INF5261 – Development of Mobile Information Systems

e-Me Mobile:

Accessible authentication for mobile devices

Gunn Kristin Breien Johansen
&
Siri Bergmann Stølen

University of Oslo (UiO)
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Table of Contents

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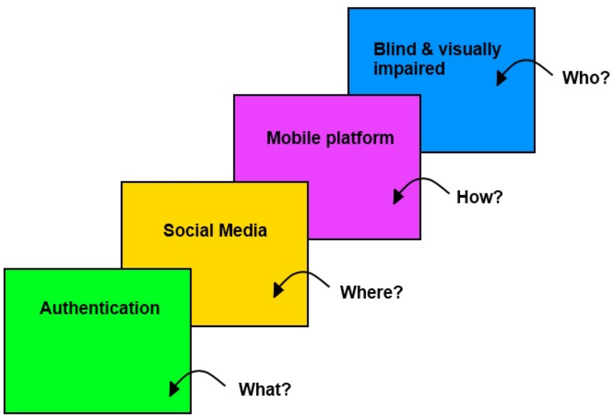
Introduction

In this paper we will describe the process of a project done in the course INF5261 "Development of mobile information systems and services" at the Institute of Informatics - University of Oslo, Norway. The overarching theme for is authentication in social media for blind and visually impaired. We are working within the research project *e-Me* which started in 2010 and will last until 2013. Their project goal is "to obtain new knowledge about inclusive identification and authentication mechanisms in the new social media" (e-Me, 2011).

In this project we are looking into the authentication process in social media on a mobile platform for the blind and visually impaired. This raises the question whether this user-group wants to use technology especially designed for them? In this paper we will discuss custom technologies for the blind and visually impaired versus universal design and accessibility for all.

Ministry of Equality and Social Affairs in Norway has adopted a law prohibiting discrimination on the basis of disability (Discrimination and Accessibility Act). It contains paragraphs on how the physical world should be designed to make it more accessible. The section "liability for the universal design of information and communication technology (ICT)" makes a project like this relevant these days (Lovdata, 2011).



The illustration is an attempt to describe the scope of this project.

Authentication

Nowadays our mobile phones contain a lot of personal information; many use it for work, mail and banking services. Mobile devices are also easily lost or stolen and we, now more than ever, need protection against unauthorized access. Authentication methods have traditionally in some degree been limited to verification based on identity (e.g. username) and credentials (e.g. password). Yet mobile users require frequent access for brief periods, making repeated password entry inconvenient and time-consuming. For blind/visually impaired password authentication on mobile devices makes access even more difficult. Therefore we decided to explore some alternative access methods and non-text password technology. The field of biometrics, especially on the mobile platform, will therefore be explored in this report.

Social media

Social media is expanding rapidly and people as well as corporations and the public sector are using it increasingly. “Over 200 million people use Facebook on their mobile phones to share photos, access applications and stay connected with friends“ (Yao, 2010). This growth makes it important to include all and make social media accessible to everyone. At the same time the mobile access are becoming more and more widespread. In this race there are many existing services that exclude certain users. We will be looking into the field of universal design and mobile accessibility.

The mobile platform

While e-me primarily is focusing on universal design on computers, we will see what opportunities are available through the use of *mobile* technologies. To access social media through mobile phones you usually need a smart-phone, and we have chosen the touch-screen platform as our objective. It is interesting to learn how blind and visually impaired can interact with a touch device. What improvements can be made in the authentication process to make it easier for them to browse social media? This project has aimed towards a prototype application, which attempts to meet the requirements of blind and visually impaired in a best possible way.

Blind and visually-impaired

Some of our initial questions were in what extent blind and visually-impaired use mobile phones for social media access. Most existing online authentication methods rely on text-input of username and password. Are there alternatives that are more suitable for those with visual-impairments? What kind of authentication and login methods do they prefer? The Nettborger project found that blind and visually impaired had problems when it comes to interacting with visual interfaces (Tollefsen et al., 2011). We have consequently targeted our user group and are focusing on the blind and visually impaired, and it turned out to be an interesting and challenging group to work with. We had limited experience with blindness and our priority was therefore to get to know what technology they use or don’t use, what challenges they meet in their use of digital media in addition to their habits i social media. It was also important to research existing technology designed for the blind, such as text-to-speech programs.

