface alone. After every evaluation is finished, the team can discuss, communicate and compare their individual findings. During a period of evaluation, which typically lasts for one to two hours (ibid., p. 28), the evaluator goes through the interface several times and inspects all of the dialogue-elements' conformance with the heuristics. This can also be called conformance testing or standards review, as in accessibility-related evaluations, typically used heuristics are inspired or derived from the WCAG-guidelines.

Participants

As Nielsen and Mack (ibid.) recommend to have three to five evaluators in a team, I chose to perform this examination together with three other expert users. This made us a team of four evaluators and a mixed group of people. The evaluators (me included) were students at master level, all within the field of interaction design. Some of the evaluators had experience with universal design and accessibility, and all were familiar with the method heuristic evaluation. I chose to involve evaluators with some knowledge of accessibility and usability standards, evaluation methods, as well as being users of Facebook, as an important part of heuristic evaluation is to be familiar with the website under evaluation before it starts. Although heuristic evaluation can be carried out by people who are not trained in evaluation methods, better results are obtained by trained experts (Desurvire, Kondziela and Atwood, 1992).

Materials

Four different mail accounts were acquired and prepared for the tests, and every participant were given their own e-mail account, planned for use under the registration process on Facebook. Each evaluator was also provided with a flowchart, illustrated in figure 4.2, of the expected

process while registering, as well as an image, that was to be uploaded as a profile image under the evaluation. Lastly they were provided with an Excel spreadsheet meant for keeping the findings in a structured fashion, in order to relieve the analysis of the findings' workload.

Heuristics

Following is a list of principals and guidelines that all are said to promote accessibility on websites. They were carefully chosen in order to emphasize prominent challenges visually impaired often meet and were derived from WAI's Web Content Accessibility Guidelines (WCAG) 2.0. This means that this evaluation also tested conformance with some of the guidelines in WCAG 2.0. The heuristics were checked on every page that is included in the registration process from start to finish. When a web page is one of a series of pages presenting a process, all pages should conform to the specified guidelines.

1. **H1 - The website provides text alternatives for non-text content**
   It is important to provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, Braille, speech, symbols or simpler language. Images should have an alternative text as an `<alt>`-attribute can describe what the image represents. Text entry and password fields, as well as select controls should also have proper `title`- or `label`-attributes.

2. **H2 - The page should have sufficient headings**
   Assistive technologies allow users to navigate through a document by its heading structure, therefore sites should have sufficient headings

3. **H3 - Meaningful sequence**
   This means that when the sequence in which content is presented affects its meaning, it should be presented in a correct reading sequence. This may help people who rely on assistive technologies that read content aloud. The meaning in the information sequence in the default presentation will be the same when the content is presented in spoken form.

4. **H4 - The site does not rely on colour alone for information**
   Colour is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element.

5. **H5 - All functionality is accessible from a keyboard**
   All functionality of the content should be operable through a keyboard.

6. **H6 - How do I register? Help is readily available and accessible**
   There should be a page that offers help for people that does not know or understand how to register on Facebook.

7. **H7 - The site is perceivable without use of style sheets**
   Websites should be functional, usable and accessible even without use of style sheets[7].

8. **H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript**
   Assistive technology users have a hard time using websites that take use of newer technology such as scripts and other proprietary languages. This can easily be checked with for example turning JavaScript[8] of in the browser.

9. **H9 - The site offers sensible error messages**
   If for example users forget to fill in a text field that is required, or do something else that is wrong, error messages should provide a solution as well as describing the problem.

10. **H10 - If CAPTCHA is used for authentication, is there alternatives to visual and audio?**
    A common way to distinguish between real human users and spam is use of CAPTCHA. These solutions form huge challenges for visually impaired users. Because of this, there should be provided an alternative method of authentication.

Procedure

The evaluation was performed in January 2011 on the registration process current at that time. The evaluators received the specified heuristics, as well as some practical information and the other mentioned materials. After that, they had some time to perform the evaluation. This was done by themselves on the evaluators' own computers, so that the findings of the various evaluators would not influence each other.

When the evaluation was finished the evaluators kept the findings in the mentioned Excel spreadsheet, that later was sent to me for further examination. I then made a summary of these findings and tried to attach the findings to specific heuristics, if that was not done already. The last step in the heuristic evaluation was having a joint conversation with all the evaluators. We discussed the findings and tried to create a joint report of the findings.

An explanation of the findings gathered from the heuristic evaluation can be viewed in section 5.2 and also in appendix C.

[7] Cascading style sheets (CSS) is a language used to describe the look and formatting of a document written in a language meant for the web.

[8] JavaScript is a programming language that is primarily implemented as part of a web browser in order to provide enhanced user interfaces and dynamic websites.

3.4.3 User tests

User testing involves measuring the results of users performing given tasks that relates to usability or accessibility. A user test simulates a situation from real-life, it contains observation of users performing definite tasks and tests and is used to evaluate the usability or accessibility of a system (Toftøy-Andersen and Wold, 2011). These results are often used as pointers for improvement of parts with low usability or accessibility. These tests can also be called "usability tests", but as I see "user tests" as more neutral in relation to the focus of this thesis, this is the term that I have chosen to use.

What the focus of this method is can be shifted between what is relevant for the current study. In my study, the focus is the accessibility of the user registration, and the user tests will therefore be adapted in a way that serves the purpose of examining this. In contrast to heuristic evaluation, where a system is evaluated by a group of expert-users, user-tests can be performed by regular users. It is important that everyone in the study knows that *it is the system that is tested, and not the user.*(ibid., p. 63)

The measurements made regard to how easy it is to use the system/web site(effectiveness) the amount of time used to perform the task (efficiency), and the user's experience while doing the task (user experience).

Formal user testing are an empirical method that require the design of formal usability- or accessibility experiments that are carried out under controlled conditions. Testing can be conducted in a suitable laboratory or through field observations. The implementation of a user test can be divided into nine steps (Wixon and Wilson, 1997):

1. Define a task
2. Choose the test method and define the procedure
3. Construct the test materials and collect the needed equipment
4. Conduct a pilot test
5. Recruit the test participants
6. At the start of each test session explain the goals of the test and brief the participants about their rights.
7. Conduct the test session.
8. Thank and debrief the participants

9. Perform any initial analysis

As a part of this thesis, I have performed user tests together with visually impaired users, with focus on the accessibility registration process and identity management on Facebook. While planning and during implementation of these tests I have followed the mentioned steps presented by Wixon and Wilson (ibid.).

Participants

A key activity in user tests is to recruit a solid selection of participants. This has been a somewhat challenging matter as the desired participants needed to be blind or as visually impaired that they take use of assistive technology when using a PC. Thankfully I have had a lot of help from MediaLT on recruiting participants and they have provided me with hints of people that have been interested and able to perform user tests. As they have a solid network of people with various disabilities, MediaLT have been in charge of the initial contact with potential participants.

I have in this study performed four independent usability tests, in which the overall goal has been to see how users experience Facebook's registration process. On an earlier stage, it has been performed evaluations using an automated accessibility evaluation tool, in addition to heuristic evaluations with expert users, and some of the things I have looked for while using this evaluation method is whether the findings from use of the other methods affect the real users with special needs use of Facebook.

My overall ambition were to perform 4-5 user tests, which I would observe and to film on video camera. Together with MediaLT it became clear to me that the best and most convenient way to go about the tests would be to perform the tests in the participants' homes. There they have the setups they need and know well. If I wanted to do these tests in an external laboratory, it would perhaps lead to unnecessary and irrelevant factors, which could influence the performance of the participants and inhibit realistic behaviour. This gives the user tests some of the characteristics of field studies.

The importance of testing with more than one person can be said to be quite obvious. In order to get as realistic as possible findings, and cover a wide field of the real user base, I have had a desire to recruit participants of as much variation as possible. It has although not always been easy to find interested people, but fortunately I was allowed to become acquainted with four enthusiastic and positive people who wanted to participate and perform user tests.

The distribution of gender has been three women and one man. The age of the participants was relatively evenly distributed, as two participants were from 25 to 35 and the remaining two was from 45 to 55 years old. One thing that could have helped making this investigation more varied and strengthen the validity would be to perform user tests with younger users with visually impairments, maybe as young as 15-year old users. Due to the constraints regarding time and other scarce resources, this was unfortunately hard to fulfil, but on the other hand it can be said that this study has its validity in that the user competence has been as varied as it has.

The competence and skills that the users held was a variable that, in this study maybe more than other, played a very important role. Much can be said about that information systems and web sites should be designed so that everyone can use it. This goal is not always achieved, but there is a need for the user's competence, when it comes to use of PC and assistive technology, to be at a certain level, before we can start talking about universal design. This is something the participants in my study also have been aware of, and sometimes self-conscious about, while I also have stressed making a point out of that it is the system that is tested, and not the users. That being said, it is fair to say that an unknown percentage of the defects and problems experienced during the user tests partly can be connected to lack of experience and computer skills. More on this can be found in the user test sections in 5.3 and 6.2.

The participants I have had the pleasure of working with had, as written, varied competence and experience in the use of computers and internet. One of the participants had relatively little experience and low competence in the use of assistive technology, such as JAWS, while another participant currently works as an instructor in use of assistive technology, computers and internet. The remaining two had fairly similar levels of competence, but it was still quite divergent results from the tests these two participants performed. Three of the four already had their own Facebook account, but all of them explained that they needed help of a sighted third party to register that Facebook account. All three of them explained that they use the mobile version of Facebook several times a week.

Materials

When conducting user tests of a information system or a website, there are often some preparations to be done. There is rarely room to spend time on preparation while being on the participants' clock, which means that things should be in order when the test session starts. In addition to the importance of having carried out the tasks you have to, before the test begins, it is important that all material serves the purpose of the test, such as valid test tasks and other things that can affect how the test is carried out.

In my case, I tried to focus on these things, and aimed at being as prepared as possible. The fact that the participants have been blind has not had any impact on how I have prepared myself for the user tests. I had, like with the heuristic evaluation, prepared four e-mail accounts, which were intended for use in the registration process by each participant. Each participant was also given a fake first and last name, a password, a gender and a birth date, which were to be stated in the registration. In addition to this, they were also given their own picture that was intended for uploading as a profile picture. These data were given as a text and an image file on a USB pen, that the participants were given before the test began. In addition, I sent a letter of information and consent to the participants[9], which is recommended to do by the Privacy Ombudsman for Research (NSD) in Norway. I also had to apply for a license from NSD in order to make video recordings of the test sessions[10].

I was given the opportunity to borrow a video cameras and tripods by both MediaLT and of my research group at IFI, which have been valuable and indispensable tools for me as an observer, especially for the analytical work that was done after the tests. I also used a tool called Morae Manager 3.2.1, developed by TechSmith Corporation[11]. This program was heavily used during the user tests, along with a video camera, which let me make notes directly into the video sequences. Using this tool really eased the analysis work in very many ways and also allowed for the development of realistic graphs that I have used to represent the findings that were made. A screenshot of the program in use can be seen in figure 3.5.

For each user test, I had also made a task sheet that I used next to Morae. This helped me to keep an overview of which tasks I wanted the participants to perform during the tests. This sheet is included in the appendix F. I chose to use a grading on a scale from 0-2 of the results for each task:

0. Not completed
1. Carried out with help or with problems
2. Carried out without help and without problems

In addition to the materials that I had to provide and prepare for the user tests, the participants themselves provided the assistive technology that they needed for performing the tasks given. This included personal computers and necessary software installed, such as JAWS[12], in addition to loud speakers for speech synthesis as well as Braille keyboards.

[9] can be seen in Appendix E
[10] can be seen in Appendix D
[11] http://www.techsmith.com/morae.asp
[12] Popular screen reader software. Read more about JAWS in section 4.3.1

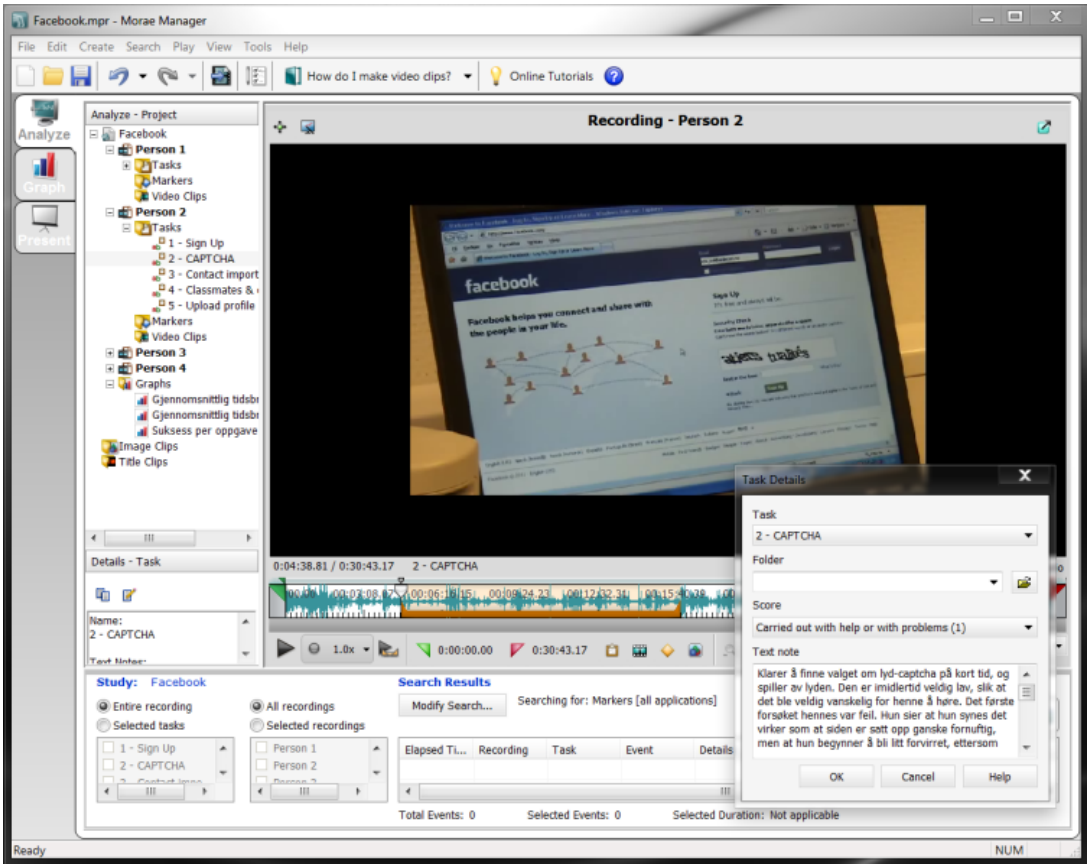

Figure 3.5: Screenshot of Morae Manager in use

Procedure

The user tests were performed in February 2011 on Facebook's registration process current at that time. The test sessions took place at the participant's workplace or home and I focused on making the participants feel comfortable with being filmed and observed during the user tests.

When I had positioned the video camera with focus on the computer screen, the sessions started with me explaining a little bit about what the focus in my master thesis is, as I also tried to shed light on the participant's level of experience and competence regarding use of computers, internet and assistive technologies through normal, free-flowing conversation. I did not ask them directly what their level of competence is like, as this could have been uncomfortable for them to answer.

A valid point that was emphasized by the first participant before the first session began, was that it was important that I gave as little clues as possible on what the meaning of the specific web pages was, as this in many ways could be said to defeat the whole purpose of the test. One of the key things in these user tests was exactly to see how the participants got to

know the web site and its pages. I therefore tried to hold back as much information as I could, but I had to give them some data, such as the profile information they needed to fill out while going through the registration process.

During the test sessions I made notes both by hand in the task sheets, in addition to making more formal notes as bookmarks in the video recorded in Morae Manager (mentioned in the previous section). The detail of the notes were restricted to superficiality of some extent, as I at the same time felt a need of being present and trying to experience the same as the user did. On that note, it may have been a good thing to involve another observer, so that it would be more certain that everything that took place was recorded in one way or another. That being said, the conversations that took place during the tests also hold valuable data, which have been saved in the recordings as well, and available for analysis at the next stage.

An explanation of the findings gathered from the user tests can be viewed in section 5.3.

"I had to get help to create a profile on Facebook."

Blind woman in survey of disabled people and social media
Tollefsen et al. (2010)

Chapter 4

Case

This chapter presents and describes the case in this thesis and the partners that I have collaborated with throughout the period. I will give a short presentation of the research projects involved and provide an overview of visual impairments and assistive technology. I will also give a presentation of Facebook, which is the focal point for evaluation in this thesis. First I will start off with describing the case and setting the stage for my study.

As mentioned earlier, my work and my thesis has been associated with two projects; e-Me and Nettborger. Therefore the primary objective of this thesis has been to provide new knowledge of accessibility of user registration and identity management in the social networking site Facebook. I contribute with valuable research on accessibility challenges in social media, and I am a part of creating a pool of knowledge that addresses the challenges related to accessibility- and inclusion issues in identity management. The project that inspired me to write this thesis was e-Me, which I describe in the following section.

4.1 e-Me

e-Me is a research project that began in May 2010 and lasts until 2013. The research partners Norwegian Computing Centre (NR), Karde AS and Tellu AS, in addition to the academic partners from the Department of Informatics and the Department of Private Law of the University of Oslo conduct the research work. Three case organizations (The Brønnøysund Register Centre, Storebrand ASA and Encap AS) and three organizations representing disabled users (Seniornett, Norwegian Dyslexia Association and the Norwegian Association of the Blind and Partially Sighted) also participate in the e-Me project.

The project addresses accessibility and inclusion issues and challenges in the research field inclusive identity management (IIDM). The primary objective of e-Me is to provide new knowledge that can significantly improve the usability and accessibility of identity management systems and authentication mechanisms in social networks without compromising privacy, security and legal frameworks.

4.2 Nettborger

The main focus in the project Nettborger is to explore how social media can be designed in a universal way (MediaLT, 2011). The project is managed by MediaLT, which is a company with a focus on universal design. The paramount objective of the project is to develop a proof of concept of how social media can be used to in order to encourage participation in the community for everyone. My thesis goes primarily under the scope of the first milestone in the project, which is about identification of central challenges concerning the accessibility of user interfaces in social networking sites. There is currently little research on which challenges that exist and how one can solve them. This functions as an emphasis on the validity and relevance of my thesis, and by being a part of this project, I can also be a part of advancing new competence in this field, in which there exists little knowledge. In the next section I will give an account of the company that manage this project, MediaLT.

4.2.1 MediaLT

Media Lunde Tollefsen A/S (MediaLT), call themselves a different ICT-company. Their area of concentration is technology aimed at people with disabilities and their goal is to help improve disabled people's standard of living in Norway through innovative research. They mean that technological solutions should be adapted in a way that enables as many people as possible to have the possibility to use them. The company offers adaptation, training and development within ICT for people with disabilities.

One of the fields MediaLT have increasing demand in is evaluation and development of accessible websites. They have thorough competence on universal design, and have focus on research and innovation. The company was established by Morten Tollefsen and Magne Lunde in 1999, and the fact that they both have visual impairments makes this company stand out as an important contributor in the field of accessibility in Norway.

In this thesis, MediaLT has provided me with valuable help in doing user testing, as well as giving me interesting data from a survey Nettborger held concerning disabled and use of social

media (Tollefsen et al., 2010).

4.3 Visual impairments

If you ask people which one of our six senses that is the most important, the majority would probably say the sight. As much as 80% of the sensory impressions are through the eyes. According to the World Health Organization, 130 000 Norwegians are so impaired that they have trouble with everyday tasks like reading the newspaper, recognizing people on the street and going to the store. More than 1000 Norwegians are totally blind, and visually impaired accounts for 25% of the world's disabled people (Blindeforbund, 2011).

The concept of "visual impairments" refers to people with irreparable loss of vision and this definition covers a wide area of various disabilities. Sight problems, such as those that can be corrected by glasses or contact lenses, are not included in this definition. Although, it does cover the impairments that can be corrected by medical intervention. Short-sightedness or long-sightedness are not visual impairments.

About one out of five registered visually impaired people can be described as seeing nothing at all. Many technically blind people have some useful perception of light and colour. The level of visual impairment can vary in proportion to lighting conditions and the form of the day. It may be constant condition or it could be one that is in gradual deterioration.

Many people have some type of visual problem at some point in their lives. Some can no longer see objects far away, others have problems reading small print. These conditions can often be easily treated with eyeglasses or contact lenses. But when one or more parts of the eye or brain that are needed to process images become diseased or damaged, severe or total loss of vision can occur. In these cases, vision can't be fully restored with medical treatment, surgery, or corrective lenses like glasses or contacts.

4.3.1 Assistive technologies

The following is an overview of helpful assistive technologies for people who have visual impairments. The list is composed by Tiresias (2010):

Braille displays Braille displays create a tactile translation of information on a computer screen. Some displays have a reusable, refreshable surface.

Braille embossers A Braille embosser is a printer that renders text as Braille.

CCTV systems/Video magnifiers A closed-circuit television (CCTV) or a video magnifier uses a stand-mounted or hand-held video camera to project a magnified image onto a video monitor, a television screen or a computer monitor.

Keyboards Large print keyboards featuring keys several times the size of normal ones. Also available are key top stickers with larger fonts and a 'glove with enlarged key markings that stretches over a keyboard.

OCR software Optical character recognition (OCR) software can be used with a PC and a scanner to copy printed text to a computer and store it electronically so it can be read by a screen reader or enlarged with magnification software.

Screen magnifier Software that will magnify a part of the screen and display it in an enlarged version elsewhere.

Screen readers Software that reads the contents of a computer screen, converting the text to speech. One example is JAWS, which stands for "Job Access for Windows and Speech". This is a screen reader program created by Freedom Scientific[1], which allows people who are visually impaired to gain access to information on their computers. JAWS provides access in two different ways: speech and Braille.

Speech/voice recognition software Software that allows users to give commands and enter data using their voices, rather than a keyboard or mouse.

Speech synthesizers Speech synthesizers convert electronic text to speech.

Stand-alone reading machines Stand-alone reading machines are an option for people who do not have a PC or do not want to use one. They combine a scanner, OCR and speech synthesis software so that printed text can be scanned and read by the same machine. The document is captured by the scanner, changed into text by the OCR software and then read out in synthetic speech.

4.4 Facebook

As written, I have chosen to evaluate the most popular social networking site (Halogen, 2011), Facebook, regarding the accessibility of its user registration process. This has been done by evaluating all steps necessary to register a user and end up at the home page within the account. The selection of site is based on the study performed by Halogen (ibid.), and the list of social networking websites ordered by popularity on Wikipedia (2010a). I have chosen the site that is the most popular, as well as having thorough personal experience with Facebook.

[1] http://www.freedomscientific.com/

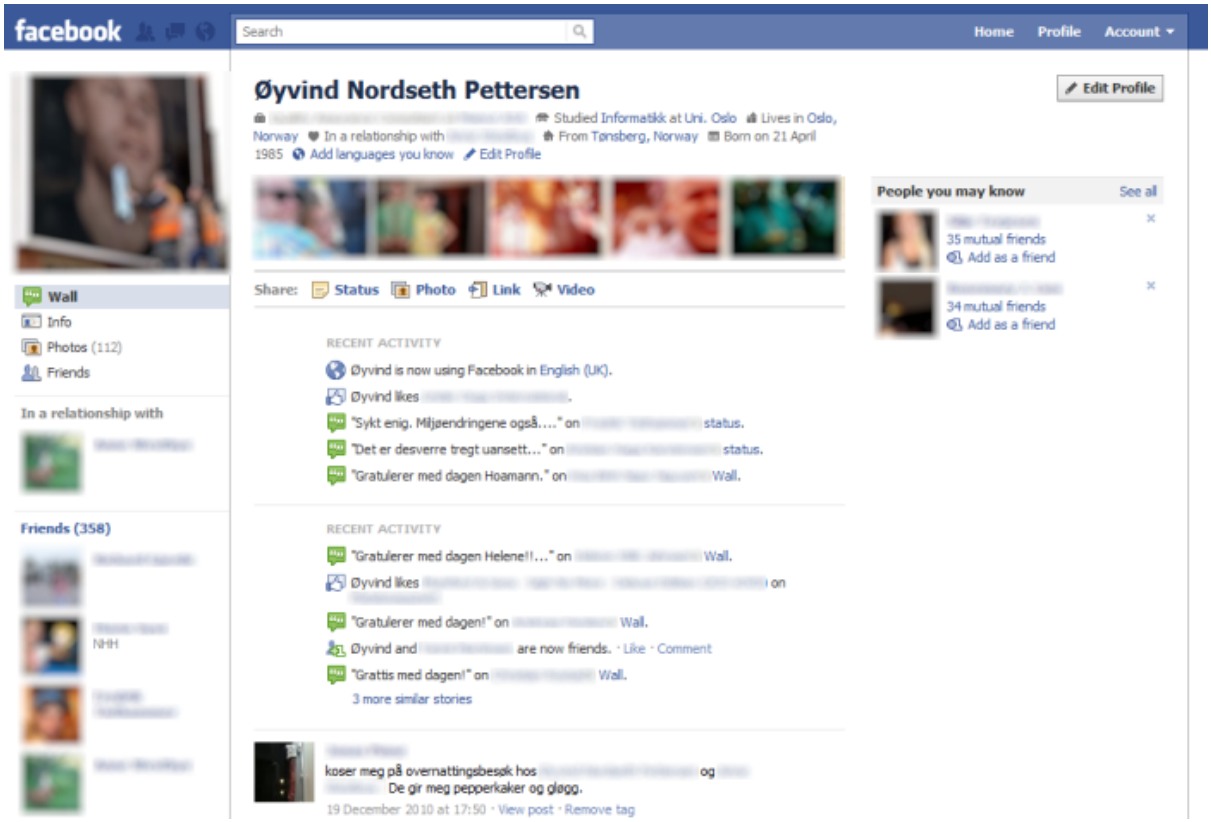

Figure 4.1: Profile page on Facebook (names and pictures are blurred)

Facebook is a social networking site and a social utility that has sprung from the renowned Harvard University, USA, where it in the first place was meant to be an online community for students and employees at Harvard. The name Facebook has its origin from school directories in USA that is handed out to all new students. Facebook was established in 2004, and according to Facebook themselves, the site gives people the possibility to share and make the world a more open place. It also helps you to make contact with friends that you haven't seen in a long time, make new acquaintances, as well as maintain the ones you already have. The main focus of Facebook is network building.

Even though Facebook originally is from USA, the social networking site has had massive support around the world, as more and more people have visited the site and made profiles. According to a study performed by Halogen, Facebook, as of November 2010, had over 2.5 million users in Norway and 564 million users globally (Halogen, 2011). This can although be seen as slightly excessive, as the same study mentions that Facebook base their numbers on the number of unique IP addresses and not on the number of users.

Facebook is built in a way that users creates profiles that contain personal information, pictures and interests. This profile is the foundation for the continued activity. Further on

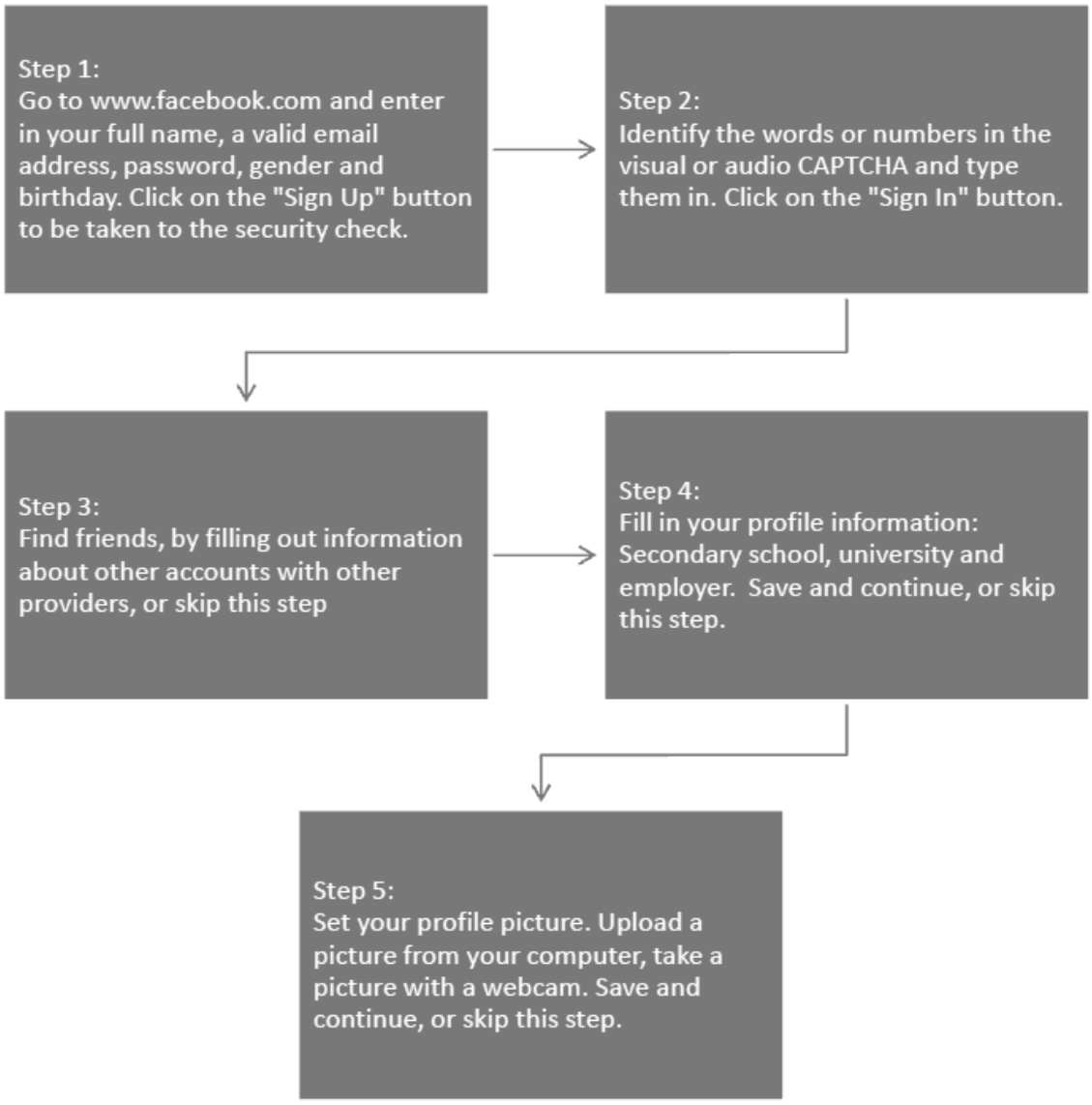

Figure 4.2: Flowchart of all the steps in the user registration process on Facebook

users then can create relationships with other users, exchange private or public messages and relate to different types of groups. Another fundamental feature to the experience of Facebook is a person's home page, which includes a news feed of his or her friend's updates.

With regards to the focus in my thesis, Facebook has already made some improvements in making their site more accessible for visually impaired users. Because screen readers do not handle web pages with more advanced computing codes as well, Facebook has developed a full HTML version of the site, which is examined further in the next section. In addition, Facebook has an accessibility help centre in place that offers frequently asked questions related to accessibility, and provides tips for users with assistive devices, but this page is not available

in Norwegian. They also provide an audio CAPTCHA alternative to the written CAPTCHA, making it possible for an assistive technology user to register with the site. While I have mentioned these slight improvements, my thesis will show that there definitively are still a lot of room for more improvement.

4.4.1 Facebook Mobile Site

As mentioned in the parent section, Facebook has developed a full HTML version of their site. This site is developed partially for mobile platforms, but this site can also be used when requiring a higher degree of accessibility. It is also worth to mention that this version of Facebook is free of challenging script languages, in addition to be relieved of CAPTCHA as the main authentication method.

It could be argued that this gives a higher degree of accessibility on Facebook, and there are no known indications of that it is insufficient for visually impaired users. It could also be argued that the mobile version is not necessarily easier to use for visually impaired users because it is designed in a more accessible way; it may be merely because it is so stripped of content. One challenge regarding this mobile version, however, is the lack of awareness of it, as I learned that few visually impaired knew of the possibility to use the mobile version on a desktop computer.

Figures 4.3 and 4.4 show how the start page and the registry page look like on this version.

Figure 4.3: Start page on Facebook's mobile version

Figure 4.4: Registry page on Facebook's mobile version

"I don't really know how to find what I'm supposed to find. All I see is a whole bunch of links with the same name."

Blind woman
PARTICIPANT IN USER TEST

Chapter 5

Findings

This chapter presents the findings that have been generated through the evaluation methods that I have applied; Use of an automated accessibility evaluation tool, heuristic evaluation and user tests. The research has been planned in a way that the differences in the results that each evaluation method generate are emphasized.

These findings help me to answer the research questions in this thesis. Findings from each method are presented chronologically as the methods were performed. Interesting and relevant findings are emphasized and brought further into the discussion chapter. First, I will go through the findings from the automated accessibility evaluation.

5.1 Use of an automated accessibility evaluation tool

The goal of this type of evaluation of the accessibility of user registration on Facebook, was to get an overview of the level of conformance with WCAG and which WCAG success criteria that are violated and considered as failures. From this it would be possible to get an indication of what type of problems that appear, without involving users in the evaluation process. As I was unable to specifically set Worldspace FireEyes to focus on violations that would apply specifically to visually impaired users, the findings are only representative when disabled users with different impairments are taken into consideration.

There were found totally 64 violations, all failing to conform to WCAG 2.0 level A, which is the lowest level of accessibility conformance. A complete overview of the results can be found in appendix B. As we can see in figure 5.1, the most common violations are the ones regarding the

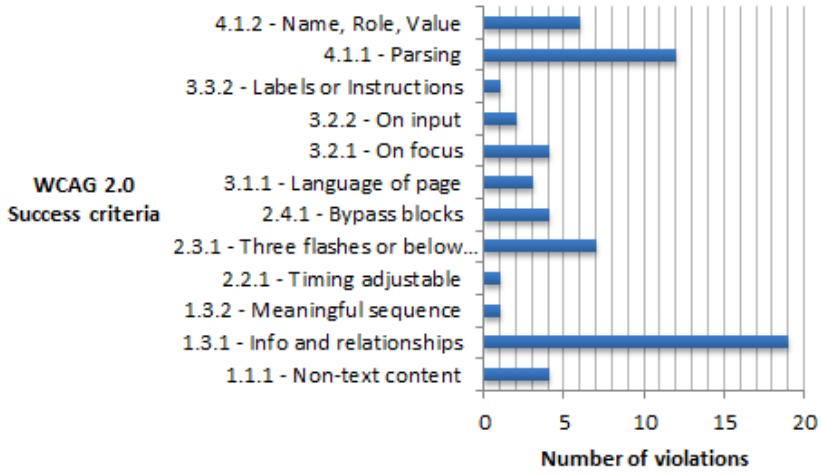

Figure 5.1: Violations ordered by WCAG 2.0 success criteria

perceivability of the web site. The WCAG 2.0 success criteria 1.1.1, 1.3.1 and 1.3.2 all focus on these violations. Issues that are symptomatic of this are many, and among other things, lack of alternative text on images and improper use of headings, title- and label attributes stand out. Figure 5.2 underlines the dominance of this type of problem, as nearly half of the problems that the tool discovered were related to the lack of text equivalents and improper use of attributes.

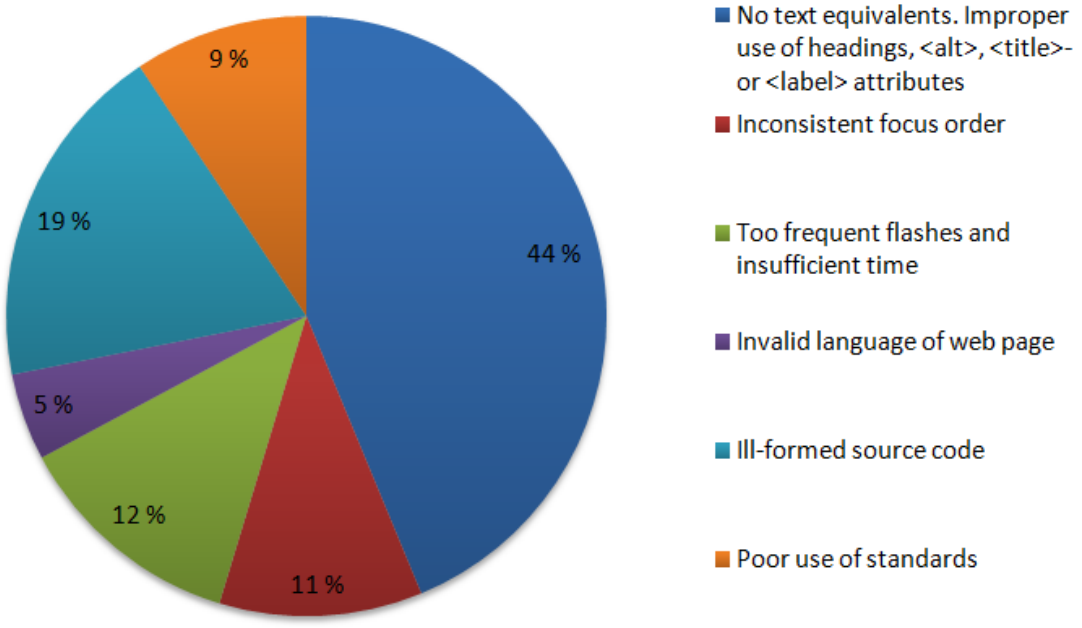

Figure 5.2: Accessibility problems found by Worldspace FireEyes

One of the other violations regarding perceivability, concerns the success criterion 1.3.2, meaningful sequence. This violation means that the order of the content in the source code differ from the visual presentation of the content. This may also cause serious confusion for assistive technology users, as screen readers read the sites sequentially.

Also frequently violated is the success criterion 4.1.1 that focuses on parsing. A fifth of the problems were due to ill-formed source-code. These violations can be said to disrupt the robustness of the web site, as content needs to be well-formed in order to be accurately interpreted and parsed by user agents, such as browsers and screen readers. This involves the need for compatibility, as Facebook violates this success criterion when it comes to the validity of the mark-up and the JavaScript used.

The language of the page is also considered through the success criterion 3.1.1. The web page's language should of course be set and also valid, in order to allow users with disabilities to be better equipped to understand the content.

5.2 Heuristic evaluation

This evaluation was conducted as planned, by having each evaluator using 1 to 1.5 hours each on carrying out the evaluation individually. Below is a list of aspects that emerged during the evaluation and discussion we had together. The overview is structured so that it follows the order of the heuristics. The spreadsheets that were used during the evaluation can be found in Appendix C, together with a detailed overview of the complete findings. A chart of the results can be viewed in figure 5.3.

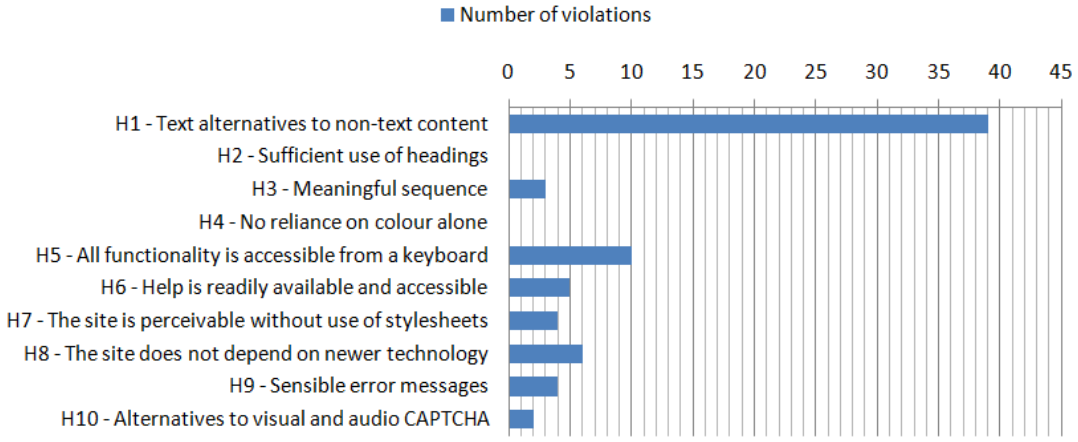

Figure 5.3: Accessibility problems found through heuristic evaluation

H1 - The website provides text alternatives for non-text content

The importance of providing text alternatives for any non-text content is often stressed as one of the most important features in accessible web design. This involves not only images, but also

form elements, such as text entry- and password fields, select controls such as dropdown menus, buttons and links. Important attributes when it comes to the mentioned non-text content are the `<alt>`-, `<title>`- and `<label for>`-attributes. All of these provide a possibility for assistive technology users to perceive the meaning of the elements on a web page.