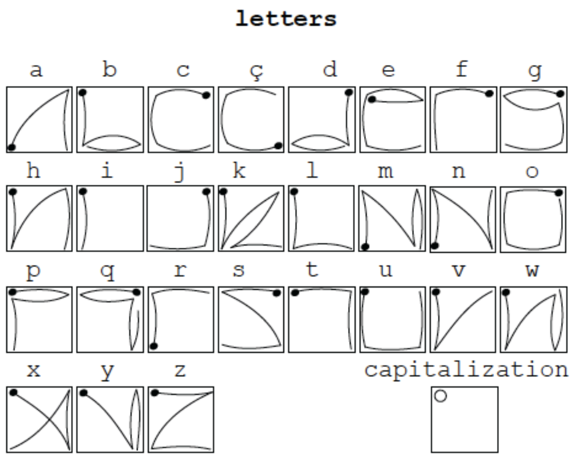
Theory

To get familiar with the technology and concepts we are working with we will explore the field of universal design and mobile accessibility standards (WAI and WCAG). In addition, some accessibility features and guidelines related to the two major mobile operative systems, Andriod and iOS, will be examined. Further, the report will look into biometrics used as alternative authentication methods. To see how these access methods work in practice, we found it natural to include a review of an iPhone app using biometrics as authentication (iSignOn). It is well known that online authentication is troublesome, and we have looked into a relatively new phenomenon, OpenID, attempting to solve access challenges. These two technologies are closely related to our prototype ideas, which will be presented later in the report. The get familiar with our target group we have included some statistics presenting Facebook and mobile usage amongst members from National Association of Blind and Visually-impaired (NABP)[1] (Tjøstheim & Solheim, 2010).

Related literature

We have attempted to map out what literature has been written about the topic before. We read some articles, found surveys, mobile specifications and got an excerpt from an unfinished master thesis[2]. The aim with this was learn more about the topic and to figure out where it would be necessary for us to do our own research. This answered several of our questions, and we learned that blind and visually impaired were using both social media and mobile phones. Statistics showed us that they did not only use their phones for conversations, but quite a few of them were also familiar with apps, mobile Internet and text-to-speech programs.

Li et al. (2008) presents BlindSignt; a system enables to access calendars and contacts during a conversation. They are looking into different ways of eyes-free navigation on the phone, without interruption by providing auditory feedback. They were focusing on sounds and speech as output, while we will focus on text-to-speech technology. We got inspired by their section about related technology. BlindSight explored some alternative input methods in their research. EdgeWrite and Unistroke are methods providing new text entry techniques, which could be transferable to today's smart phones and touch-screens. All in all it made us aware that there are other types of input than text-input that can be used.



EdgeWrite and Unistroke –alternative input alfabet

[1] Blindeforbundet
[2] Accessibility of user registration and identity management of Facebook (Øyvind N. Pettersen, 2011)

Universal design

The article “Universal design for mobile phones: a case study” by Plos and Buisine illustrate how blind people are using the raised dot on the number 5 as a guide when navigating on the keypad, and how problems might appear as a result of lack of relief or tactile discrimination. Visually impaired often experience problems related to font size on the screen or on the keypad, in addition to luminosity and contrast problems (2006). Plos and Buisine states that the intent of universal design is “to simplify life for everyone by making product, communications, and the built environment more usable by as many people as possible at a little or no extra cost. Universal design benefits people of all ages and abilities” (2006). Since we have limited our target group to blind and visually impaired, our project cannot be considered clean universal design. Still it gives us an opportunity to learn about one part of universal design, which is the goal within the e-me project.

Accessibility and technology

Accessibility focuses on people with disabilities such as auditory, cognitive, neurological, physical, speech, and visual impairments (WAI, 2011). Blind and visually-impaired find their way around the web by using well-established technology such as screen-readers, screen-magnifiers, and custom color-schemes. However, if a web-page is badly coded they may encounter difficulties. For instance, a web-page that are mainly made up by pictures, along with wrong use of the html *alt*-tag for describing these pictures, will be unusable for the blind. The World Wide Web Consortium has an initiative to combat such accessibility issues called Web Accessibility Initiative (WAI). They provide international guidelines for the programmers and designers for how a web-page should be build to meet the requirements for universal design. Web Content Accessibility Guidelines (WCAG) 2.0 is guidelines for making Web content more accessible. These recommendations will make content accessible for people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these (W3C, 2008). When following these guidelines it will make your Web content more usable to users on a general basis.

Mobile technology - Android and iOS accessibility

Because we are approaching mobile technology, we found it useful to look into how two of the largest providers of smart-phone OS, Android and Apple have catered to people with disabilities.

In the developer guide for Android there is a chapter about how to design for accessibility. They claim many Android users have disabilities that require them to interact with their Android devices in different ways. These include users who have “visual, physical or age-related disabilities that prevent them from fully using or seeing a touchscreen” (Android

Developers, 2011). To make users navigate their device easier Android provides an accessibility layer that support features like text-to-speach, haptic feedback, and trackball/d-pad navigation that augment the user experience. To make sure applications provides a good experience also for user with disabilities Android have put up two basic rules that will solve the most access-related problem and they recommend developers to follow.