This heuristic had the most violations and there were found a total of 39 violations regarding this on the five pages in the registration process. These violations were quite evenly distributed over the five pages, and the most frequent issue was the lack of meaningful alternative text on images. Some images had alternative text, but this was for the most part not meaningful.

It is a well known rule within web design and development that `<img>`-elements of smaller size than 8x8 pixels should be replaced by use of CSS techniques. Even though this often is complied with, there were many problems regarding this that were found during this evaluation, which often lead to confusion for assistive technology users. There were also an extensive use of incomprehensible numbers and letters as `<label for>`-attributes on buttons, instead of using sensible and informative texts. There was also proof of a quite common misconception, as many of the images have `<title>`-attributes that state what the image represents, but no alternative text. Use of `<title>`-attributes does not compensate for lack of `<alt>`-attributes.

H5 - All functionality is accessible from a keyboard

To be able to use the keyboard as the primary navigation tool is often a necessity for most visually impaired users. Not only does it open for total independence from use of mouse, but it can also help people with other disabilities overcome physical limitations, as well as having benefits such as alleviating repetitive strain. For this to be possible, web sites must be programmed in a way that allows for all functionality to be accessible from a keyboard. Designers of dynamic web sites with different functionality, such as Facebook, have many challenges regarding this. On Facebook, use of JavaScript, pop-ups and other advanced techniques makes it harder to maintain the rule of having all functionality accessible and available from keyboard only.

There are some techniques that can provide better keyboard navigation. One that has been with us for quite some time is use of access keys. These are permitted in HTML5[1] and are specified by using the access key attribute. The value of an element's access key attribute is the key the user will press, usually while holding down the CTRL-, ALT- or Shift-button on the keyboard, in order to activate or focus that element. One example of how to employ access keys is the following: `<a href="index.html" accesskey="h">Home</a>`.

[1] HTML5 is the latest revision of the HTML standard and a language for structuring and presenting content for the web. More on the possibilities HTML5 brings can be found in section 7.4

The opening page of Facebook had no violations when it came to keyboard use. Use of the TAB-button allowed for shifting of focus on form elements, but there were no use of access keys. As I will present further under H8 (JavaScript), Facebook does not function properly with JavaScript (JS) disabled. The "Sign Up" button on the first page, could not be accessed without JS. On the second page, with CAPTCHA authentication, it was not possible to get focus on the links "Try another text or an audio CAPTCHA". This makes it very difficult for visually impaired users that need to take use of audio CAPTCHA of obvious reasons. Also, it is not possible to get focus on the link "What's this?". It can be argued that these violations are somewhat connected to the issues experienced when examining the heuristic regarding meaningful sequence (H3).

Another issue that all evaluators experienced while testing by keyboard arose only when pop-ups appeared. When choosing to upload or take a picture, a pop-up appears, which we found not to be accessible through use of keyboard only, and this was one of the key topics for follow-up for the user tests.

H7 - The site is perceivable without use of style sheets

For the most part, screen readers parse pages as if style sheets were turned off. Therefore it is important that websites are functional, usable and accessible even without use of CSS. There are also possibilities for applying media-specific CSS, such as Braille (for output to a Braille tactile feedback device) and Speech[2], which became its own module in CSS3. If a web page depends on use of style sheets in order to be perceivable, it should be a minimum requirement that style sheets for various media types and devices follow.

Facebook's pages are generally perceivable without style sheets. Some notes have been made, although, as to whether the three first pages make enough sense to be accepted as fully perceivable. The two first pages have two additional dropdown menus that do not offer any meaningful information, which appears when style sheets are turned off in the browser. As this is confusing enough for a sighted user that navigates the pages through a browser, the confusion must be total for a visually impaired user that perceives the pages through assistive technology.

On the third page, one can see that it is taken use of frames for presenting the various service providers (Hotmail, Yahoo, etc.). It is questionable whether this is an accessible technique, as frames function as one web page inside another web page. The confusion must therefore be overwhelming for assistive technology users, also here. In addition, a lot of text that is meant to be hidden, appears when the style sheet is turned off.

[2]The Speech module was added in CSS 2.1 as a replacement for the aural media type, which was deprecated

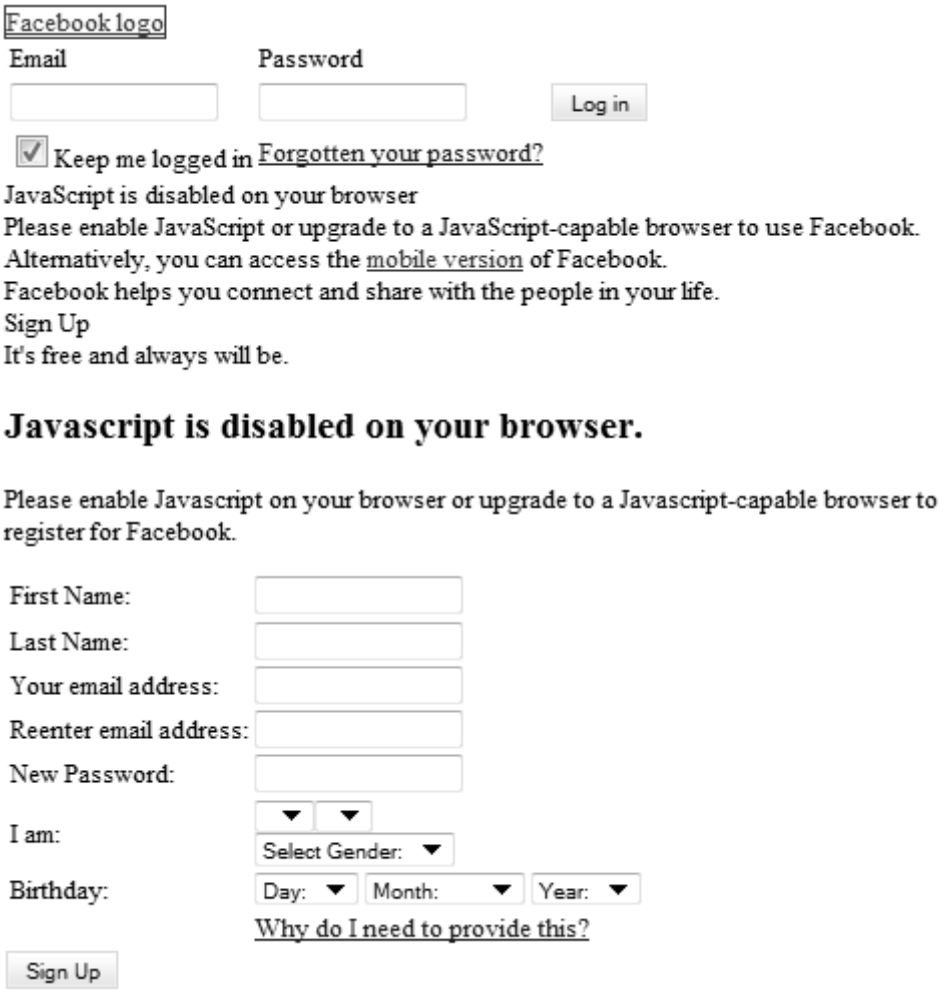

Figure 5.4: Facebook with JavaScript, style sheets and images disabled in Mozilla Firefox 3.6.13.

H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript

When JavaScript (JS) is turned off in the browser, Facebook asks the user to enable JS or upgrade to a JS-capable browser to use their site. This message also suggests an alternative, which is to access the mobile version of Facebook, which I have written about in 4.4.1.

Various functionality on Facebook does not work with JS disabled. For example, the "Sign Up"-button on the first page cannot be accessed without JS enabled, in addition to the whole CAPTCHA module on the second page that seizes to work with JS disabled. Also, to continue from one page to another is impossible without JS, in addition to the problems experienced on the last page in the process. On the fifth page, where the purpose is customization of the user's profile, uploading pictures, taking a picture or even continuing is impossible without JS. To top it off, one evaluator was even thrown back one step in the registration process, when JS was

switched off.

Due to all the issues we met when evaluating this heuristic, there was a consensus that Facebook does depend on newer technology. Neither Microsoft's Silverlight nor Adobe's Flash is used, but without JS, the pages were not usable or accessible. This makes it really difficult for users depending on screen readers and Braille tactile feedback devices, as problems regarding compatibility between assistive technology and newer technology such as JS often arise.

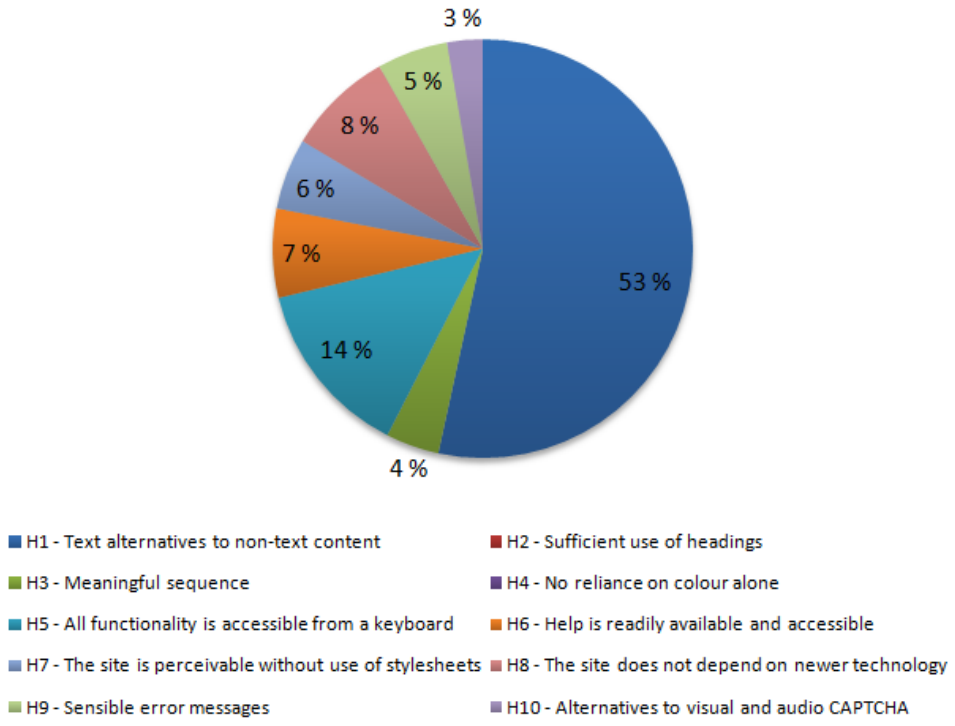

Figure 5.5: Accessibility problems found through heuristic evaluation, ordered by percentage

H10 - If CAPTCHA is used for authentication, are there alternatives to visual and audio?

This heuristic is regarding use of CAPTCHA authentication. This is a usual and well-known method of distinguishing between real human users and spam. It is already known that these solutions form insurmountable challenges for visually impaired users (Holman et al., 2007; Meiselwitz and Lazar, 2009). Facebook uses CAPTCHA for authentication on the second page in the registration process. The default application of it is visual. It is provided a link for trying different words, and audio CAPTCHA, but they were, as mentioned, not accessible by keyboard only. All of the evaluators agreed that the audio CAPTCHA was totally incomprehensible, as the sound is scrambled with really low resolution, and the voice speaks in English in a much too high tempo. In addition to not working without JavaScript, all of these issues shape stumbling

blocks for specially visually impaired users, and were also added to the queue of interesting subjects for confirmation when testing with real visually impaired users.

5.3 User tests

In this section I go through the findings from the user tests ordered by each step in the registration process. This is primarily because I believe that this can provide a better overview and understanding of which of the steps the findings relate to, and that it therefore will give a better indication of which functionality that can be seen as the most challenging and problematic for visually impaired users.

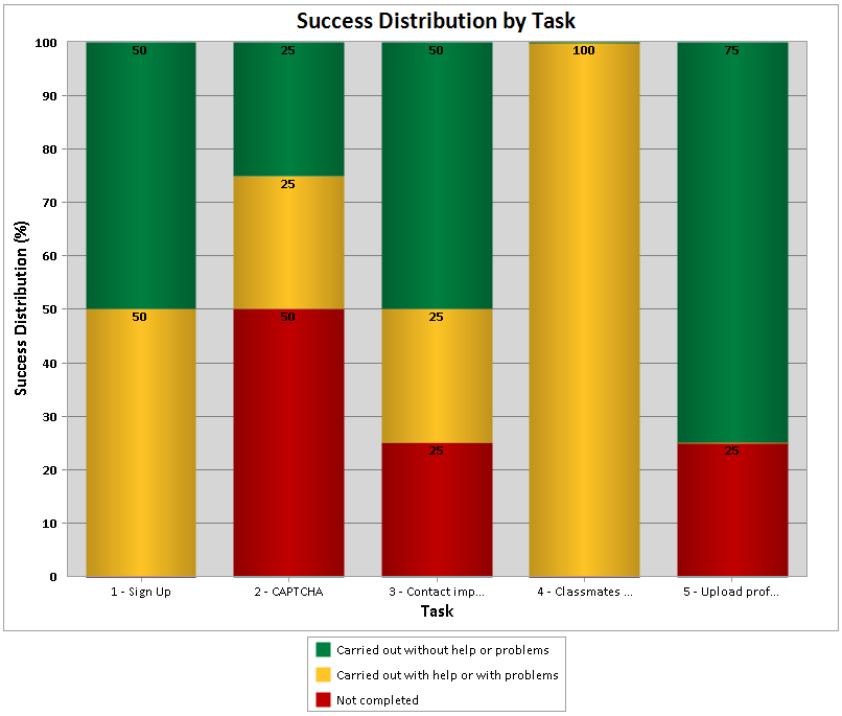

Figure 5.6: Success distribution in user tests ordered by task

The figure 5.6 shows how the participants solved the tasks they were given and that they had to go through in order to register a profile on Facebook. One can see that some of the users needed guidance on many of the steps, and it was apparent that some of the users experienced difficulties. In these overall results it is 40% yellow, which represents instances of users that carried out a step with help or with problems. However, the figure also shows that 40% of the total results are green, which represents steps where the users did not have any problems or were in need of help from the test leader. The remaining 20% is red, which means that the steps were not completed at all.

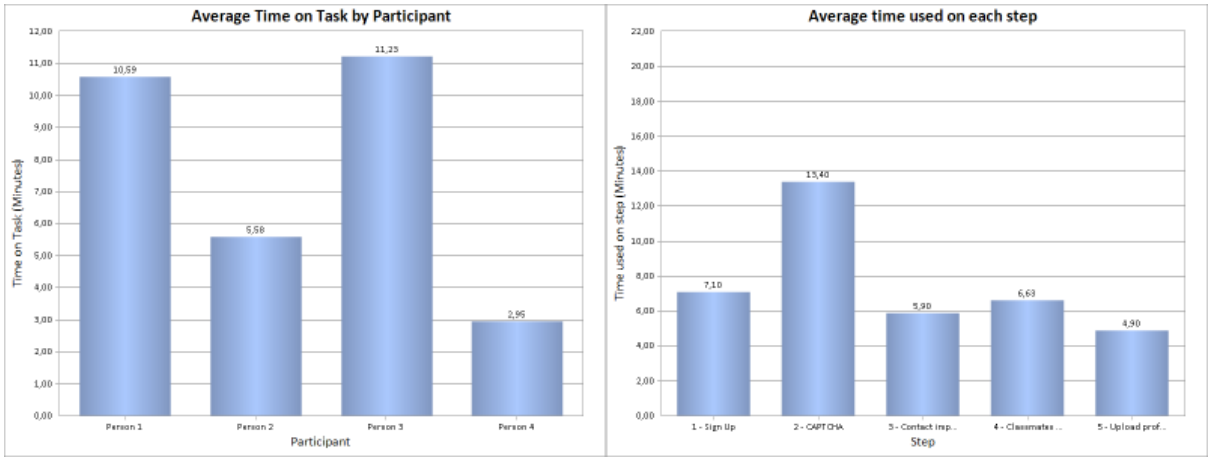

Figure 5.7: Average time used on each step ordered by participants (left-hand side) and by step (right-hand side)

5.3.1 Step 1 - Sign up

There was some confusion for two of the participants regarding what fields they were to use in order to enter the information needed to register an account with Facebook. They were frustrated by first finding only the login fields, and it took quite a while for them to find out where they were supposed to fill out the registration information. The two other participants knew from experience that the fields they came across first were the login fields, and that they were to be used only when logging in, but not when signing up. This step can therefore be said to lack structure and contain sequences that can be perceived as illogical. As we can see in figure 5.8 there are quite obvious differences in how easy it is to understand where to begin, and what the logical order of the fields is. On the right-hand side in the figure we can see the user interface that sighted users experience, and on the left-hand side we can see how the screen reader JAWS perceive and present the same page to visually impaired users.

In addition to the problem mentioned above, two of the four participants experienced problems when they tabbed between different fields. It was discussed whether this was due to incorrect settings in the screen readers, but we agreed in both occasions that it was due to inadequate use of titles and labels on the fields. Because of this, much of the functionality of the speech synthesis was influenced by pronouncing wrong names on the said fields. Some items were also read out as having “no label”.

Error messages that the participants received appeared below the “Sign Up”-button, which we can see in figure 5.9. As only parts of the site are updated when error messages appear, this can result in a loss of sync between the browser and screen reader, and the latter will not be able to present the messages to the user. These error messages are not presented in a

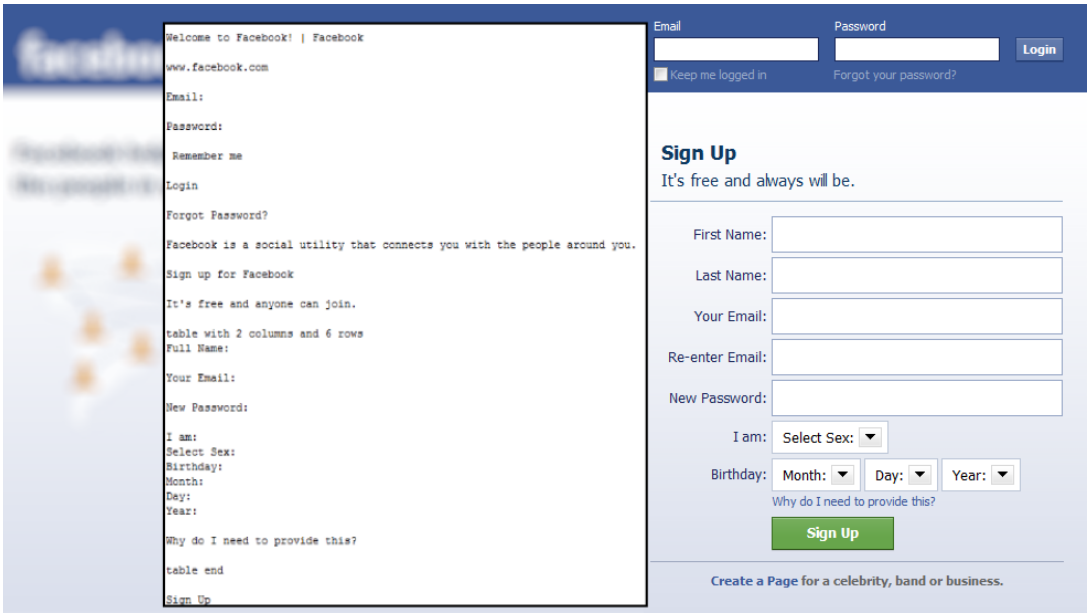

Figure 5.8: Differences in how sighted users (right-hand side) and JAWS (left-hand side) perceive a web site

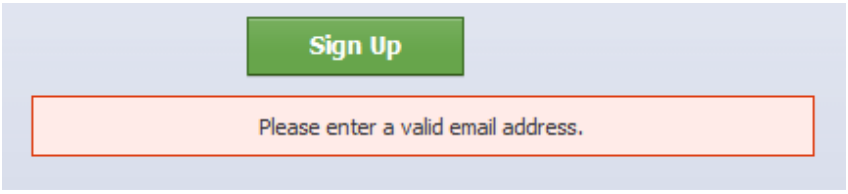

Figure 5.9: Placement of error messages on the sign up page of Facebook

sensible way, and this will again lead to confusion for the visually impaired users, as they are unable to understand what the problem is. This occurred frequently, at least once for two of the participants, and therefore represents a major challenge.

Two of the four participants went through this step without any problems or help, while the remaining two had problems or needed help. The main differences between these two groups may be the experience and competence in the use of computers and internet.

5.3.2 Step 2 - CAPTCHA

The step that involved the CAPTCHA authentication method was expected to contain the main challenges in the registration process on Facebook. CAPTCHA is a controversial method of authentication, mainly because of its obvious lack of accessibility in relation to visually impaired users. An aid that Facebook has provided, with the goal of making this process more

accessible, is CAPTCHA in audio form. Whether this works and makes the authentication feasible was one of the key points I was hoping to verify or invalidate in this step.

All of the first three participants managed to find the link that offered audio CAPTCHA in a relatively short time. The last participant had an alternative method for solving the CAPTCHA, which I will come back to. When the playback of the audio CAPTCHA started, several problems emerged. All of the three participants that tried to use the CAPTCHA felt that the words were read out too quickly, that it was difficult to hear the nearly incomprehensible words because of the background noise that was added, in addition to that they thought there were too many words that they had to catch. One of the participants found it a challenge to remember all the words, and needed to use a text editor to note the CAPTCHA that was read out.

It became clear that the participants were dependent on making individual preparations before the audio CAPTCHAs were played. As mentioned, one participant felt the need of having a text editor ready because he did not manage to find the field for input in time. Another participant was concerned that the volume would not be loud enough. In addition, it was a recurring problem that the audio CAPTCHA interfered with the speech synthesis, which therefore meant that participants had to disable the screen reader before the CAPTCHA started.

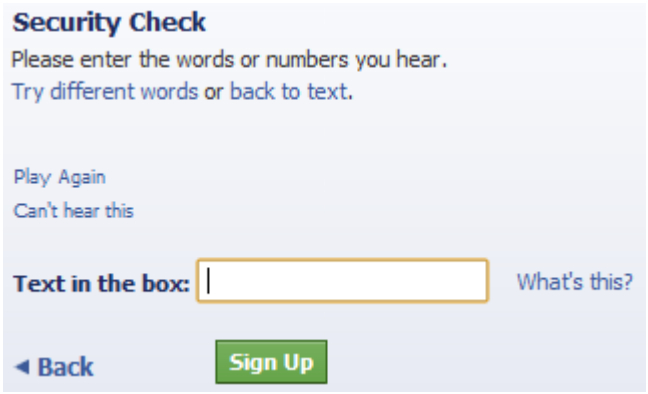

Figure 5.10: The audio CAPTCHA on Facebook

To complete the audio CAPTCHA, seen in figure 5.10, on the first attempt seemed almost impossible to do for the participants. Three out of the four participants needed many attempts, and only one of the three who used audio CAPTCHA managed to complete it on her fourth attempt, after 15 minutes of trial and error. Because it occurred so often that they needed more than one attempt, it was important that it was easy to play the audio CAPTCHAs again or try other audio CAPTCHAs. This was the cause of major problems for everyone involved. One participant did not even find the “Try again” link and had to turn the screen reader on and off, and then perform the first step again. When he tried again he received a message that

said that he had used too much time to resolve the CAPTCHA. The link that would provide an opportunity to play the sounds again was not presented as a link in the screen reader for two of the participants, which caused great confusion. The text was visible for them, but it was not always clickable.

In addition to all the other challenges there were also time limits. Several participants admitted that they became stressed when they learned that there were time constraints involved. As they use their hands to both read and write, it is difficult for them to do both simultaneously, and time limitations are therefore stressful and form the cause of much frustration. This error message was, in addition, not visible to the participant, as those mentioned in step 1. One participant had never perceived the error message that the text she entered did not match the security check. When a new attempt on entering words was made and the participant chose "Sign in", she was sent back one step to the first page in the registration process. Eventually, she realized this, and she figured that she had pressed the "Back"-button instead of the "Sign in"-button by fault. This was arguably because of the lack of intuitive and logical tabbing order.

"Play again" is not available as a button and it can be said that the problems that arose around this can have something to do with *JAWS*/other screen readers and their compatibility with JavaScript. In addition to the above-mentioned problems and challenges, there was also a recurrent issue that the form fields from step 1 always were visible in addition to the form fields in step 2. This adds to the notion that this step also lacks structure and contain illogical sequences.

The fourth participant had no problems with authentication through CAPTCHA. The reason for this was that she used the web browser Mozilla Firefox[3], and were therefore able to use adaptations that help making web pages more accessible, such as Webvisum[4], which helps solving CAPTCHAs and the problems that come with them. The functionality of Webvisum contains:

- Adding a name to page links that have no names or that are poorly labelled
- Adding a name to page titles that have no names or that are poorly labelled
- Adding a name to page forms that have no names or that are poorly labelled
- Adding a name to images that have no names or that are poorly labelled
- Extracting text from navigational image menus
- Solving CAPTCHAs

[3]Mozilla Firefox is a free and open source web browser. As of March 2011, Firefox is the second most widely used browser in the world (W3Counter, 2011). More information can be found on http://www.mozilla.com/nb-NO/firefox/

[4]Webvisum is a web browser add on that enhances web accessibility and empowers the blind and visually impaired. More information can be found on http://www.webvisum.com/

I learned from this participant, who has quite some experience and currently works with training other visually impaired people in the use of computers and Braille, that most visually impaired users use Internet Explorer because JAWS has not worked with Firefox/other browsers until recently. Older versions of JAWS than 10.0 work only with IE and even though that there now are versions that support other browsers, it still takes time before the habit of using IE is altered. *"Many are afraid to try new things and that very few people know about alternatives to IE."* she said.

To take use of the advantages of using Webvisum, you need an invitation, as well as having Mozilla Firefox installed on your computer. When the add-on is switched on in Firefox, you have to right click on the page containing the CAPTCHA, and from the menu, choose "Solve CAPTCHA". A few seconds later, the words are sent to the clipboard as plain text, and it can be pasted into the required field. The participant said that sometimes she has to try twice in order for Webvisum to resolve the CAPTCHA, but she has never needed more than two attempts. The participant used relatively little time to orient herself on the web page, in her attempt in the user test. Eventually, she found out that this was the page that contained the CAPTCHA security check, which did not involve any special challenges, as she used Webvisum. She right-clicked and selected "Solve CAPTCHA", and soon found the CAPTCHA on her clipboard. *"It could not be any easier!"* the user said, as she pressed the "Register"-button.

Two of the four participants could not complete this step, while one of them needed four attempts and had some problems and need of help. The last participant completed the CAPTCHA without any problems or need of help. The main difference in the completion of this step may also here be the experience, competence in the use of computers and internet and also knowledge of helpful tools, such as Webvisum.

5.3.3 Step 3 - Contact importer

There were varying results in terms of completion in this step. Two of the users completed the step without having any significant problems or need of help, while the remaining two experienced major problems, with one of them having to give up. The biggest problem and something that was consistent for all of the participants was that they became uncertain and confused regarding which fields that was appropriate to enter information in. One of the participants emphasized that there was very little use of headings in this step, which made it difficult to understand what this site was about. The only header that was available was "Getting started".

As pointed out in figure 5.11, a huge problem for most of the participants was that there were many links and buttons with the same name "Find friends", a total of five. The problems with poorly named links and different elements with the same label, caused much confusion.

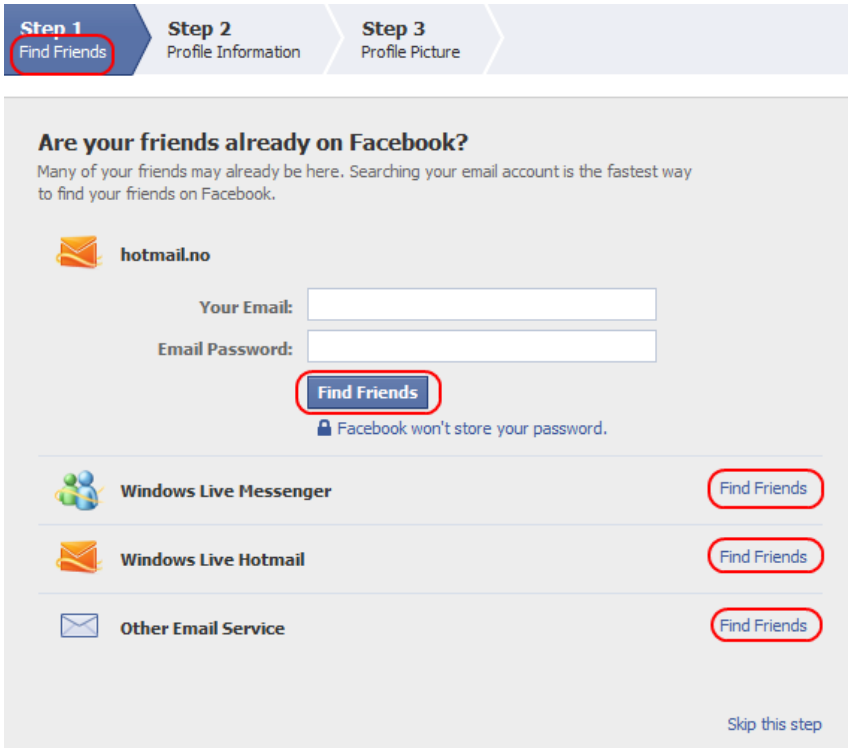

Figure 5.11: Numerous links with the same name when importing contacts on Facebook

One of the participants missed the appropriate field, and typed her e-mail address and password without really having entered anything.

In addition, there were some challenges associated with the pop-up window that appears when you have entered an email address and password. For one of the participants the pop-up window made Internet Explorer (IE) crash, which meant that we had to restart both IE and the screen reader. Another participant's screen reader did not find the pop-up window at all, which made it impossible for this participant to complete the step.

5.3.4 Step 4 - Classmates & co-workers

None of the participants managed to complete this step without having any difficulties and problems or needing help from the test leader. There can be various reasons for this, but it is obvious that this step contained elements of various technology that posed challenges for the participants. The site is built in a way that lets the users enter information about themselves into the different text fields, and as they fill out the fields, drop down menus appear below each field. These fields act as predictive services that come with suggestions on what to write and provide an auto-fill function. The first field is for "High School", which has an associated "Class year" field. The same applies to the field for "College/University". These drop down menus and

"Class year" fields were the focal point of the problems that occurred in this step.

Technology that is based on dynamic changes of only small areas of a web page at a time has previously shown to be challenging for users of screen readers and Braille keyboards. Some of the participants' speech synthesizers said that there was a "List of four items", when they discovered that the predictive dropdown menus existed, as in figure 5.12. The items in these menus however, were not possible to choose, as they were not clickable. The remaining participants never realized that the dropdown menus appeared at all.

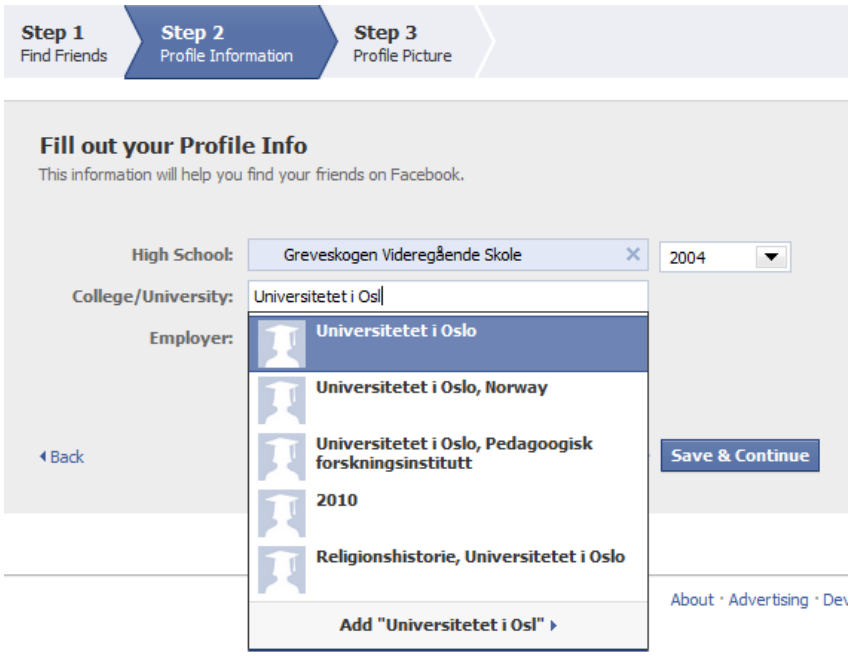

Figure 5.12: Dynamic menus that appear when filling out profile information on Facebook

After filling out the "High School", "College/University" and "Employer" fields, all of the participants continued to the "Save & Continue" button, without having knowledge of the two "Class year" fields that also were present. As mentioned, these fields appear dynamically and are thus not visible until after the participants had tabbed further. This is problematic because the screen reader are unable to perceive this in advance, which means that the focus order in the tabbing becomes faulty.

The two "Class year" fields that are adjacent to the two aforementioned key fields must therefore be searched for by the participants in order to be perceived. It is clear that it would be more meaningful if the tabbing sequence had made the users arrive on these fields directly after each of the key fields. Some of the participants clicked on the "Save & Continue" button without even knowing that the "Class year" fields were not filled out. They never received any notice of this, which made it impossible for them to learn about the fields at all and thus be able to take advantage of their functionality. The technology used in this step is clearly not

optimal with use of screen readers.

Apart from the fields mentioned above, that appeared dynamically, the fields on this page seemed to be relatively simple and easy for the participants to keep track of. The fields all had good enough labels, so that everyone understood what the meaning of the fields was.

5.3.5 Step 5 - Upload profile picture

The last step in the process that one must go through in order to create an account and a profile on Facebook is the one that deals with uploading a profile picture. Tasks like this can often be challenging for users with visual impairments, because tasks such as opening file browsers and taking use of advanced controls to upload pictures often are made possible through use of more advanced technology than regular HTML. On Facebook, it is no different, as the pop-up window, which we have become familiar with through the previous steps, is important also in this step. It was therefore interesting to see whether the participants were able to complete this task without any problems and whether they found it challenging and problematic. Each participant was given an image file beforehand, which was put on the local test machine that the participant used. The test did not have any focus on whether the participant was able to navigate the file system on the machine, as this can be said to be outside the scope of this thesis.

Three of the participants, all with their differences when it comes to age and competence, all had great success in completing this step. There were no problems for anyone of the three in using the pop-up window seen in 5.13, and all of them took use of the controls that opened the file browser without any problems. Links and buttons in the pop-up window, in addition to the main window, were all very simple and easy to find.

For all of these three participants, there was some uncertainty at first, especially regarding the purpose of the web page. All of them spent some time looking for hints on what the page was about, but eventually they found out what they were supposed to do.

The last participant experienced greater problems than the other participants. She also struggled with understanding what the page's purpose was, but she could not figure it out. She explained that she felt that it was far too little use of headings on this page. She searched for form fields and could only find the "Save & Continue" button. She then searched for links and found the "Upload picture" link. The pop-up window that then appeared was completely invisible to her, but at long last she found the "Browse" button, that she found impossible to click on. This participant did not wish to continue and gave completing this step up.

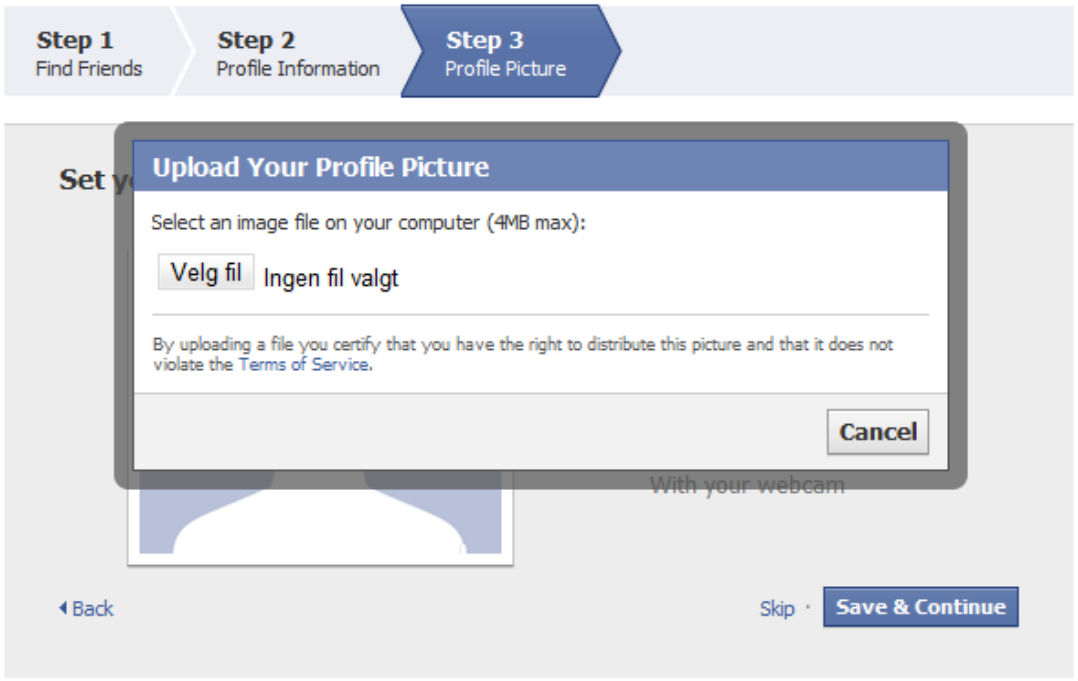

Figure 5.13: The pop-up window that appears when uploading a profile picture on Facebook

The participants spent the least time on this step in average. The first three participants used very little time and completed the step without experiencing any problems or need of help, and therefore represent a success rate of 75%.

"There should be training in the use of social media. It isn't easy to learn this all on my own."

Partially sighted person in survey of disabled people and social media
Tollefsen et al. (2010)

Chapter 6

Discussion

Several evaluation methods have been applied in order to increase the reliability of this study. Every method used supports one another and all lead to interesting information about the accessibility of the user registration process on Facebook and the validity of the methods. In this chapter, I will discuss the findings from the different evaluation methods, but to begin with I will discuss the curious relationship between usability and accessibility, with a basis in the articles reviewed in the theory chapter.

6.1 The relationship between usability and accessibility

The following part of the discussion deals with the terms usability and accessibility and has a goal of making the relationship between them clearer. This part of discussion has a theoretical focus and I found it relevant to discuss the following research question: ***What is the relationship between usability and accessibility? How do the one affect the other?***

As the article of Huber and Vitouch's goals was to break down the unclear relationship between the two key terms accessibility and usability, I had expected to see clearer definitions of them. There is some vagueness in what definition of accessibility they side with, although they refer to Petrie and Kheir's (2007) study and how they describe accessibility and usability problems. As mentioned, Huber and Vitouch's approach to the problem revolved around testing three websites with differences in WCAG conformance levels and evaluating their respective usability. They clearly state that their findings express that web sites that are more accessible, also are more usable (Huber and Vitouch, 2008).

It also appears from Huber and Vitouch's (2008) article that accessibility factors are equally important for all users, non-disabled as well as disabled users. This is interesting, as it points toward accessibility problems being a sub-set of usability problems, as proposed in Thatcher and Waddell's (2003) article and also mentioned in Petrie and Kheir's (2007) study.

Petrie and Kheir (2007) refer to the usability definition provided by ISO 9241 (ISO, 1998), and attempt to establish a similar definition for accessibility, because of the unclear specification of the concept. As Huber and Vitouch (2008) do, Petrie and Kheir also state that little empirical data that deal with the relationship between accessibility and usability, currently exist.

I think that Petrie and Kheir (2007) make more of an effort than Huber and Vitouch (2008), when it comes to defining accessibility. It seems apparent to me that in order to compare two terms and their relationship in the best way, distinct delimitations and definitions have to be made, and this is exactly what Petrie and Kheir's (2007) article do, and in my opinion Huber and Vitouch (ibid.) fail to do in their article.