- Make all of your user interface controls accessible with a trackball or directional controller (d-pad) [3].
- Label your all input widgets (e.g. buttons) using the description attribute.
  (ibid.)

One of the challenges people with disabilities meet when they are using an application is to learn how to use it. It is therefore important to make the learning process as easy a possible. Developing a user interface that complies with Android's standard interaction patterns, instead of creating your own or using interaction patterns from another platform can realize this. This consistency is especially important for many disabled users, as they may have less contextual information available to try to understand your application's interface (ibid.).

Apple serves accessibility technology for iPhone, iPad, iPod, and Mac OS X. Examples for the blind and visually impaired are screen magnification, VoiceOver and screen-access technology. VoiceOver is the world's first screen reader that can be controlled using gestures. Other inventions such as braille mirroring enable deaf and blind kids to work together on the same computer at the same time (Apple, 2011). In some blogs[4] there has been claimed that iPad could be the best mobile accessibility platform on the market. We have tested some of the accessibility tools on iPad and iPhone such as VoiceOver, magnification/zoom, font-size and screen-contrast. You can get many other accessibility applications, but these tools mentioned are included in the OS itself. These made us understand a little more about what technology the blind and visually impaired use in their contact with digital media. We have also been lucky to have an amazing demonstration of the gesture controlled VoiceOver tool by a blind person at MediaLT - making different gestures, using from one to four fingers, on the iPhone touchscreen for navigating.

Biometrics on mobile devices

As we have researched our user group and some accessibility features on the mobile platform it is time to move over to alternative authentication methods; *biometrics*. Biometrics is verification of identity using unique bodily characteristics. It is used as a form of identity

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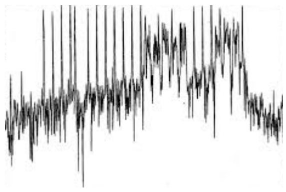
[3] Track ball/d- pad makes it possible for the user to navigate on the screen without using the touch screen.
[4] http://www.tuaw.com/2010/06/01/the-ipad-could-be-the-best-mobile-accessibility-device-on-the-ma/ and http://deboraheo.posterous.com/ipad-best-mobile-accessibility-device-on-the

access management and access control by recognizing humans based upon one or more intrinsic physical or behavioral traits (Biometrics, 2011). When hardware tokens, such as bankID, smartcards etc. can be stolen and passwords can be cracked, biometrics relies on your specific bodily characteristics. Biometrics can be divided into two classes, physiological and behavioral. Physiological are related to the shape of the body, for example fingerprints, face recognition, DNA, palm print, hand geometry, iris recognition and odor/scent. Behavioral are related to the behavior of a person. Examples include typing rhythm, gait, and voice (ibid.). Biometrics can offer some good alternatives, not depending on traditional password methods. We have decided to focus on the following biometrics, to see if they can be useful in mobile authentication for blind people:

- Fingerprints
- Voice recognition
- Signatures

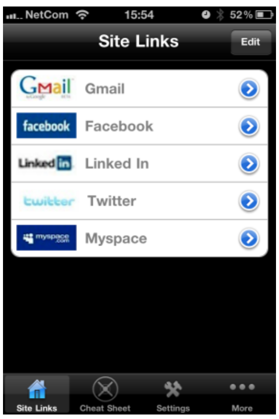




Related technology

We have tested some of the existing apps using biometrics on mobile devices to learn and get inspired. There were a few iPhone apps for reading fingerprints, but most of it turned out to be scam. iPhone touch-screens is not sensitive enough to get all the details in a fingerprint. However, on some Acer computers, they use of fingerprint authentication for login, so the technology is definitely there. The input is different, and we have yet explore the mobile platoform technology.

iSignOn is an iPhone app who claims to replace all passwords by using signature recognition (more about this later). Voice Authentication System (VAS) uses spoken words to verify claimed identities over the phone or web. It calculates vocal measurements of an individual's vocal tract. Sophisticated algorithms convert these measurements into a voice print - a unique digital representation of an individual's voice (Voice Authentication, 2011).

iSignOn - signature recognition app for iPhone



iSignOn is an application for iPhone which allows you to access several of your web accounts by drawing your signature with your fingertip on the screen. The technology is not the same as the one used in OpenID, but the idea is similar. The application is supposed to make your life easier, because you only need to remember one signature to access many password protected web sites. You can choose from a list what accounts you want to add to the application, and the first time you access the selected websites you are asked to type in your password. After this the application will send the password for you, and you only sign-in by drawing the signature you have specified (iSignOn, 2011). Disregarded that this program is not particularly adapted to people with disabilities, it is a solution similar to this we are aiming to make.

Open ID - simple access

OpenID is an interesting technology to look into, as it offers use of an existing account to sign in to multiple web portals, without needing to create new accounts (OpenID, 2011). We have not looked into the security issues of biometrics as it is outside our scope, but OpenID is a technology that could be used in this context. With OpenID, your password is only given to your identity provider, and that provider then confirms your identity to the websites you visit. Other than your provider, no website ever sees your password, so you don't need to worry about an unscrupulous or insecure website compromising your identity (ibid.). You can choose the identity provider you want, and there exists many providers or hosts such as Google, Wordpress, flickr, yahoo! and Facebook.

Facebook and mobile usage statistics

Through the e-me project we got in contact with the Norwegian Computing Center (Norsk Regnesentral) and they were kind and sent us the notes from this survey. The survey contains answers from 150 blind and visually impaired. Because of the relatively low number of participants the survey does not give us enough data to generalize, but it can give us an impression of the trends among this user group in Norway today. Central questions we had before starting the project was if blind and visually impaired are mobile users, and if they used screen-based technology. Following are some of the numbers from the survey "The use of social media among blind and visually impaired in Norway 2010" (Tjøstheim & Solheim, 2010).

Facebook statistics

Year	Daily	Weekly	Monthly/seldom	Not using
16-24	80%	5%	5%	10%
25-39	45%	15%	12,5%	27,5%
40-59	26%	8%	30%	36%
60-75	0%	3%	13%	30%

(Tjøstheim & Solheim, 2010)

122 of 150 of the people asked answered that they were using a computer. From these numbers we can see that people in this survey are heavy users of screen-based technology and social media. Those who answered that they did not use Facebook got the opportunity to answer some questions to clarify why that is. These are some of the answers:
"I have tried, but was not able to use Facebook" 36% (18 of 50).
"I would like to use Facebook, but no one can help me getting started" 52% (26 of 50).
This reveals that the interface of Facebook probably could be improved in terms of adapting to users with these kinds of disabilities. And the reason that many people don't use Facebook is not that they don't want to, but that they find it to hard to access and use.

Mobile usage among members of NABP

Year	Text-messaging	Mobile Internet	Apps	Text to speech program
16-24	90%	65%	45%	--
25-39	95%	44%	41%	38%
40-59	92%	27%	42%	60%
60-75	44%	3%	9%	2%

(Tjøstheim & Solheim, 2010)

These numbers answer our question connected to the users interaction with mobile technology. From all of the persons asked, except a couple, were using mobiles. This was not unexpected, but what we did not expect was that so many of them also used mobile Internet and apps. Smartphones have become a success over the last few years, and we can see that it is more common to use mobile Internet and apps among younger people.
If we look at the numbers from the two tables we have reason to believe that people also access their social media accounts from their phones, as we also wanted to focus on in this assignment.

In November 2010 MediaLT invited disabled to share their experiences using social media. This was done on behalf of the Nettborger project, which focuses on how social media can be designed universal. The report from this survey tells us that there are existing social networks that are mainly focusing on people with disabilities, but that most people prefer to use Facebook and similar networks and be where everyone else are (Tollefsen et al., 2010).

The theory has guided us towards getting an overview of the problem-area and getting familiar with the field of accessibility and universal design. The target-group has become clearer and technology made for accessibility has been tested.

Methods

The methods in this section are chosen to increase our knowledge about the user-group and to get first-hand information about their experience in accessing social media on smart phones. We have conducted interview with a blind and a visually impaired to get "inside information" and to observe how they interact with mobile devices. We have also distributed a survey to get some answers to our research question. Does this user-group prefers to use custom technology designed for them, or is the ultimate is universal design and accessibility for all? Further we have conducted a heuristic evaluation of the application iSignOn to get familiar with biometric technology. The prototyping process will also be presented here.

Questionnaire - online survey

We have been in contact with NABP and their two competence-centers Tambartun[5] and Huseby[6] - respectively located in Melhus and Oslo. They forwarded the survey to some of their members (e.g. their youth group). Our contact person from the association told us that surveys and online forms/questionaires could be difficult to answer for blind, so it was also distrubuted in .pdf and .doc.

The Nettborger project contained information about how disabled people are using social media, and the statistics from Norwegian Computing Center gave us insights about blind and visually impaired and their usage of mobile phones and social media. However, our intension with this survey was - in addition to information about mobile use and social media - to get some insights on their relationship to access methods.