By using the two terms *usable* and *technical accessibility*, I think that Petrie and Kheir (2007) emphasize the two most prominent aspects of accessibility. It seems clear to me that they wish for designers to focus more on the user-centred definition of accessibility. How can one combine these definitions to achieve the goal of accessible websites? In addition to this, they propose another independent definition of accessibility, which is quite similar to the one of usability given by ISO (1998).

The findings presented in Petrie and Kheir's (2007) article convey that the proposed relationship between accessibility and usability regarding *universal usability*, which is illustrated by figure 2.7, is the most fitting. This is in contrast to the conclusions made in Huber and Vitouch's (2008) article, that can be said to support the second model, where accessibility problems is seen as a sub-set of usability problems, illustrated by figure 2.5.

Also mentioned in Petrie and Kheir's (2007) article is the formulation that points toward usability problems being a sub-set of accessibility problems. This can be said to be erroneous if one examines a simple example. If an image on a website is missing the `<alt>`-attribute, meaning that there is no alternative text to represent the image, a visually impaired user that uses a screen reader would lack the possibility to know what the image represents. This would on the other hand have no influence on non-disabled users' perception of the image. This is a good example of accessibility problems that cannot be seen as a problem for non-disabled users. This is also coherent with the conclusions in Petrie and Kheir's (2007) article.

Another important finding that is made in this article is the lack of relation between user-tests and WCAG ratings. Can it be said that this in a way invalidates some of the findings

in Huber and Vitouch's (2008) study? The test portals used in Huber and Vitouch's (2008) study were built with different levels of accessibility, based on the WCAG levels A and AA. Can it then be said that the lack of a significant relationship between user ratings and WCAG challenges this approach in some way? Petrie and Kheir (2007), as well as Huber and Vitouch (2008) all express that it exists little empirical data to support that websites that conform to the WCAG-requirements possess a higher amount of accessibility. Petrie and Kheir (2007) also mention a study by the Disability Rights Commission in the U.K., about the relationship between conformity with WCAG's guidelines and user-experience. The investigation points out that the relationship was anything but distinctive. (ibid.)

The third article that I examined was that of Yates (2005). The goal of Yates' (2005) study was to get an overview of the close relationship between the two terms, as the other two articles also have focused on. In the discussion regarding how the two concepts are related, I think Yates (ibid.) makes some really valid points. While he mentions that the relationship can be seen as a system of two distinct entities, he also states that they are somewhat interlinked with each other and difficult to apply or view in isolation from each other. I would say that these thoughts very much relate to Petrie and Kheir (2007), and the *universal usability*-model proposed in their article. Also in relation to Petrie and Kheir (ibid.), Yates (2005) makes another vital point that although there are clear, similarities and relations between the two concepts, it cannot be definitively stated that all accessible sites will be usable. The point that he makes about a site that is in conformance with an accessibility standard, which still can fail usability tests, supports the doubts that Petrie and Kheir (2007) express regarding the lack of a significant relationship between user ratings and WCAG.

The figure in Yates' (2005) article that is reproduced in this thesis (figure 2.8) can also be seen as an extended and complementary version of the model of *universal usability* presented in Petrie and Kheir's (2007) article (figure 2.7).

As more insight in the relationship between usability and accessibility now exists, the following section discusses the accessibility challenges that exist in the user registration process on Facebook. I will also go through and discuss the most prominent findings that were discovered throughout the different evaluation methods.

6.2 Accessibility challenges

This part of the discussion deals with the actual accessibility challenges that I uncovered through the evaluation methods used throughout the period. I will discuss the findings presented in the preceding chapter, and produce an overview of them. This part of the discussion forms the empirical basis of this thesis and revolves around the second research question: ***What are the accessibility challenges with actual practices used on Facebook as of today, when it comes to user registration and identity management?***

The findings that came out of the automated evaluation, as seen in figure 5.2, tell us that the majority of the accessibility violations were due to improper use of headings, `<alt>`-, `<title>`- or `<label>` attributes. To include these attributes, and thus give elements text equivalents when developing a website of proper validity, can be seen as quite elementary. Although, according to the findings made through evaluation with FireEyes, as well as the heuristic evaluation, this is one of the major problems regarding the accessibility of the registration process on Facebook.

Images on websites can be used as elements that provide information, or to function merely as aesthetic aids for layout purposes. Many designers insist on using images for layout purposes instead of for example using CSS (Cascading Style Sheets). There can be few doubts as to whether useful alternative text should be provided. Although, on the other hand, it may be argued that to provide a text equivalent to each and every graphical element on a website simply is unnecessary, because of the mentioned widespread way to use images for layout purposes, as Lazar et al. (2010) argue. Is there really a need for giving an image, representing a horizontal line, an alternative text that says `<alt="horizontal line">`? Some of these violations can also be said to identify false positives - problems that don't actually affect users.

While it is possible to say that the alternative text example above is of no use, I think that exactly this problem lies another place than whether text equivalents are provided or not. The technique of using image-files for these layout purposes can itself be viewed at as highly inaccessible and outdated, because it mixes layout with the content and vice versa.

The problem of missing text equivalents is not limited to only concern images and `alt`-attributes. Assistive technology users depend on proper use of headings for navigating through a website's structure, such as the `<h1>`-`<h6>`-tags, as well as depending on the `<title>`-, and `<label>`-tags, as parts of forms. How can a visually impaired user that for example uses a screen reader navigate through text entry fields in a registration form, when the fields are missing titles and labels? Select controls and password fields are just as relevant, and shortcomings in this area were also found under the evaluations. These violations represent major challenges for visually impaired users. The mentioned flaws are also related to the next type of problems

discovered, namely inconsistent focus order and ill-formed source code.

As we can see through the discussion above, the mentioned problems are all hugely related to code-specific defects. But when for example the order of the content in the source code differ from the visual representation of the content, problems also related to user experience will occur as a result of the violations in the code regarding accessibility standards.

On the other hand, through heuristic evaluation performed by expert users, using only keyboard for navigation, a fair amount of insight in some of the aspects of how visually impaired users actually experience and use web sites could be extracted. For people that are used to employing the mouse as a primary navigation tool, it can be difficult to fully appreciate the style of navigating through keyboard only. Evaluation of the heuristic that concerned use of keyboard was although maybe the part that was performed in the most realistic manner, in the heuristic evaluation.

The problems that are mentioned above were prominent when employing the inspection-based evaluation methods; automated and heuristic evaluation. I also performed empirical examinations by conducting user tests, and after I went through the five steps of registration on Facebook with four visually impaired participants, a lot of new information and interesting points for discussion arose. More than one step lacked structure and contained sequences that were not logical. Steps 1, 2 and 4 all had instances of problems regarding illogical sequences and meaningless structure, and most distinguished were the problems that arose when tabbing between fields.

As I already had seen indications of in the other evaluations, there was some insufficiency in the use of titles and labels on non-text content, as well as lack of headings. The participants in the user tests experienced some problems regarding this in steps 1 and 3. However, I would have expected that the participants would experience greater problems due to lack of text alternatives, than what was the case. The findings from the two initial evaluations indicated that this was the largest set of violations, but these did not inflict the participants too many problems.

What caused a lot of frustration, irritation and confusion were the dynamic content that more than once were presented in an unreasonable way for the visually impaired users. The participants experienced problems regarding this in nearly all of the five steps. The problems with the dynamic updates of the content on Facebook were arguably due to problems related to compatibility between JavaScript/dynamic web pages and screen reader technology. This can also be said to be a classic example of problems that can occur with dynamic sites and users using only a keyboard.

Dynamic websites that only have parts of the content being updated often produce problems regarding synchronization between browsers and screen readers in general. This was apparent especially when error messages, pop-up windows and dynamic drop down menus appeared, as these were not presented in a sensible way for the visually impaired users. These were among the problems that the automated and heuristic evaluations did not discover, but that were dominant when visually impaired users were involved in the empirical evaluation.

A lot of the technology that is used in some of the steps is clearly not optimized for use with screen readers and other assistive technology. This was obvious when pop-up windows appeared, but could not be accessed, in the CAPTCHA module, where links were not clickable, and also the dropdown menus in step 3, that were not even perceived by most of the participants. I learned that the aid of providing audio CAPTCHA was far from an accessible solution, and in stead offer many challenges and problems of its own.

Audio CAPTCHA is indeed provided, but as this method is so far from usable or accessible, this does not really help the users. Words are read out too quickly, background noise makes it difficult to hear what is said and there are too many words to remember. The CAPTCHA module also interferes with the speech synthesis of the screen reader, in addition to this. Links for trying again were not accessible, and the technology that offers playback of audio CAPTCHA is not adapted to screen readers in an adequate way. It is simply not enough to only adding audio CAPTCHA as an alternative. The technology must also be adapted so that *all* people actually can use it.

Only one out of four participants could complete that step without problems (by using Webvisum). The fact that there actually are tools that can act as remedies in solving problems that come with CAPTCHA also became clear, which I think is something that more visually impaired people should be aware of.

Other findings included the notion that outside factors, such as software versions of browsers and screen readers, must also be taken into account when testing with visually impaired users, and surely users in general as well. I think it is fair to say that some of the problems that did arose during the user tests actually may have their background in client-side problems. Outdated drivers, old software or other factors all play their part influencing how the users experience the web, and problems that they meet should not automatically be specified as design issues.

It also seems like even the "simplest" of web pages can be experienced as difficult and sometimes contain insurmountable barriers for some visually impaired users. I experienced a tremendous difference in how users with different computer experience and competence interacted with the various web pages, and it can therefore be said that there is a clear relationship

between this experience and what problems that are encountered. There was for example a distinct difference between the user experience and competence levels of the last participant and the other three participants. In addition, this participant used an older version of Internet Explorer, and also older version of JAWS. I believe that these factors were the difference between success and failure in this case, and I think that this reinforces the view that one must take outside factors into the equation as well. The most experienced participants went through some of the steps without any problems, while those with less experience and lower skills within computer use had problems with what others might think of as trivial things.

The data in figure 5.7 support the theory that user competence can have a large effect on how the users experience websites. The differences that this overview shows also say something about the common variations in user experience and skills, and that the gap regarding this, between visually impaired people, often can be quite big. The overview is also useful when it comes to the discussion about whether one should expect a certain level of user competence, before talk of universal design can begin.

The figure 5.7 also shows that the step involving the CAPTCHA module undoubtedly demanded more time, than the other steps, from the users. This, together with the figure 5.6, evidently shows that this often is the main problem when visually impaired internet users register on sites like Facebook.

I believe that I had sufficient broadness and a wide enough variety in the methods I have used, as well as in the experts and users who have participated. This is all important in order to produce as nuanced impressions as possible. To see the frustration and irritation, but also sometimes the joy that the visually impaired users experienced during the user tests was for me very interesting, inspiring, instructive and also very motivating. There were certainly some surprises that came up along the way, but there were also many points which was confirmed as expected. In the next section I will discuss the differences in the evaluation methods and the validity of their outcome.

6.3 Differences in the evaluation methods

As I have shown, there are many approaches one can take when evaluating the usability or accessibility of a website, all with their own methods and techniques. All of these approaches have their differences, such as the degree of user involvement and resource-demand, which can influence the value and the validity of their outcome. In this section I will discuss the used methods' value and validity, and focus on the last research question: ***What are the main differences regarding the accessibility problems revealed by the different types of***

evaluation methods?

When I evaluated the accessibility of user registration on Facebook by using Worldspace FireEyes, I was, as mentioned earlier, unable to specifically set the tool to focus on violations that would apply specifically to visually impaired users. Therefore the findings that were extracted from this type of evaluation can only be seen as representative for all disabled users with different impairments taken into consideration. That being said, I believe that most of the results FireEyes generated can be seen as quite relevant for visually impaired users, that for example use screen readers. It could also be argued that the findings very much focus on code-specific criteria and some of the violations can be seen as slightly pedantic. While this may be true, it seems obvious that even the smallest violation in code eventually can lead to confusion and irritation for assistive technology users. This means that the accessibility violations that designers and programmers should focus on, often will have some presence in the source code, in one form or the other.

Meaningful alternative text was the most distinguished issue in the findings from both the automated accessibility evaluation and the heuristic evaluation. But, this is one aspect where the differences between an automated evaluation tool and manual heuristic evaluation reveal themselves. When evaluating the same page through Worldspace FireEyes, the difference between meaningful and not meaningful alternative text cannot be apprehended, which in a way can be said to weaken the automated evaluation method's validity, and thus strengthen the validity of evaluation methods that include human assessment, such as manual heuristic evaluation or user tests.

As Lazar et al. (2010) mention, automated evaluation tools do lack the common sense that can determine whether an alternative text is useful or not. These texts must provide useful information, as it simply is not enough to just have an empty attribute without information. While manually checking the source code on one of the pages visited under the registration process on Facebook, empty `<alt>`-attributes flourished. These manually found violations were although not of those found by FireEyes, which is an interesting aspect of the validity of evaluations performed through use of an automated tool.

Worldspace FireEyes acted as an okay tool in providing some insight into the accessibility challenges in the user registration process on Facebook. On the other hand, it was self-evident that this would not be sufficient evaluation in order to shape a realistic image of the situation. The results that the tool provided, lacked validity and credibility without adding human insight into the mix. This gives the argument of automated evaluations being cost-efficient a blow, as fully automated evaluations can only give a pointer of the main problems on a website. It is argued that evaluation tools, such as FireEyes, can save some time and effort, but they cannot replace well-informed human evaluators or real users. Rather than thinking of automated tools

as a replacement for human evaluation, maybe we should think of automated tools merely as support to human evaluation?

The automated evaluation tool verified many things that, when manually found, actually were violations of WCAG 2.0. It seems to me that one has to do double work when using a tool such as FireEyes, because it overlooks severe violations such as lack of actual useful alternative text. This is also noted by the Web accessibility initiative, as they state on their website that these tools only will check the accessibility aspects that can be tested automatically, and that the results from these tools should not be used to determine a conformance level without further manual testing (W3C, 2011a). I could not agree more.

The findings that were composed through the heuristic evaluation were all quite as expected. There was a clear consistence with the findings that were formulated by the automated evaluation, as the predominance of issues regarding lack of text alternatives to non-text content was apparent also in these findings. The reasons for this can be many, but one that stands out, beside the fact that it actually is a real problem, is that these violations are quite easy to detect, compared with other complex violation types.

An aspect that I see as key regarding evaluation methods and their differences is that there were many problems that I found through automated and heuristic evaluation, that were not apparent when I conducted user tests. These problems turned out not to have as great influence on the user experience as expected. Many of the findings that the two initial evaluation methods composed, gave me the impression that they were huge obstacles in the accessibility of Facebook, when they actually may be seen as quite pedantic and arguably could be disproved.

There were fewer instances of "Not completed"-scores in the user tests than what I might have expected, especially after the impression I got after the automated and the heuristic evaluations. On the other hand, we can see that problems that were not dominant in neither the automated nor heuristic evaluation, gave the participants a whole lot of trouble during the user tests. As Rømen and Svanæs (2008) and Wheeler and Kreps (2008) suggest, does this not mean that conformance to WCAG 2.0 is insufficient in order to say that a web site is accessible?

As much as over half of the violations found by both the automated and heuristic evaluations were related to lack of alternative text, but this was not the most distinguished problem area when testing with real users. This could make for proof that it is important to involve real users in evaluation, and that conformance testing through automated or heuristic evaluation is simply not enough. Does WCAG 2.0 encourage developers to seek easy conformance rather than achieving real accessibility? This does, however, not mean that conformance testing are useless, but problems that they may discover, can turn out to be false positives when employing user tests also. On the other hand, some of the issues that came up in the user tests, were also

of those that stood out in the automated and heuristic evaluations.

As written in the method chapter, Nielsen and Mack (1994) recommend having more than one person evaluating in heuristic evaluation. According to them, this can ensure that most of the actual problems are found. This is also illustrated by figure 3.4. My evaluation team consisted of four evaluators, which suits Nielsen and Mack's (1994) recommendation, which is having between three and five evaluators. I think that this was a good way of doing it, as I can imagine that the workload of assembling the findings would be too big if there were more evaluators. In addition, it is fair to say that it could have resulted in a far higher number of overlapping findings. If we on the other hand had been fewer evaluators, there could have been aspects that we maybe would not have discovered.

Throughout the heuristic evaluation the evaluators had no contact with each other. This was also a recommendation in Nielsen and Mack (ibid.), as they mention this as an important element in this evaluation technique. By doing it this way I was sure that the findings were independent. I found that the joint discussion that all of the evaluators participated in after I had assembled the findings, was very informative and fruitful. The joint report of the findings was created through conversation and discussion, which gave it a credible and organic basis. Some overlap in the findings did of course exist, but more often than not there were findings that not everybody had discovered. As Nielsen and Mack (ibid.) also recommend doing, we tried to focus on explaining why these findings had violated the heuristics, and not only mention that there was a violation.

There were some aspects that became clearer to me, and the other evaluators, during the heuristic evaluation. One of them was that going through a heuristic evaluation with a focus on guidelines from WCAG 2.0 and other accessibility literature, without using screen readers or other assistive technology, can make it difficult to find all the relevant errors and violations. There are many advocates of using screen readers while conducting heuristic evaluation (Mankoff, Fait and Tran, 2005; Petrie and Bevan, 2009), and I can now better understand what they mean. All the evaluators felt that they automatically focused intensely on the source code and on whether various attributes were given to the various HTML elements. This may reflect what is meant in Petrie and Kheir (2007) and what they discuss in their article on *technical accessibility*?

Problems related to the user experience are difficult to detect when evaluating web accessibility for visually impaired, without having real visually impaired evaluators involved. *The user experience cannot be emulated.* The most outstanding issue in this case by far, was the problems that arose when the participants tried to obtain authentication by CAPTCHA. Even though it comes as no surprise, this was a problem that the software evaluation tool did not bother about, as this is a third party solution that is independent of the source code on Facebook.

In addition, this provokes issues regarding user experience and not the traditional *technical accessibility* (ibid.). The heuristic evaluation that was performed could for example not foresee the extent of the problems that the CAPTCHA inflicted, as the evaluators all were sighted, although there were predictions that this could be a problem.

I think that heuristic evaluation of the accessibility in a website is best conducted by people using the actual assistive technology, such as screen readers, and by use of keyboard only, and maybe even without displaying anything on the screen. By doing this, evaluators can get a feeling of how it is to be visually impaired. Ultimately though, I do not believe that this is half as good as having real visually impaired users testing a website together in user tests, as evaluator online behaviour often is different to user behaviour.

In my opinion, conformance testing and user testing are best separated in connection with Petrie and Kheir's (2007) terms *technical accessibility* and *usable accessibility*. The first term, which can be said to be covered by automated and heuristic evaluation, is mostly focused on the underlying source code of websites, and may not have its greatest value for the end user, although violations of course could also influence the user experience.

Contrary to the above, *usable accessibility* is more fitting when talking about user tests. This term approaches the situation from the user's perspective and focuses more on the user experience. This form for accessibility may not be of as high value for the developer, as for the designer, but can ultimately cover and provide a deeper and more realistic insight than the methods that cover the *technical accessibility*. The fact that the divide between my role, as a test leader and observer, and the participants' role, as evaluator, was so clear, helped me to keep focus on what really happened in the tests. This also gave me a solid basis for analysis and provided depth into the outcome of this form for evaluation.

One great advantage of conducting user tests is the evaluation method's capability to accurately identify problems that usually are experienced by real users, and that actually cause real frustration and irritation. While it can be argued that user tests with real users give a highly realistic reflection of the reality and can be seen are the most complete form for evaluation, it cannot be left out that it is a quite demanding evaluation method when it comes to resources. The whole process of evaluation often takes more time than performing automated accessibility evaluations or even heuristic evaluations. It can also be a challenge to recruit participants. As the users in question in my case were people with visual impairments, this lead to some challenges, as they can often be harder to come by. Thankfully, I received a lot of help and advice from MediaLT when it came to recruitment.

As Blas, Paolini and Speroni (2004) are, I am also an advocate of focusing on *usable accessibility*, ensuring an effective user experience, as opposed to *technical accessibility* that is

the main concern of the W3C guidelines. To involve the users in the evaluation is key when focusing on user experience, as the primary point of view should be from that of the user. I have gone from no user involvement whatsoever in automated testing, to full involvement in the user tests. User tests have more focus on the user experience itself, than the other evaluation methods. User experience is explained in the theory chapter in this thesis as *how people feel about a product and their pleasure and satisfaction when using it* (Sharp, Rogers and Preece, 2007). It is the user who is at the centre, even though it is the system that is tested. This manifested itself in the findings that I gathered through the data evaluations.