We wanted the survey to be as *open* as possible with the intention capturing the diversity of the respondents as they could give the answers they wanted (not being restricted to multiple-choice question). The only obligatory fields were age, gender and consent. There were nine questions (in addition to the obligatory) - covering usage of mobile phones, social media and proposed authentication techniques. We wanted them to describe their visual impairment to see if it accounted for differences in the responses. We asked if they were interested in alternative access methods for social media and suggested four authentication methods and asked for their preferences (fingerprint-scan, voice recognition, signature recognition and gyro/accelerometer movements). We also asked if they had other login preferences than listed. In addition, we were interested to know if there were specific problems they encountered in usage of mobile phone. We asked about what services they used on their phones, both developed for visually impaired and in general and if they used any programs

[5] http://www.skolenettet.no/moduler/templates/Module_Article.aspx?id=14624&epslanguage=NO
[6] http://www.statped.no/moduler/templates/Module_Overview.aspx?id=14631&epslanguage=NO

especially designed for the blind / visually impaired that they were satisfied with. See appendix for complete questionnaire.

Interview and walkthrough

In the process of getting to know our target group qualitatively, we conducted a semi-structured interview with a blind and one visually impaired person. MediaLT is a leading actor in ICT and universal design, and they are working to improve the situation of disabled persons living in Norway and the rest of the world through innovation. The interviews were conducted in their natural job environment in Oslo. The conversations were recorded and we also took notes during the interview. Both were working within the field of internet and accessibility.

The statistics and numbers from the quantitative research were not able to tell us anything about how blind and visually impaired are interacting and navigating on the display. We were interested to know more about their daily use of mobile phones, how they navigate and their relationship to digital media. In order to learn more about this we arranged a little walk-through after the interview. We asked one of the interviewees what functions or application he used on a daily basis and then to show and tell us step by step what he did. In addition to observe the process we took notes and asked questions.

Heuristic evaluation

We did a heuristic evaluation of the application iSignOn for iPhone. This application is quite similar to the one we are visualizing as a result of this project. It was therefore interesting to see how it worked. However, it is not specially adapted to disabled people, but by evaluating this application we would be able to see if there are improvements that could be done it terms of adapting such an application to blind and visually-impaired.

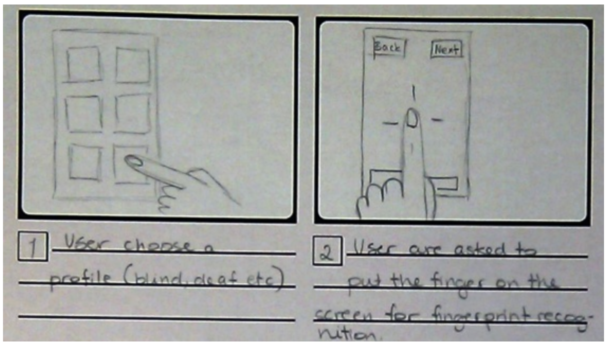
The heuristics we used were generated through Preece et al. (2007) Interactive Heuristic Evaluation Toolkit. We specified the device-type as *mobile phone*, the user-group to *disabled* and selected *all* types of applications and then choose the suggested heuristics. The heuristics worked as usability guidelines during the evaluation. We went through the interface several times looking at different interface elements and comparing them to the list of usability principles (heuristics). This was done until we were satisfied and assumed that we had identified the majority of the usability problems (ibid.). Ideally, we should have been between 3 and 5 people who carried out this evaluation, to get the best result. We would then be more likely to find all the violations, however we had to take into account that we were only two people working on this project. See appendix 3 for details.

Prototyping

In the initial phase of the project we had ambitions to design a prototype using several biometrics for social media authentication, but we have not made a working application. Instead during the project we have made a series of pen & paper sketches, and drawings of upcoming ideas. This was to help us discover and clarify requirements and constraints along with visualizing a possible application. These early prototype-ideas turned out to include almost the same functionality as the application iSignOn - only differentiating in amount of biometrics used (and target user-group). In our prototype we included fingerprint and voice recognition. The result was a lo-fi prototype, which was an expansion and adaptation of iSignOn - an attempt to meet the requirements of the blind and visually impaired.

We used the software Balsamiq[7] to create iPhone-wireframes. They illustrate the disability choice interface, the different biometric methods and the final social media login screen. We have divided the user-interface in six parts. The reason is that we assumed it easier to memorize and to tap the right place and that blind and visually impaired will prefer this navigation more. See appendix 1.

We then produced a storyboard of the scenario "User sign into Facebook". In this scenario we assumed that the user had already saved his/her Facebook password and registered three different authentication methods. With a series of sketches, the storyboard visualizes how the user can interact with the mobile device during the scenario.



We also created a lo-fi prototype in HTML. This gave us the opportunity to test the navigation between the pages and explore the functions of text-to-speech tools like VoiceOver on iPhone. The interface of the html version is icon based and simple. Through an image map it uses alt-tags to communicate to VoiceOver software the function of a specific button.
First we made the VoiceOver-text in English which again resulted in Norwegian translator problems. We therefore had to give the VoiceOver Norwegian input. See appendix 5.

[7] http://balsamiq.com

Findings
Through our choice of methods we have explored an application using biometrics, got inside knowledge about the user-group and tested ideas and voice-over technology through prototyping. In this section we will extract some of the results and findings from the methods that we want to discuss further. Findings from the survey, results from the interviews and walk-through, and the outcomes from the heuristic evaluation will be presented here. These insights have been used as guidelines for the preparation of a set of requirement proposals to a future prototype.

Questionnaires
In sum we got five replies on our questionnaire. The form was probably sent out too late in order for us to get enough answers back in time to do a generalization. The reason could also be problems with filling out the form. Disregarding the small amount, the replies were very useful. The respondents made use of the freedom to input whatever text they felt for.

There were five respondents, two women and three men in the age of 19-27.The major phone brand was Nokia (Nokia 6700 Slide, Nokia 5800, Nokia N82, Nokia N8). There were only one blind person and the others had different kind of visual impairments. On questions regarding problems with mobile usage, 40% respondents had no problems. The other (60%) reported everything from difficulties seeing the screen in sunlight to small text/print - resulting in login issues and problems reading mail, online newspapers etc. All respondents would like to login to a social website with their phone, and 40% did it often already. It was possible to select more than one checkbox resulting in the total percentage exceeding 100%. 80% would like to login with fingerprint scanning, and the rest was spread → 40% on voice recognition, 40% on signature recognition and 40% on movement/gyrometer.

Interview and facebook-walkthrough
As mentioned the goal with meeting blind and visually-impaired was to learn how they used their phones in practice. The blind person showed us how he interacted with his iPhone 4, starting with going through how he chose the accessibility settings, and turned on VoiceOver. He held his phone in his left hand, used the fingers on his right hand to navigate on the screen. Except when typing he used both hands. He had turned off the flip screen because the screen suddenly flipping horizontally annoyed him. This made confusion as he would not be able to know when the interface change view.

When voice over is turned on, the touch navigation is working different than it normally does. If you tap once the item is marked and the VoiceOver reads up the metadata, while you choose selected item by tapping twice.

“If I for instance are going into the Trafikanten application[8] I will go to the navigation folder on my screen, and I know that it is in this area [pointing to the right on the screen] and will touch and listen until I find the right one, and then I press twice to enter. Then I go through the same procedure to find the application. If you need to scroll down or up you use three fingers” (own translation). He did a couple of attempts before finding the correct folder and application, but the tempo was still fast. The most used finger gestures was slide and tap (with one, three, four fingers).

Whether he used headset was depending on the context, if he was moving in a public space like on a bus, he was more likely to use a headset than if he was in his private home.

In this walk-through we used the scenario “User log on to Facebook”. The user had a Facebook application installed on his iPhone and logged out for us to see how he managed to log in. “This is where you meet some of the difficulties with iPhone” as he said. He was able to type in his password and username without problems. He had long experience in using a keyboard, so the problem wasn’t to type in the letters. He states “iPhone is good in consuming information, but not as good when it comes to producing information”. When typing you can choose if you want to select a letter and then press or you can find the letter hold and let go to type. This was the method the user preferred, you choose your preferences in the VoiceOver application. We asked if the size of the letters/buttons on the screen was a problem, but the answer to this was no. The interviewee said himself that he is impatient and thinks the problem about writing is that it is way too time consuming, and therefore prefer to use bookmarks and favorites.

The other interview was with a visually impaired mobile user. He had a Nokia E52 with Symbian. The screen on the phone was too small for him to be able to use the visual interface. He used the keypad for navigation and typing and the built-in screen-reader *Talks* as guide. He needed help to activate the settings, on e.g a new phone. When it comes to social media he mostly used Facebook, but rarely/never logged in through his phone. H However, he used his phone to surf other pages on the web, but did often experience problems with typing in text-fields. He stated that this was a common problem with that particular phone, and that this hadn’t been a problem with his last phone Nokia E50.

Results from heuristic evaluation

The heuristic evaluation of the iSignOn application was done separately, and we spent about an hour each. The following reflections are a summary of the result from the two evaluations.

[8] An application for public transport in Oslo

We were using the application as a person with normal sight, but were trying to have in mind how a blind or visually impaired person would experience it.

We found that not all of the heuristics were as relevant, and that the evaluation worked good as a guide to discover usability problems in general. However, we could probably have chosen some heuristics from the Web Content Accessibility Guidelines (WCAG) 2.0 to focus more on accessibility. For instance, we should probably have tested the application while the VoiceOver feature was enabled; in order to see if the it was labeled so that a screen reader would work.