Evaluations regarding the accessibility of web sites often focus on conformance to accessibility standards such as the mentioned WCAG. While conformance arguably is important to some extent, there are many benefits in evaluating with real people. By doing this, one can learn how websites or information systems really work for users and one can be better equipped to understand accessibility issues. Evaluating with users with disabilities, like I have done with the visually impaired users, can identify issues that are not found by only arranging various types of conformance evaluation.

"This is a test of patience!"

Blind man using CAPTCHA on Facebook
PARTICIPANT IN USER TEST

Chapter 7

Conclusion

The main objective of this thesis has been to provide new knowledge of the accessibility of the user registration and identity management on Facebook. By examining this part of the popular social networking site, I would be able to identify key accessibility challenges in these mechanisms, and with applying various evaluation methods in my research I could examine and compare these methods and the outcome of them. Ultimately I would have a firm platform on which I can base the answers to my research questions. I start with the first research question that deals with the relationship between usability and accessibility.

7.1 The relationship between usability and accessibility

As this thesis partially has had a theoretical focus as well as on empirical studies, I wanted to try to make the relationship between the terms usability and accessibility clearer. These terms are often used concepts in interaction design literature, but can be difficult to understand separately. I therefore found it relevant to ask and answer the following research question based on the three articles reviewed in the theory chapter: ***What is the relationship between usability and accessibility? How do the one affect the other?***

Two out of the three articles mentioned in the theory chapter, Petrie and Kheir (2007) and Yates (2005), support the proposition that usability and accessibility problems can be seen as two intersecting and complementary sets. The final third, Huber and Vitouch's (2008) article, lean more against the notion that accessibility problems are a subset of all usability problems, and that accessibility problems are equally important for all users.

Usability-problems are often defined as aspects of a user-interface that make the system less usable. This can go for accessibility-problems as well, as we have learned that we can define these as aspects of a user-interface that make the system less accessible. This distinction might be slightly simple, and it can be said that Petrie and Kheir (2007) has made it more precise by defining usability problems as those experienced by both disabled users and a control group, while accessibility problems were those experienced only by the disabled users (Rømen and Svanæs, 2008). If this distinction is made, a conclusion of what seems most fitting is imminent.

As it can be argued that some accessibility problems can have an effect on non-disabled users also, it seems obvious that not all accessibility problems will have implications for all users. A website can therefore also be seen as usable, but not necessarily accessible.

In addition, there are usability problems that disabled users would not experience as issues. Even though a website is in conformance with an accessibility standard, it can still be constructed in a non-intuitive way that ruins the visual presentation of the information. Violations such as these would for example not affect blind participants, but the website could still fail usability tests.

Viewed in this light, the three categories of problems that were earlier presented, and that is illustrated in figure 7.1, composed by Petrie and Kheir (2007) and also Yates (2005), seem the most complete to me: “pure accessibility problems”, “pure usability” problems and at last the overlapping “universal usability” problems.

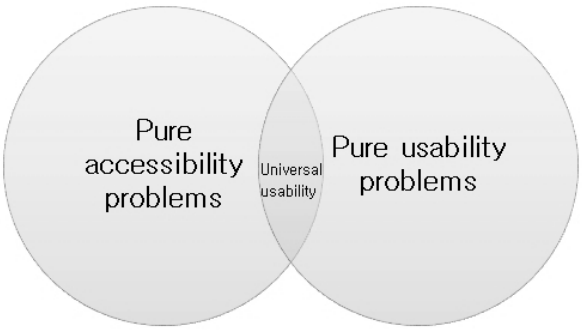

Figure 7.1: The relationship between usability and accessibility problems (Petrie and Kheir, 2007)

7.2 Accessibility challenges

Evaluation has continuously been presented as an important part of interaction design in this thesis. By having performed different types of evaluation methods, I have gained knowledge

about the accessibility of Facebook. In order to set my findings in order, the following research question will be answered in this section: ***What are the accessibility challenges with actual practices used on Facebook as of today, when it comes to user registration and identity management?***

Facebook has great defects when it comes to what I in this thesis refer to as *technical accessibility*. These are mainly code-specific shortcomings and violations regarding *inadequate use of headings, titles, labels and lack of alternative text*, which were dominant in the automated and the heuristic evaluation in general. Over half of the problems found by these evaluation methods were related to this, which must be a pointer that this actually is an important issue. These problems were however not as outstanding as expected when the user tests with real users were performed. The problems should be considered as representing accessibility challenges regardless, because of the comprehensive field these violations cover.

Use of keyboard was not as easily done on Facebook as it should have been. Violations regarding this were found by the heuristic evaluation as well in the user tests, and it became clear that this is a central problem especially in the user tests. Adaptation of a web page for keyboard use only demands that there is a well-formed structure and that there are sequences in the web page that are meaningful and logical when it comes to focus and tabbing order. There were elements in the five steps in the user registration process that were not accessible by keyboard at all. Dynamic elements that were on the outside of traditional HTML provoked problems regarding this. Even though these problems relate to another distinctive accessibility challenge also, I believe that these problems compose their own challenge as well.

Newer technology that is used is also a problem area when it comes to the accessibility. When pages have a lot of dynamic content, problems regarding compatibility between the newer technology, such as JavaScript in Facebook's case, and the assistive technology break out. This challenge manifested itself mainly in the user tests, but were also significant in the heuristic evaluation, as Facebook is not usable without JavaScript. When involving real users however, I could see that even though they had not disabled JavaScript in their browsers, a lot of the functionality that was dynamic provoked a loss of synchronization between the browser and screen reader nonetheless. An accessibility challenge that presented itself is therefore about extensive use of newer technology, such as JavaScript.

As in Meiselwitz and Lazar (2009), the main problem for most of the participants in the user tests, was *CAPTCHA*. This obstacle of authentication prevented three out of four users from continuing in the registration process without problems or having need for help. Even though audio CAPTHCA is provided as an aid, this form of authentication is not accessible on Facebook as the surrounding technology do not help visually impaired users in completing the authentication. In stead, this leads to more problems. My findings therefore add weight and

insight to the notion that CAPTCHA is an inaccessible solution and an element that form a great accessibility challenge on Facebook especially, but also on the web in general.

7.3 Differences in the evaluation methods

As I have shown in this thesis, there are different ways of measuring and evaluating accessibility. I have tried to shed light on the value and validity of the methods that I have used, and I will answer the following and last research question in this section: ***What are the main differences regarding the accessibility problems revealed by the different types of evaluation methods?***

By doing evaluations of the accessibility of Facebook through use of three different methods, I have seen several things that have given me a good basis to make reasonable conclusions on these matters, even though I am aware that the relatively low number of participants can pose a threat to the validity of my findings. First of all, I have seen that there is a distinct grouping of the three methods that I have used. There is namely a clear divide between automated/heuristic evaluation and user testing, which mainly is based on the degree of involvement from users. It seems to me that the two former types of evaluation methods are mainly focused on conformance to WCAG and code-specific criteria, while user testing is more focused on the *user experience* itself.

I have several times in this paper used the terms *technical* and *usable accessibility*, which are also mentioned in a number of relevant articles (Blas, Paolini and Speroni, 2004; Brajnik, 2006; Petrie and Kheir, 2007). I can see that these terms are very representative of the main differences between these groups of methods and also regarding the different accessibility problems revealed by the different types of evaluation methods. I believe that a combination of these methods may be the most sensible way to go about evaluating for web accessibility, because this can help composing a complete set of valid findings.

Problems that were uncovered through the automated and heuristic evaluations turned out not to have as great influence on the user experience as expected. On the other hand, issues that were prominent in the user tests were seldom of those that stood out in the automated and heuristic evaluations. The differences between these problems were more often than not related to their focus on user experience.

I believe that the degree of user involvement greatly influences the different evaluation methods' outcome as well as the validity of them. The fact that many of the problems that were discovered during the automated evaluation never gave the users any problems during the

user tests, indicate instances of false positives. The validity of the heuristic evaluation was also somewhat weak, as these findings included some false positives as well, and also neglected to discover issues that stood out in the user tests.

The most outstanding difference that I have seen is therefore the complete change of focus from conformance testing to user testing. The focus goes from being strictly on code-specific attributes and conformance to WCAG 2.0, to be mainly on the *user experience* itself. It became clear to me that the findings from the user tests were richer and had more gravity than the more simple findings from the automated and the heuristic evaluations. Through what I experienced by comparing my findings, I conclude that to have a solitary goal of conformance to WCAG 2.0 is simply not enough for saying that the user registration process on Facebook is accessible.

7.4 Future work

Future work and research in the same field as this thesis is under should take a deeper dive into web accessibility and social media. I believe that there currently is a need for an extensive review of the accessibility of various social networking sites, not only Facebook, even though this is the largest social networking site. This would further advance the knowledge of the field and help drawing up more general conclusions about the accessibility of user registration mechanisms.

There is also a need for investigating the accessibility of other parts of social networking sites, than only the user registration and identity management. I learned that there are a lot of the existing functionality in social networking sites today that are experienced as inaccessible by disabled people. Tollefsen et al. (2010) have already made an extensive report on this, which I also recommend for further reading.

As I pointed out in this thesis, lack of user competence can be an issue with disabled users. A visually impaired user with low competence in web use and use of assistive technologies can still experience a web site as problematic, even if the website is designed in an accessible way. There is a need of continued focus on training disabled people in use of computers, web and assistive technology, as for example the pioneers in MediaLT do. They are promoters of “Datakortet”, which is a certificate of a level of competence in ICT. There is a need for further research on current learning methods and the outcome of these, as well as for enhancing the reputation and range of training programs.

The possibilities with the new features in *HTML5* should also be further investigated with

a focus on accessibility. *HTML5* introduces several new semantic elements[1] representing logical sections or components of a web page, such as `<section>`, `<nav>`, `<article>`, `<aside>`, `<hgroup>`, `<header>` and `<footer>`. These new elements provide a way for designers and developers to define various parts of a document in a more intuitive way. This all has the potential to improve accessibility in a big way, especially if screen readers and other assistive technologies start passing the associated information along to users. This is an area with quite little current research.

At last, an examination of the workarounds that disabled users tend to use in order to overcome obstacles due to inaccessible solutions. This is also an area with quite little research, and I learned through my research that many disabled users develop and adopt their own ways of using the Internet. I have mentioned one of these workarounds, namely *Webvisum*, and issues regarding security could arise with comprehensive use of *Webvisum* or other workarounds.

[1] Semantic elements are elements that are used according to their meaning, not because of the way they appear visually.

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Appendices

Appendix A

Terminology and concepts

A.1 Human-related terms

User A person that is using a computer or Internet service. A user may have a user account that identifies the user by a user name. With relevance to social networking sites, a user can be a member of one or more social networks.

User profile A profile represents a user in social networking sites. It is in many ways the user's face outwards that the user want to represent herself with. It is often a collection of personal data associated to a specific user, a profile refers therefore to the explicit digital representation of a person's identity.

Disability This is an umbrella term, covering impairments, activity limitations, and participation restrictions. Disabilities can be physical, sensory or intellectual. One example of a physical disability is visual impairment, which means loss of vision.

A.2 System-related terms

Social networking site This means websites and services for users providing the possibility to interact with other users. Examples of sites like these are Facebook, Twitter and LinkedIn.

User interface Enables interaction between man and machine. The design of a user interface affects the amount of effort the user must expend to provide input for the system and to interpret the output of the system. Closely related to usability.

A.3 Academic terms

Interaction design Defines the structure and behaviour of interactive systems. The goal that interaction designers often have is to create meaningful relationships between people and the products and services that they use.

Human-computer interaction (HCI) Denotes the study of interaction between people and computers. Academic research in HCI includes methods for describing and testing the usability of interacting with an interface.

Accessibility When related to ICT, it gives an account of how accessible a solution is by as many people as possible, especially users with disabilities.

Usability Represents the usefulness of a product or a service and how easy it is to use.

Inclusive design Also known as universal design and design for all. These terms refer to the design of ICT solutions that make them possible to use by as many people as possible.

Identity management Refers to techniques for organizing the identity of a user in order to grant access or authorize execution of a given task.

A.4 Other technology-related terms

Registration The process of registration is often the first hurdle when starting to use social networking sites. It is common that users register by providing their full name, addresses and other credentials.

Identification A means of proving a person's identity. Often done by providing a user name and password.

Authentication This can be seen as the successor of identification, as authentication can be explained as having one's identity verified.

Encryption This is an important part of the authentication-process as the goal of encryption is to to prevent unauthorized access by converting information into code. Encryption can be described by using the lock-metaphor, as encryption has many of the same properties as a lock. To un-encrypt, a key must be provided, often in the form of a password.

Password Related to the encryption-term, the password fits into the same metaphor. A password is easily compared to a key, that fits into a lock (encryption). It can appear as a textual string of characters, biometry in the form of fingerprints, retinal scan or voice-recognition, as graphics as well as other variants.

Login/Logout Wikipedia describes this as the process by which individual access to a computer system is controlled by identification of the user using credentials given by the user. A user can log in to a system to obtain access and can then log out or log off when the access is no longer needed. To log out is to close off one's access to a computer system after having previously logged in (Wikipedia, 2010b).

Single sign-on Denotes a property of access control of multiple, related, but independent software systems. It enables users to log in only once and then be automatically authenticated when they attempt access to other resources. Also known as decentralized identity management.

CAPTCHA This refers to a type of test used in computing to ensure that a value in a form is not generated by a computer. CAPTCHA is an invented acronym for "Completely Automated Public Turing test to tell Computers and Humans Apart." These tests rely on visual perception, therefore visually impaired users are unable to view a CAPTCHA, and thus be unable to perform the task protected by a CAPTCHA. Therefore, many sites have also implemented audio versions of CAPTCHAs, that is supposed to provide more accessible means. Naturally, these images has no text equivalents accompanying them, as that would make them give-aways to computerized systems. The figure A.1 is an example of a modern CAPTCHA.

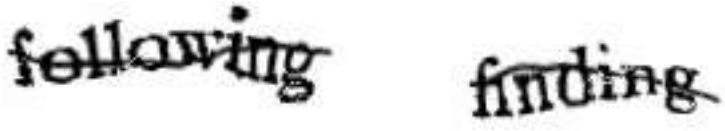

Figure A.1: A modern CAPTCHA

Appendix B

Results from use of accessibility evaluation software

Rule ID	Severity Code	Message Code	Xpath	WCAG 2 Level	WCAG 2 Success Criteria
050101-Q1	level.manual	This may be a data table that is missing header information or missing header and data cell asso	/html/body/div[3]/div[3]/div/div/di	N/A	N/A
070302-Q1	level.manual	Check if script creates moving or blinking content.	/html/body/script[2]	N/A	N/A
PARA-P-Q1	level.manual	If a timed user response is required, option to request more time or disable the timed function s	/html/body/script[2]	N/A	N/A
070302-Q1	level.manual	Check if script creates moving or blinking content.	/html/body/script[4]	N/A	N/A
PARA-P-Q1	level.manual	If a timed user response is required, option to request more time or disable the timed function s	/html/body/script[4]	N/A	N/A
090401-Q1	level.manual	Check if document has proper tab order.	/html	N/A	N/A
070302-Q1	level.manual	Check if script creates moving or blinking content.	/html/head/script	N/A	N/A
PARA-P-Q1	level.manual	If a timed user response is required, option to request more time or disable the timed function s	/html/head/script	N/A	N/A
050101-Q1	level.manual	This may be a data table that is missing header information or missing header and data cell asso	/html/body/div[3]/div[4]/div//div/d	N/A	N/A
070302-Q1	level.manual	Check if script creates moving or blinking content.	/html/head/script	N/A	N/A
PARA-P-Q1	level.manual	If a timed user response is required, option to request more time or disable the timed function s	/html/head/script	N/A	N/A
070302-Q1	level.manual	Check if script creates moving or blinking content.	/html/head/script	N/A	N/A
PARA-P-Q1	level.manual	If a timed user response is required, option to request more time or disable the timed function s	/html/head/script	N/A	N/A
070302-Q1	level.manual	Check if script creates moving or blinking content.	/html/head/script	N/A	N/A
PARA-P-Q1	level.manual	If a timed user response is required, option to request more time or disable the timed function s	/html/head/script	N/A	N/A
010101-A	level.violation	Image is missing a text equivalent.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 1.1.1
010101-A	level.violation	Image is missing a text equivalent.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 1.1.1
010101-A	level.violation	Image is missing a text equivalent.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 1.1.1
010101-A	level.violation	Image is missing a text equivalent.	/html/body/div[3]/div[4]/div//div/i	Level A	Success Criteria 1.1.1
120401-F	level.violation	Select (combo) control does not have an explicit label or a title attribute.	/html/body/div[3]/div[3]/div/div/di	Level A	Success Criteria 1.3.1
120401-F	level.violation	Select (combo) control does not have an explicit label or a title attribute.	/html/body/div[3]/div[3]/div/div/di	Level A	Success Criteria 1.3.1
030504-A	level.violation	This page does not have enough headings.	/html[@id='facebook']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='firstname']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='lastname']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='reg_email__']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='reg_email_confirmatio	Level A	Success Criteria 1.3.1
120401-C	level.violation	Password field does not have an explicit label or a title attribute.	/input[@id='reg_passwd__']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/select[@id='sex']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/select[@id='birthday_day']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/select[@id='birthday_month']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/select[@id='birthday_year']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='captcha_response']	Level A	Success Criteria 1.3.1
120401-F	level.violation	Select (combo) control does not have an explicit label or a title attribute.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 1.3.1
120401-F	level.violation	Select (combo) control does not have an explicit label or a title attribute.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='u767494_2']	Level A	Success Criteria 1.3.1

120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='u767495_6']	Level A	Success Criteria 1.3.1
120401-E	level.violation	Text entry field does not have an explicit label or a title attribute.	/input[@id='u767495_10']	Level A	Success Criteria 1.3.1
030504-A	level.violation	This page does not have enough headings.	/html	Level A	Success Criteria 1.3.1
SC132DOM	level.violation	The DOM order does not match the focus order.	/input[@id='persistent']	Level A	Success Criteria 1.3.2
SC221S36-Q1	level.manual	If script has been used to create moving/scrolling text in a static window or area, a mechanism t	/html/head/script	Level A	Success Criteria 2.2.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/img[@id='u765883_1_login_status	Level A	Success Criteria 2.3.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/img[@id='u765887_2_login_status	Level A	Success Criteria 2.3.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/img[@id='u765887_3_login_status	Level A	Success Criteria 2.3.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/img[@id='u765890_4_login_status	Level A	Success Criteria 2.3.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 2.3.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 2.3.1
070101-A	level.violation	Limit flashing of any size content to no more than three flashes in any one-second period.	/html/body/div[3]/div[4]/div//div/d	Level A	Success Criteria 2.3.1
120101-A	level.violation	Missing title for this frame or iframe element.	/iframe[@id='bootloader_iframe']	Level A	Success Criteria 2.4.1
120101-A	level.violation	Missing title for this frame or iframe element.	/iframe[@id='bootloader_iframe']	Level A	Success Criteria 2.4.1
120101-A	level.violation	Missing title for this frame or iframe element.	/html/body/iframe	Level A	Success Criteria 2.4.1
120101-A	level.violation	Missing title for this frame or iframe element.	/iframe[@id='bootloader_iframe']	Level A	Success Criteria 2.4.1
040301-B	level.violation	The primary language of this document is invalid.	/html[@id='facebook']	Level A	Success Criteria 3.1.1
040301-B	level.violation	The primary language of this document is invalid.	/html[@id='facebook']	Level A	Success Criteria 3.1.1
040301-A	level.violation	The primary language of this document has not been set.	/html	Level A	Success Criteria 3.1.1
SC321107-Q1	level.manual	Make sure that no changes of context occur when this component receives focus.	/input[@id='q']	Level A	Success Criteria 3.2.1
SC321107-Q1	level.manual	Make sure that no changes of context occur when this component receives focus.	/input[@id='u767494_2']	Level A	Success Criteria 3.2.1
SC321107-Q1	level.manual	Make sure that no changes of context occur when this component receives focus.	/input[@id='u767495_6']	Level A	Success Criteria 3.2.1
SC321107-Q1	level.manual	Make sure that no changes of context occur when this component receives focus.	/input[@id='u767495_10']	Level A	Success Criteria 3.2.1
SC322SEL-Q1	level.manual	Make sure that no changes of context occur when select control value changes.	/select[@id='birthday_month']	Level A	Success Criteria 3.2.2
SC322SEL-Q1	level.manual	Make sure that no changes of context occur when select control value changes.	/select[@id='birthday_year']	Level A	Success Criteria 3.2.2
SC332POS	level.violation	Label is not properly positioned.	/input[@id='email']	Level A	Success Criteria 3.3.2
SC411NID	level.violation	The id attribute's value should be unique.	/input[@id='locale']	Level A	Success Criteria 4.1.1
SC411JSV	level.violation	Invalid Javascript.	/html/body/script[3]	Level A	Success Criteria 4.1.1
SC411JSV	level.violation	Invalid Javascript.	/html/body/script[4]	Level A	Success Criteria 4.1.1
SC411VAL	level.violation	Markup is invalid or non well-formed.	/html	Level A	Success Criteria 4.1.1
SC411JSV	level.violation	Invalid Javascript.	/html/head/script	Level A	Success Criteria 4.1.1
SC411VAL	level.violation	Markup is invalid or non well-formed.	/html	Level A	Success Criteria 4.1.1
SC411JSV	level.violation	Invalid Javascript.	/html/head/script	Level A	Success Criteria 4.1.1
SC411VAL	level.violation	Markup is invalid or non well-formed.	/html	Level A	Success Criteria 4.1.1
SC411VAL	level.violation	Markup is invalid or non well-formed.	/html	Level A	Success Criteria 4.1.1
SC411JSV	level.violation	Invalid Javascript.	/html/head/script	Level A	Success Criteria 4.1.1