The most relevant violation we found on the last heuristic, which was about extraordinary users, we choose to interpret this as people with disabilities. In our case we were looking especially for problems blind and visually impaired might meet. Several places on the application there are grey text which can make it difficult to read as the contrast is low. The text is also a bit small, for some people. The last issue we discovered was that when adding and logging in to LinkedIn the use of Captcha, which is not suitable for blind people (see appendix 3).

Storyboarding

The storyboarding made us aware of the fact that the next button was unnecessary and would just lead to too many steps. Instead we decided that when the correct input was provided the application would move right to the next page after confirming that the input was correct. This would lead to fewer steps and would make it easier for the blind and visually-impaired users as they don't have to try to find the button.

The storyboard also made us remember that we also have to consider the visually-impaired and not only the blind. As a result of this we decided to add some visual feedback to the prototype in addition to sound and haptic response. We have to assume that the part of the target group that have some vision have far from perfect vision, which makes it extra important to use large text and a good contrast between the text and the background.

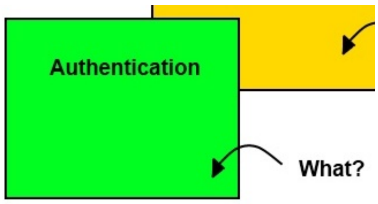
Result - our prototype

We have not focused this project towards making a prototype, as it turned out to a daunting task, regarding the diverse user-group. Thorough the survey we got feedback that alternative log-in methods was interesting. We also presented our ideas on the interviews and got some feedback. One of the respondents did not prefer the six divided screen, and did not see any problems with using the regular screen instead (e.g. lists). We tested the prototype with VoiceOver and it read out the content. It read out the English metadata in Norwegian - but the main point is that it worked. One of the interviewees showed us that he to a certain degree had learned to hear English text with a Norwegian VoiceOver. Further improvement is to add functionality for the user to select the contrast and font-size. Also adding haptic feedback after completing tasks could be useful. We have created a set of functional and non-functional requirements that should be fulfilled when developing a mobile application for blind and visually impaired (see appendix 4).

Discussion

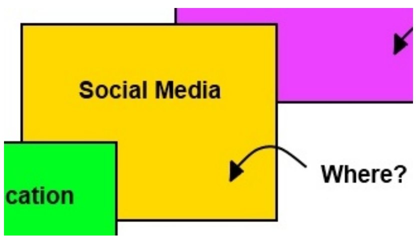
We will use the scope from the introduction to structure the discussion of the different aspects of this project; the authentication process in social media on a mobile platform for the blind and visually impaired. We will discuss social media preferences amongst this user group. We will also compare different mobile platforms and discuss security aspects of biometrics. In addition we will present Harrison and Dourish (1996) concept of context in relation to usage of mobile devices. We will also use Boyeras (2007) concept of the digital divide to make an understanding of the diversity of users.

Authentication – biometrics



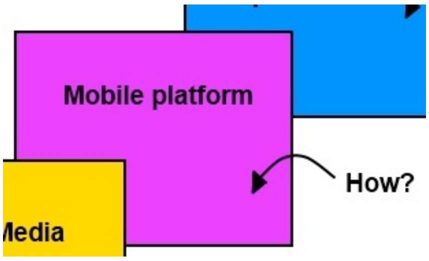
Through our research, we found good alternatives for password and username input. Authentication with biometrics was a clever idea since our respondents reported that writing often was difficult. They also had login issues, problems reading text, seeing the screen. We have seen that the target group has been positive to alternative logon using such biometrics. The survey pointed out fingerprints to be the most interesting alternative technology. Still, this technology has limitations that make it difficult to use. For example that the iPhone screen is not sensitive enough to read fingerprints. Another issue with biometrics is the security aspects, but this is outside our scope. The technology does not offer privacy (if you speak load, gyro etc.), but an important issue to explore before taking this further.

Social Media



We have focused the project only to login to social media. We see now that we could have been focusing login routines on a general basis, since text input (passwords and usernames) is problematic anyway. Since our topic is associated with the e-me project, it was natural to focus on the problem area of social media. In addition it was a better option than for example BankID, since this will not require an equal degree of security. From what we read in the paper "Et notat om funksjonshemmedes bruk av sosiale medier" we have the impression that people with disabilities prefer to use social media like Facebook rather than specialized social networks (Tollefsen et al., 2011). That's why have been focusing on the most common social networks.

The mobile platform



During the project we have in various ways reviewed the operative systems of Android, iOS and Symbian. As it is today, we would say that iOS is the most advanced and efficient platform for accessibility. They have more accessibility built into their system, while Android does not have the built-in tools in the same extent. First you have to download external apps, such as "TalkBack" for voice-over, and secondly the functionality iPhone and does not work properly (from our own testing). We have looked into Android's guidance for developers who make applications designed for accessibility. They rely more on outside programmers and external applications, while Apple has more internal developers. For blind and visually impaired iOS represents the preferred accessibility platform, but it is still important that Android keep track of the competition, to avoid an accessibility monopole.