SC411JSV	level.violation	Invalid Javascript.	/html/head/script	Level A	Success Criteria 4.1.1
SC411VAL	level.violation	Markup is invalid or non well-formed.	/html	Level A	Success Criteria 4.1.1
SC412DOM	level.violation	Use DOM functions to add content to the page.	/html/body/script[2]	Level A	Success Criteria 4.1.2
SC412DOM	level.violation	Use DOM functions to add content to the page.	/html/head/script	Level A	Success Criteria 4.1.2
SC412H91	level.violation	Specify name, value or state for HTML links and form elements.	/html/body/div[3]/div[3]/div/div/di	Level A	Success Criteria 4.1.2
SC412DOM	level.violation	Use DOM functions to add content to the page.	/html/head/script	Level A	Success Criteria 4.1.2
SC412DOM	level.violation	Use DOM functions to add content to the page.	/html/head/script	Level A	Success Criteria 4.1.2
SC412DOM	level.violation	Use DOM functions to add content to the page.	/html/head/script	Level A	Success Criteria 4.1.2

ID	WCAG Principle	WCAG Guideline	WCAG Success criteria	Message	Lvl.	Nr.
A1	1 - Perceivable	1.1 - Text alternatives	1.1.1 - Non-text content	Image is missing a text equivalent.	A	4
A2	1 - Perceivable	1.3 - Adaptable	1.3.1 - Info and relationships	Select (combo) control does not have an explicit label or a title attribute.	A	4
A3	1 - Perceivable	1.3 - Adaptable	1.3.1 - Info and relationships	Text entry field does not have an explicit label or a title attribute.	A	12
A4	1 - Perceivable	1.3 - Adaptable	1.3.1 - Info and relationships	Password field does not have an explicit label or a title attribute.	A	1
A5	1 - Perceivable	1.3 - Adaptable	1.3.1 - Info and relationships	This page does not have enough headings.	A	2
A6	1 - Perceivable	1.3 - Adaptable	1.3.2 - Meaningful sequence	The DOM order does not match the focus order.	A	1
B1	2 - Operable	2.2 - Enough Time	2.2.1 - Timing adjustable	If script has been used to create moving/scrolling text in a static window or area, a	A	1
B2	2 - Operable	2.3 - Seizures	2.3.1 - Three flashes or below t	Limit flashing of any size content to no more than three flashes in any one-second	A	7
B3	2 - Operable	2.4 - Navigable	2.4.1 - Bypass blocks	Missing title for this frame or iframe element.	A	4
C1	3 - Understandable	3.1 - Readable	3.1.1 - Language of page	The primary language of this document is invalid.	A	2
C2	3 - Understandable	3.1 - Readable	3.1.1 - Language of page	The primary language of this document has not been set.	A	1
C3	3 - Understandable	3.2 - Predictable	3.2.1 - On focus	Make sure that no changes of context occur when this component receives focus.	A	4
C4	3 - Understandable	3.2 - Predictable	3.2.2 - On input	Make sure that no changes of context occur when select control value changes.	A	2
C5	3 - Understandable	3.3 - Input Assistance	3.3.2 - Labels or Instructions	Label is not properly positioned.	A	1
D1	4 - Robust	4.1 - Compatible	4.1.1 - Parsing	The id attribute's value should be unique.	A	1
D2	4 - Robust	4.1 - Compatible	4.1.1 - Parsing	Invalid Javascript.	A	6
D3	4 - Robust	4.1 - Compatible	4.1.1 - Parsing	Markup is invalid or non well-formed.	A	5
D4	4 - Robust	4.1 - Compatible	4.1.2 - Name, Role, Value	Use DOM functions to add content to the page.	A	5
D5	4 - Robust	4.1 - Compatible	4.1.2 - Name, Role, Value	Specify name, value or state for HTML links and form elements.	A	1

Explanation	
A1	Images should have an alternative text. The <alt>-tag can describe what the image represents.
A2	Select controls should, as a part of forms, have proper title or label attributes.
A3	Text entry fields should, as a part of forms, have proper title or label attributes.
A4	Password fields should, as a part of forms, have proper title or label attributes.
A5	Assistive technologies allow users to navigate through a document by its heading structure, therefore sites should have sufficient headings
A6	This violation means that the order of the content in the source code differ from the visual presentation of the content. This may cause confusion for assistive technology users.
B1	This violation makes it difficult for users to complete tasks without unexpected changes in content or context that are a result of a time limit.
B2	This violation can interfere with a user's ability to use the whole page
B3	Blocks of content that are repeated on multiple pages should have titles, so that users that navigate sequentially through content can access the main content of a Web page quickly and easily .
C1	The web page 's language should be valid, in order to allow users with disabilities to be better able to understand the content.
C2	The web page 's language should be set, in order to allow users with disabilities to be better able to understand the content.
C3	Any component that is able to trigger an event when it receives focus should not change the context.
C4	Entering data or selecting a form control should have predictable effects, and not change the context.
C5	Labels or instructions should be provided when content requires user input.
D1	Content should be well-formed in order to be accurately interpreted and parsed by user agents.
D2	Content should be well-formed in order to be accurately interpreted and parsed by user agents.
D3	Content should be well-formed in order to be accurately interpreted and parsed by user agents.
D4	Standard controls should be used, in order to ensure that assistive technology users can gather information about, activate and keep up to date on the status of user interface controls in the content.
D5	Standard controls should be used, in order to ensure that assistive technology users can gather information about, activate and keep up to date on the status of user interface controls in the content.

Appendix C

Results from heuristic evaluation

1. **H1 - The website provides text alternatives for non-text content**

   - **Page 1**
     - The Facebook-logo has an `<alt>`-attribute with the value "Facebook logo". This is also the case for pages 1, 2 and 3 as well. Only 1 out of 5 images on this page has meaningful alternative text. It is also a known rule that every `<img>`-element that is less than 8x8 pixels should be replaced by CSS techniques for styling.
     - The gender-, day-, month- and year drop down menus have no label. Otherwise, it is surprisingly good when it comes to labels for form elements.
     - The buttons "Sign Up" and "Log in" both have `<label for>`-attributes, but instead of sensible texts, they are identified by incomprehensible numbers and letters. They do not have `<alt>`-attributes.
   - **Page 2**
     - Only 1 out of 8 images have meaningful alternative text. There is use of visual CAPTCHA, and this image has (of course) no alternative text, as this would defeat the whole purpose.
     - The buttons "Sign Up" and "Log in" both have `<label for>`-attributes, but instead of sensible texts, they are identified by incomprehensible numbers and letters. They do not have `<alt>`-attributes.
   - **Page 3**
     - The logos of the various mail account providers has no `<alt>`-attribute, but they have a `<title>`-attribute that says which service it represents. Use of `<title>`-attributes does not compensate for lack of `<alt>`-attributes. This is a usual misconception.
     - The icons for "friend request", "notification" and "messages" has no `<alt>`-attribute, but they too have a `<title>`-attribute that says what the image represents.
   - **Page 4**
     - The button "save and continue" lacks `<alt>`-attribute and `<title>`-attribute. All input elements that have a type attribute value of "image", should have an `<alt>`-attribute.
     - The Facebook-logo's `<alt>`-attribute has suddenly gone missing.
     - The icons for "friend request", "notification" and "messages" has no `<alt>`-attribute, but they too have a `<title>`-attribute that says what the image represents.
   - **Page 5**
     - Only 1 out of 5 images have meaningful alternative text. 3 of those without do not provide any meaning, but the image that represents the profile picture,

should have alternative text. It is also a known rule that every `<img>`-element that is less than 8x8 pixels should be replaced by CSS techniques for styling.
  - The Facebook-logo's `<alt>`-attribute has suddenly gone missing.
  - The icons for "friend request", "notification" and "messages" has no `<alt>`-attribute, but they too have a `<title>`-attribute that says what the image represents.
  - The image element that represents the profile picture does not have an `<alt>`-attribute.

2. **H2 - The page should have sufficient headings**
   - **All pages**
     - There is only one heading `<h1>`, but the page has so little content that it's not necessarily a huge problem.
3. **H3 - Meaningful sequence**
   - **Page 2**
     - The links "Try another text or an audio CAPTCHA" never get focus.
   - **Page 3**
     - No, the focus suddenly disappears.
   - **Page 5**
     - No, not when pop-ups appear.
4. **H4 - The site does not rely on colour alone for information**
   There were no violations found
5. **H5 - All functionality is accessible from a keyboard**
   - **Page 1**
     - Generally, yes, but not the "Sign Up"-button if JavaScript is disabled.
   - **Page 2**
     - It is not possible to get focus on the links "Try another text or an audio CAPTCHA". This is a huge problem! Also, it is not possible to get focus on the link "What's this?". This is somewhat connected to the issues experienced when examining the heuristic regarding meaningful sequence.
   - **Page 3**
     - Not possible to apply the other methods of finding your friends by keyboard only.
     - When hovering over the "Account"-link, a menu appears, which I cannot access through keyboard only.

- **Page 5**
  - No, when choosing to upload or take a picture, a pop-up appears, and it is not possible to get focus in these pop-ups.
  - When hovering over the "Account"-link, a menu appears, which I cannot access through keyboard only.

6. **H6 - How do I register? Help is readily available and accessible**

   - **All pages**
     - Help-link is available from the right bottom corner. It is not a very visible link, and it has no `<alt>`-attribute.

       This could, however have been a link in the registry-part of the page.
   - **Page 2**
     - The link "What's this?" appears, which offers an explanation of CAPTCHA.

7. **H7 - The site is perceivable without use of style sheets**

   - **Page 1 and 2**
     - Yes, it is, but two additional dropdown menus without any meaning appears, when style sheets are turned off in the browser. Confusing.
   - **Page 3**
     - Yes, but when the style sheet is turned off, one can see that this page uses frames, of all things.
     - In addition, a lot of text that is meant to be hidden appears when the style sheet is turned off.

8. **H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript**

   - **Page 1**
     - When I turn off JavaScript in the browser, Facebook asks me to enable JavaScript or upgrade to a JavaScript-capable browser to use Facebook. It then suggests an alternative, which is to access the mobile version of Facebook. I can't press the "Sign Up" button, without JavaScript enabled.
   - **Page 2**
     - This page depends on JavaScript.
   - **Page 3 and 4**
     - This page depends on JavaScript, as I cannot continue with JS disabled. No error messages appear either.
   - **Page 5**

  - This page depends on JavaScript, as I cannot upload picture, take picture or continue with JS disabled. When JS was turned off, I was suddenly thrown back one step!

9. **H9 - The site offers sensible error messages**

   - **Page 1**
     - Yes, it does, but it could have been done in a more thorough way, as it only states that not all of the fields are filled and not which one(s), when I neglect to fill out a form element. The birthday information dropdowns give more instructive messages.
   - **Page 3**
     - Nothing happens, when trying to find friends through Yahoo. No error messages whatsoever if invalid e-mail addresses are entered.
     - The page does not work as it should when JavaScript is disabled. I get no error messages concerning this issue though.
   - **Page 4**
     - The page does not work as it should when JavaScript is disabled. I get no error messages concerning this issue though.
   - **Page 5**
     - When pressing upload picture with JavaScript disabled, nothing appears but a blank page. I get no error message explaining what is wrong.

10. **H10 - If CAPTCHA is used for authentication, is there alternatives to visual and audio?**

    - **Page 2**
      - CAPTCHA is used for authentication, and the default application of it here is visual. It is provided a link for trying different words, and audio CAPTCHA. The audio CAPTCHA is totally incomprehensible, as the sound is scrambled and the voice speaks in English and way too fast.
      - In addition, the CAPTCHA-alternatives are unreachable by keyboard only.

Heuristic evaluation nr. 1

		Pages				
		Page 1 - Sign Up	Page 2 - CAPTCHA	Page 3 - gettingstarted.php?step=contact_importer	Page 4 - gettingstarted.php?step=classmates_coworkers	Page 5 - gettingstarted.php?step=upload_profile_pic
Heuristics	H1 - The website provides text alternatives for non-text content	Only 1 out of 5 images have meaningful alternative text. It is also a known rule that every <img>-element that is less than 8x8 pixels should be replaced by CSS techniques for styling. Gender, day, month and year dropdown has no label. Otherwise, surprisingly good when it comes to labels for form elements	Only 1 out of 8 images have meaningful alternative text. There is use of visual CAPTCHA, and this image has (of course) no alternative text, as this would defeat the whole purpose. Otherwise OK	OK	OK	Only 1 out of 5 images have meaningful alternative text. 3 of those without do not provide any meaning, but the image that represents the profile picture, should have alternative text. It is also a known rule that every <img>-element that is less than 8x8 pixels should be replaced by CSS techniques for styling.
	H2 - The page should have sufficient headings	There is only one heading, but the page has so little content that it's not necessarily a huge problem.	Same as with page 1	Same as with page 1	Same as with page 1	Same as with page 1
	H3 - Meaningful sequence	Yes	Yes	No, the focus suddently disappears.	Yes	No, not when popups appear.
	H4 - The site does not rely on colour alone for information	No	No	No	No	No
	H5 - All functionality is accessible from a keyboard	Generally, yes, but not the "Sign Up"-button if JavaScript is disabled.	Same as with page 1	Yes	Yes	No, when choosing to upload or take a picture, a popup appears, and it is not possible to get focus in these popups.
	H6 - How do I register? Help is readily available and accessible	Help-link is available to right bottom corner. It is not avery visible link, but it's there, and it has a title.	Same as with page 1	Same as with page 1	Same as with page 1	Same as with page 1
	H7 - The site is perceivable without use of style sheets.	Yes, it is, but two additional dropdown menus without any meaning appears, when stylesheets are turned off in the browser. Confusing.	Same as with page 1	Yes, but when the stylesheet is turned of, one can see that this page uses iframes, of all things.	Yes	Yes
	H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript.	When I turn off JavaScript in the browser, Facebook asks me to enable JavaScript or upgrade to a JavaScript-capable browser to use Facebook. It then suggests an alternative, which is to access the mobile version of Facebook. I can't press the "Sign Up" button, without JavaScript enabled.	This page depends on JavaScript.	This page depends on JavaScript, as I cannot continue with JS disabled.	This page depends on JavaScript, as I cannot continue with JS disabled.	This page depends on JavaScript, as I cannot upload picture, take picture or continue with JS disabled.
	H9 - The site offers sensible error messages	Yes, it does, but it could have been done in a more thorough way, as it only states that not all of the fields are filled and not which one(s), when I neglect to fill out a form element. The birthday information dropdowns give more informational messages.	Yes	There is not really anything you can do that would provoke an error message	There is not really anything you can do that would provoke an error message	Not much to do wrong here either, but if there is no available cameras on your system, an error message appears that asks you to connect a camera and try again.
	H10 - If CAPTCHA is used for authentication, are there alternatives to visual and audio?	N/A	CAPTCHA is used for authentication, and the default application of it here is visual. It is provided a link for trying different words, and audio CAPTCHA. The audio CAPTCHA is totally incomprehensible, as the sound is scrambled and the voice speaks in english and way too fast.	N/A	N/A	N/A

Heuristic evaluation nr. 2

		Pages				
		Page 1 - Sign Up	Page 2 - CAPTCHA	Page 3 - gettingstarted.php?step=contact_importer	Page 4 - gettingstarted.php?step=classmates_coworkers	Page 5 - gettingstarted.php?step=upload_profile_pic
Heuristics	H1 - The website provides text alternatives for non-text content	Startsiden til Facebook. Har nødvendige labels for alle input feltene.	Ingen bilde-tekst for CAPTCHA'en, men det er jo det en grunn til... Label for input-boksen... Jeg skjønner ikke hvorfor label'en "Tekst i boksen:" gjør pekeren om fra vanlig peker til "pointer" som om det var en klikkbar link.	Her er alt veldig bra, bortsett fra dropdown-menyen til høyre, men det går bra...	Bra labels for input, ellers ingen bilder... Manglene alternativ tekst for lenkene...	Ingen <alt>-tag på bilde, ikke på linkene heller...
	H2 - The page should have sufficient headings	"Velkommen til Facebook" gir jo litt mening, men kanskje ikke alt for lett å forstå at det er her man registrerer en ny bruker	"Velkommen til Facebook" er fortsatt headingen... Det kunne ha vært "Velkommen til Facebook - Registrer deg" for å vise at man har gått et steg videre...	"Kom i gang" er en helt ok forståelig tittel	Fortsatt "Kom i gang", kunne ha fortalt brukeren at det har gått et steg...	Fortsatt "Kom i gang"... De er i hvertfall konsekvente...
	H3 - Meaningful sequence	N/A	Ja	Tja, litt rart at importere venner kommer før mer informasjon om en selv, men det er jo det Facebook er ute etter...	Som i Page 3	Ja
	H4 - The site does not rely on colour alone for information	"Registrer deg"-knappen er grønn, men det står jo "registrer deg" så er vanskelig å misforstå	samme som på "Page 1 - Sign Up"	Nei, ikke i dette tilfelle... Eller kanskje de små iconene ved Facebook logoen, men disse er ikke ordentlig i bruk enda...	Nope	Nei
	H5 - All functionality is accessible from a keyboard	Ja	Det går faktisk ikke an å få tak i linkene: "prøv en annen tekst" og "[eller] en lyd captcha". Dette er et stort problem! Det er heller ikke mulg å få tak i linken "Hva er dette"	Jeg klarer ikke å åpne de andre variantene av måter man kan finne vennene sine på	Ja, bra!	Ja!
	H6 - How do I register? Help is readily available and accessible	Det er en hjelp-link nederst på siden, denne sender deg til en utfyldende hjelp-side for hele facebook... Kunne ha vært en link i selve registreringsdelen av siden.	"Hjelp" er fortsatt nede til høyre, og man vil mest sannsynlig miste det man har tastet inn hvis man prøver å gå inn på hjelp-sidene i dette "steget". Dog, er det en "Hva er dette?" liksom-link som gir en fin hjelpende tekst når den blir klikket på. Dette etterlyste jeg på Page 1 - Sign H6.	Ikke noe annen hjelp enn den vanlig hjelp-linken nede i høyre hjørne...	Samme som Page 3, men har en forklarende tekst om hva som skal gjøres.	Her er ikke ting sååååå godt forklart, hjelp nede til høyre som vanlig
	H7 - The site is perceivable without use of style sheets.	Fungerer nogenlunde bra... Det kommer opp en del tekst som skjules av CSS'en, som kan gjøre siden litt uforståelig	Hvis man skrur av style sheets på denne siden så kommer faktisk skjemaet fra forrige side opp, dessuten kommer det mer tekst som CSS'en brukte å skjule... Liksom-linkene fra H6 er bare vanlig tekst blitt... Det er faktisk samme side som Page 1, bare at et kall har blitt gjort på å loade captcha'en	Uten CSS kommer det veldig mye tekst som egentlig skulle vært skjult... Lager problemer...	Kommer fortsatt mye skjult tekst fram når CSS skrus av... Men det er det samme som går igjen nå...	Akkurat som de to forrige sidene kommer det mye skjult tekst fram... Kan oppstå misforståelser
	H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript.	Kommer opp en melding om at man må skru på javascript for å kunne fortsette.. Eller bruke mobilversjonen, som egentlig er et godt alternativ...	samme som på "Page 1 - Sign Up"	Ting fungerer ikke uten javascript kommer meg ikke videre...	Fungerer ikke uten javascript	Når jeg skrudde av javscript, så hoppet jeg plutselig tilbake et steg uten å klikke noe som helst...
	H9 - The site offers sensible error messages	Feilmeldingen om javascript forstår man, men den forteller ikke om hvordan man slår på javascript	samme som på "Page 1 - Sign Up" Dessuten fin feilmelding på feil CAPTCHA	På forsøket på å finne på emailer skjedde det ingenting ved bruk av Yahoo alternativet, her burde det kommet at det ikke var en gyldig e-post address... Veldig lite feilmeldinger som dukker opp... Dårlig..	Så å si umulig å gjøre feil	Gode feilmeldinger på "feil filformat" og "ikke webkamera"
	H10 - If CAPTCHA is used for authentication, are there alternatives to visual and audio?	N/A	Ja, men ikke mulig å nå med keyboard	N/A	N/A	N/A

Heuristic evaluation nr. 3

Pages

Heuristics	Page 1 - Sign Up	Page 2 - CAPTCHA	Page 3 - gettingstarted.php?step=contact_importer	Page 4 - gettingstarted.php?step=classmates_coworkers	Page 5 - gettingstarted.php?step=upload_profile_pic
H1 - The website provides text alternatives for non-text content	Facebook-logo gir en alt-tag som sier "facebook logo". Det kommer også en notis opp når en holder musen over, som sier "go to facebook home" Knappene "sign up" og "log in" gir ingen god alternativ tekst, bare tall og bokstaver som ingen kan skjønne noe av Kartet over nettverket som er på siden gir ingen alternativ tekst, bare en overskrift som sier "Facebook helps you..... " Har ikke sjekket alle tekstbokser osv, men opplever at en del ikke har noe beskrivende tekst for hva som skal fylles ut. (gjennganger for flere av sidene)	Igjen har facebook-logo alt-tag som sier Facebook logo, og tittel som sier og to facebook home. Knappene sign up og log in har også her uforstående tall og bokstaver. Kartet over nettverket som er på siden gir ingen alternativ tekst, bare en overskrift som sier "Facebook helps you..... " CAPTCHA-bildet har ikke alt-tag	Logoene til de ulike som man kan importere kontakter fra har ikke alt-tag, men de har tittel som sier hvilken tjeneste det gjelder. Knappen for "find friends" har bare uforståelige tall og bokstaver som alternativ tekst. Bildet for step 1 har ikke noe alternativ tekst som jeg kan finne. Facebook-logo er som de andre sidene De tre ikonene for friend request, notification og messages har ingen alt-tag, men har tittel tilsvarende navnene som er nevnt. Profilbildet, som kommer opp når en holder over account har alt-tag tilsvarende navnet på innlogget bruker.	Kan ikke se at knappen for "save and continue" har fått noe alt-tag ellet tittel Facebook-logo mangler alt-tag, og nå står det bare home i tittel De tre ikonene for friend request, notification og messages har ingen alt-tag, men har tittel tilsvarende navnene som er nevnt. Profilbildet, som kommer opp når en holder over account har alt-tag tilsvarende navnet på innlogget bruker.	Facebook-logo mangler alt-tag, og nå står det bare home i tittel De tre ikonene for friend request, notification og messages har ingen alt-tag, men har tittel tilsvarende navnene som er nevnt Bildet som representerer mitt profilbilde har ingen alt-tag eller tittel.
H2 - The page should have sufficient headings	Det er ikke noe overskrift for "log in", mens "sign up" har overskrift som forklarer hva som er i bolken	Heller ikke her er det overskrift for "log in", mens "sign up" og "security check" sier noe om hva so kommer i bolken under.	Eneste heading er Are your friends already on Facebook?, hvor en under der får mulighet til å legge til venner fra ulike kilder. Overskriften gir en indikasjon på at du kan finne venner i bolken som kommer.	Eneste header som er der er "Fill in your Profile info", som gir en grei beskrivelse av hva som skal skje i bolken under.	Set your profile picture er eneste overskriften som er brukt, og beskriver hva som skjer i blokken under.
H3 - Meaningful sequence	Når en tabber seg igjennom går den igjennom en linje (horisontal) av gangen. På denne siden resulterer det i at sekvensen er forholdsvis god. I alle skjemaer får en feltene "lest opp" i riktig rekkefølge.	Når en tabber seg igjennom går den igjennom en linje (horisontal) av gangen. Linkene Try another text or an audio CAPTCHA blir ikke markert noen gang, så det er vanskelig å vite om taben har vært innom de. Ser ut som de blir hopptet over	Når en tabber seg igjennom går den igjennom en linje (horisontal) av gangen. Dette fungerer fint for denne siden, da rekkefølgen på valgmulihetene er logisk.	Når en tabber seg igjennom går den igjennom en linje (horisontal) av gangen. Dette fungerer fint for denne siden, da rekkefølgen på valgmulihetene er logisk.	Når en tabber seg igjennom går den igjennom en linje (horisontal) av gangen. Dette fungerer fint for denne siden, da rekkefølgen på valgmulihetene er logisk.
H4 - The site does not rely on colour alone for information	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.
H5 - All functionality is accessible from a keyboard	Når en tabber seg igjennom alle menyvalg, blir ikke knappene markert når en er kommet til de. Dette gjør at det er vanskelig å vite om det er knappen en er kommet til. All funksjonalitet på siden kan nåås med tastaturet	Linkene Try another text or an audio CAPTCHA blir ikke markert noen gang, så det er vanskelig å vite om taben har vært innom de. Ser ut som de blir hopptet over, og er derfor ikke tilgjengelig fra tastaturet	Det ser ut til at det meste er tilgjengelig via tastatur, men når jeg holder musen over account, så kommer det opp en meny som jeg ikke får tak i via tastaturet.	Det ser ut til at det meste er tilgjengelig via tastatur, men når jeg holder musen over account, så kommer det opp en meny som jeg ikke får tak i via tastaturet.	Det ser ut til at det meste er tilgjengelig via tastatur, men når jeg holder musen over account, så kommer det opp en meny som jeg ikke får tak i via tastaturet.
H6 - How do I register? Help is readily available and accessible	Kan ikke se at der finnes noe side om hvordan registrere seg. Bare link til " Why do I need to provide this?" Der er en side som ligger i menyen helt nederst, som linker til help. Fra denne siden er det mulihet til å finne hjelp til mye rart. Virker ikke veldig enkelt å finne frem.	Får opp en mulighet "What's this?", ellers er all forklaring som er mulig listet i siden. Der er en side som ligger i menyen helt nederst, som linker til help. Fra denne siden er det mulihet til å finne hjelp til mye rart. Virker ikke veldig enkelt å finne frem.	Også her er det bare help som ligger i bunnmenyen som er tilbydt.	Også her er det bare help som ligger i bunnmenyen som er tilbydt.	Også her er det bare help som ligger i bunnmenyen som er tilbydt.
H7 - The site is perceivable without use of style sheets.	Finner ikke mulighet for å skru av Css i chrome	Finner ikke mulighet for å skru av Css i chrome	Finner ikke mulighet for å skru av Css i chrome	Finner ikke mulighet for å skru av Css i chrome	Finner ikke mulighet for å skru av Css i chrome
H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript.	Kan ikke se at det skjer noe forskjell når jeg har skrudd av javascript på denne siden. Men når jeg trykker på knappen "sign up" får jeg feilmelding om at "JavaScript is disabled on your browser". Alle feltene jeg har fyllt ut blir slettet (noe som er veldig irriterende!) Jeg får beskjed om å skru på javascript, eller alternativt bruke mobil versjon. Jeg skrudde på igjen javascript	Kan ikke se at det skjedde noe forskjell når jeg skrudde av javascript, men jeg fikk ikke komme videre uten å skru det på.	Får ikke opp siden hvis ikke javascript er på, men dersom jeg skrur javascript av mens siden er oppe, skjer det ikke noe. Dersom jeg prøver å trykke på "find friends" i et av de valgene som ikke er "åpen" mens javascript er av, skjer det ingen ting. Heller ingen feilmelding kommer	Når jeg skrur av javascript, får jeg ikke lenger opp autovalg når jeg starter å skrive inn skoler jeg har gått på. Jeg får heller ikke lagre, og når jeg ikke får lagre, så får jeg ingen feilmelding, det bare skjer ikke noe	Når jeg skrur av javascript og tykker på upload picture, så får jeg bare opp en blank side, ingen feilmelding eller noe som forklarer hva som er galt. Når jeg har fått lastet opp bilde, og så skrur av javascript igjen, så får jeg ikke lagret bilde, og ingen feilmelding kommer.
H9 - The site offers sensible error messages	Får f.eks opp **"You must fill in all of the fields"** dersom ikke alle felter er fylt ut. Sier ikke noe om hva som mangler. Får også grei feilmelding når jeg ikke har på javascript. Får feilmeldingen "The name contains invalid characters." under registrering. Kan vel ikke ha tallet 2?	Fikk ikke noe feilmelding på noe, men det gikk heller ikke noe galt	Får ikke opp feilmelding når javascript ikke er aktivert, selv om jeg trenger å aktivere.	Får ikke opp feilmelding når javascript ikke er aktivert, selv om jeg trenger å aktivere.	Når jeg skrur av javascript og tykker på upload picture, så får jeg bare opp en blank side, ingen feilmelding eller noe som forklarer hva som er galt. Når jeg har fått lastet opp bilde, og så skrur av javascript igjen, så får jeg ikke lagret bilde, og ingen feilmelding kommer.
H10 - If CAPTCHA is used for authentication, are there alternatives to visual and audio?	Ikke brukt på denne siden	Jeg får mulighet til å høre lyd i stedet for bilde. Men jeg fikk ikke tilgang til det uten tastatur.	Ikke brukt på denne siden	Ikke brukt på denne siden	Ikke brukt på denne siden

Heuristic evaluation nr. 4

		Pages				
		Page 1 - Sign Up	Page 2 - CAPTCHA	Page 3 - gettingstarted.php?step=contact_importer	Page 4 - gettingstarted.php?step=classmates_coworkers	Page 5 - gettingstarted.php?step=upload_profile_pic
Heuristics	H1 - The website provides text alternatives for non-text content	Nei, ikke alle	Nei, ikke alle	Facebook, venneforespørseler, meldinger og varsler har egne navn som kan være forståelig om man får title lest opp, men ellers ingen alt tekst	Nei	Nei
	H2 - The page should have sufficient headings	N/A	N/A	N/A	N/A	N/A
	H3 - Meaningful sequence	Ja	Ja	Ja	Ja	Ja
	H4 - The site does not rely on colour alone for information	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.	Jeg oppdager ikke at sidene bruker farge alene for å gi informasjon.
	H5 - All functionality is accessible from a keyboard	«Registrer» knappen funket ikke ved å trykke enter, den måtte ha ett museklikk.	Forsåvidt, men ikke uten JavaScript	Jeg forsøkte flere ganger via enter knappen å trykke på "finn venner" linkene, men det fikk jeg ikke gjøre. Jeg ga til slutt opp, «hopp over» kanppen var den eneste som responderte når jeg tastet enter. Dropdown menyen som hører til brukerkonto fikk ikke jeg til å funke uten museklikk på brukerkonto.	Nei, det er ikke mulig å velge de forskjellige måtene å legge til mailkontoer.	Opplasting av bilde går ikke i det hele tatt. Teksten er ok, men ingenting skjer når jeg taster enter. Her er det også bare hopp over som funker med enter.
	H6 - How do I register? Help is readily available and accessible	Lite man kan gjøre galt her. Hjelp neders til høyre er tilgjengelig	Hjelp neders til høyre er tilgjengelig	Hjelp neders til høyre er tilgjengelig	Hjelp neders til høyre er tilgjengelig	Lite man kan gjøre galt her. Hjelp neders til høyre er tilgjengelig
	H7 - The site is perceivable without use of style sheets.	Ok, men litt uforståelig på noen steder.	Nei, her blir det vanskelig å forstå siden	Nei, det kommer opp masse irrelevant tekst.	Nei, det kommer opp masse irrelevant tekst her også.	Samme som de to foregående sidene
	H8 - The site does not depend on newer technology, such as Flash, Silverlight or JavaScript.	For å i det hele tatt få registrert meg måtte jeg pent slå javaskriptet på igjen, den ville ikke la meg gjøre det uten	Avhengig av JS	Eneste funksjon mulig når det er gjort er å hoppe over. Lagre tasten responderer ikke i det hele tatt.	Avhengig av JS	Avhengig av JS
	H9 - The site offers sensible error messages	Ja, får beskjed om å skru på JS.	Egentlig	Ingen	Ingen	Ingen
	H10 - If CAPTCHA is used for authentication, are there alternatives to visual and audio?	N/A	Det er både visual og audio CAPTCHA, men det er umulig å forstå hva som blir sagt i den med lyd.	N/A	N/A	N/A

Appendix D

License from the Privacy Ombudsman for Research (NSD)

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Jo Herstad
Institutt for informatikk
Universitetet i Oslo
Postboks 1080 Blindern
0316 OSLO

Vår dato: 09.02.2011 Vår ref: 26182 / 3 / LT Deres dato: Deres ref:

TILRÅDING AV BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 28.01.2011. Meldingen gjelder prosjektet:

26182	*Accessibility of User Registration and Identity Management in Facebook*
Behandlingsansvarlig	*Universitetet i Oslo, ved institusjonens øverste leder*
Daglig ansvarlig	*Jo Herstad*
Student	*Øyvind Nordseth Pettersen*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/-helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://www.nsd.uib.no/personvern/prosjektoversikt.jsp.

Personvernombudet vil ved prosjektets avslutning, 01.04.2011, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Vigdis Namtvedt Kvalheim Lis Tenold

Kontaktperson:Lis Tenold tlf: 55 58 33 77
Vedlegg: Prosjektvurdering
Kopi: Øyvind Nordseth Pettersen, Cort Adelers gate 17, 0254 OSLO

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 26182

Det gis skriftlig informasjon og innhentes skriftlig samtykke. Personvernombudet finner skrivet tilfredsstillende.

Personvernombudet legger til grunn at taushetsplikten ikke er til hinder for førstegangskontakt og legger til grunn at deltakernes identitet ikke blir kjent for prosjektleder før de selv samtykker til deltakelse direkte til han eller gjennom MedialLT og/eller forskningsprosjektet Nettborger.

Personvernombudet finner at det kan bli samlet inn og registreres sensitive personopplysninger om helseforhold, jf. personopplysningsloven § 2 nr. 8 bokstav c.

Opplysningene samles inn gjennom observasjon. Observasjonene blir videofilmet.

Personvernombudet legger til grunn at bruk av privat pc er i tråd med Universitetet i Oslo sine rutiner for datasikkerhet.

Innsamlede opplysninger anonymiseres ved prosjektslutt, senest 01.04.2011. Med anonymisering innebærer at navnelister slettes/makuleres, og ev. kategorisere eller slette indirekte personidentifiserbare opplysninger. Videoopptak makuleres.

Appendix E

Letter of information and consent

UNIVERSITETET I OSLO

Øyvind Nordseth Pettersen
Cort Adelersgate 17,
0254 Oslo

Institutt for Informatikk
Postboks 1080 Blindern
0316 Oslo
Gaustadalléen 23

DET MATEMATISK
NATURVITENSKAPELIGE
FAKULTET

Forespørsel om å delta i brukertester i forbindelse med en masteroppgave

Jeg, Øyvind Nordseth Pettersen, er masterstudent ved Institutt for Informatikk ved Universitetet i Oslo og holder på med den avsluttende masteroppgaven. Studiet har fokus på utfordringer sterkt svaksynte og blinde opplever under registering av brukerkonto på Facebook, og gjøres i samarbeid med firmaet MediaLT og forskningsprosjektet Nettborger.

Som datagrunnlag for dette ønsker jeg å gjennomføre noen brukertester av sterkt svaksynte og blinde personer. Testene vil ta for seg alle stegene man må gå gjennom for å lage en profil på Facebook, for så og undersøke hvordan denne prosessen er tilgjengeliggjort for brukere av teknologiske hjelpemidler som skjermlesere og Braille-tastaturer. Det er også ønskelig med en samtale rundt temaet i etterkant av testen. Jeg vil bruke filmopptaker og ta notater mens testen kjøres og vi snakker sammen. Testen og samtalen vil ta omtrent en time, og vi blir sammen enige om tid og sted.

Det er frivillig å være med og du har mulighet til å trekke deg når som helst underveis, uten å måtte begrunne dette nærmere. Dersom du trekker deg vil alle innsamlede data om deg bli slettet. Opplysningene vil bli behandlet konfidensielt, og ingen enkeltpersoner vil kunne kjenne seg igjen i den ferdige oppgaven, ettersom filmopptakene kun vil bli brukt av undertegnede til analyse. Opplysningene anonymiseres og opptakene slettes når oppgaven er ferdig, innen utgangen av 2011.

Dersom du har lyst å være med på brukertesten, er det fint om du skriver under på den vedlagte samtykkeerklæringen og sender den til meg.

Dersom det er noe du lurer på kan du ringe meg på telefonnummer 97 53 74 23, eller sende en e-post til *oyvinpet@ifi.uio.no*. Du kan også kontakte min veileder Jo Herstad ved institutt for informatikk på telefonnummer 22 85 24 27, eller Morten Tollefsen i MediaLT på telefonnummer 21 53 80 10.

Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste A/S.

OSLO, 15/01-2011

Med vennlig hilsen:

Øyvind Nordseth Pettersen
Cort Adelers gate 17
0254 Oslo

SAMTYKKEERKLÆRING

Jeg har mottatt informasjon om studien av tilgjengeligheten i registreringen på Facebook

Dato for testen:_____

Sted:_____

Navn på testleder:_____

Signatur:_____

Navn på testperson:_____

Signatur:_____

Dersom du har spørsmål angående dine rettigheter innenfor denne forskningen eller som menneskelige subjekter, kan de kontakte veilederen for intervjuet:

Testleder og observatør:
Navn: Øyvind Nordseth Pettersen
Adresse: Cort Adelers gate 17, 0254 Oslo
E-post adresse: *oyvinpet@ifi.uio.no*
Telefon: 97 53 74 23

Veileder:
Navn: Jo Herstad
Adresse: Institutt for informatikk, Postboks 1080 Blindern, 0316 Oslo
Kontor telefon: 22 84 00 51
E-post adresse: johe@ifi.uio.no

Appendix F

User testing task sheet

Oppgaver	Side	Utførelse	Notater
– **Åpne www.facebook.com** – **Finn de felter som skal fylles ut og skriv inn informasjonen som trengs.** – **Fullfør denne siden**	1 - Sign Up	0. Ikke 1. Gjennomført med hjelp eller problemer 2. Gjennomført uten problemer	
– **Gjennomfør CAPTCHA-sikkerhetssjekken** – **Fullfør denne siden**	2 - CAPTCHA	0. Ikke 1. Gjennomført med hjelp eller problemer 2. Gjennomført uten problemer	
– **Velg Windows Live Hotmail** – **Oppgi mailadressen og passordet du fikk utdelt før testen startet.** – **Fullfør denne siden**	3 - Contact importer	0. Ikke 1. Gjennomført med hjelp eller problemer 2. Gjennomført uten problemer	

Testperson nummer:

Dato:

– **Finn de felter som skal fylles ut og skriv inn informasjonen som trengs.** – **Fullfør denne siden**	4 - Classmates & co-workers	0. Ikke 1. Gjennomført med hjelp eller problemer 2. Gjennomført uten problemer
– **Last opp et bilde og fullfør denne siden**	5 - Upload profile picture	0. Ikke 1. Gjennomført med hjelp eller problemer 2. Gjennomført uten problemer