If we are going to compare Android and iOS it can seem like iOS is a couple of steps ahead. The reason is that there are more accessibility features built in the iPhone and ready to use instantly, while android are depending on outside developers. The user have to go to the Android market place to download an accessibility application in order to adapt the phone to their needs. With iOS you can adjust the settings from iTunes on your computer, which can make it easier for blind and visually impaired to do this themselves.

Many blind people will not use technology specifically designed for them - which make Apple a good choice. This quote from our own questionnaire emphasizes this: "I'm a notorious opponent of software developed specifically for the disabled. For this reason, Apple does a very good job. Google with its Android operating system is well underway, but the built-in screen readers, is still not so good that it works quite effectively" (own translation, blind male, 27 years).

We were surprised that many people in the target group were using Nokia phones. The reason can however be that Nokia have been existing for a longer period while smartphones are relatively new in comparison. Blind and visually-impaired need more time to familiarize themselves with new things than normal-sighted do. In the report done by MediaLT about disabled and social media we find a quote from a blind woman that confirms this in context of Facebook. "I find it difficult to get an overview, the structure is changing constantly. When you have learned to navigate the page, it's suddenly a different structure next time" (own translation, Tollefsen et al. 2011).

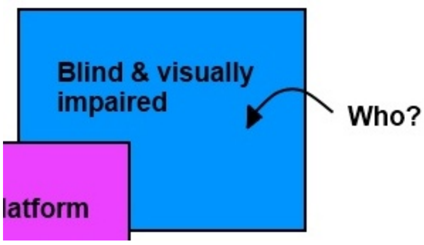
Context

Mobile devices opens up for a different kind of behavior than static technology that tie you to a desk in a fixed environment. One of the most obvious differences might be that people bring their mobile phone with them at anytime, anywhere. This means that the place and context surrounding them are constantly changing and they risk being interrupted while using their device. Harrison and Dourish (1996) are discussing the difference between space and place and states that the appropriate behavioral framing in everyday action comes from a sense of place and not from a sense of space. By this they mean that where you are, what social or cultural context you are in and your understanding of this all affect how you behave.

Blind and visually impaired faces an extra challenge when they use their mobile phones, as the text-to-speech technology is necessary for them to use their device. This means that if they are in a noisy environment this might affect them more than others, as they will experience problems with navigation when they cannot hear the voice from the phone. Lack of privacy can also be a big challenge. For instance when blind and visually-impaired are typing into their phone, they get feedback on their input in form of sound if they use the text-to-speech technology. The letters that they type in will be read out loud, which is not desired in all situations, especially when it comes to authentication details like password and username. Both our interviewees mentioned that they in a public setting, like on the buss would prefer to use headphones.

Other differences we are facing on mobile terminals vs. fixed terminals are the appearance and size, the screen is much smaller on mobile devices which give the user a much smaller space to navigate. The complete interface is smaller, which means both the content and the keypad. However the mobility of the user and the mobility of the device opens up for other forms of input and output that in some ways can replace the typing. This can be taken advantage of during an authentication process.

Blind and visually impaired user-group - digital divide



Through our research and questionnaires we have come across two so-called super-users. They were familiar with digital media and not afraid to start using new technology. One of them was eager to get the new iPhone5 and seemed to have an extended overview of the field. The other was using most functions on a iPhone4 and also had an iPad. It can seem like they don't see themselves differently from other users, despite the fact that they are blind they will use the technology that exists. One of the respondents wrote when we asked about authentication methods “I use what the different services have to offer, and not something extraordinary because of visual-impairment” (own translation from questionnaire, blind male, 27 years). It could lie in this attitude the reason why these are super users.

As we have mentioned previous in the report it can be time consuming to learn new technology, and people have different interests; some are more interested in technology than others which might affect their level of expertise. The people we interviewed both worked within ICT, something that their answers also reflected. However, we can not assume that they represent the typical mobile user. All users are different and some are more comfortable with technology than others. From the Nettborger project a visually-impaired woman, stated that she would like to try using Facebook, but don’t know how to start (Tollefsen et al., 2011). In relation to this we can talk about the *digital divide*. Boyera defines the digital divide as “the gap between those with regular, effective access and ability to use digital technologies and those without” (2007). He also states that an important step in the direction of bridge this gap has been the deployment of mobile networks all around the world.

The solution we are picturing would help making the authentication process easier and more accessible for blind and visually-impaired and therefore contribute in bridging this gap. This supports Boyeras view that “the Mobile Web option, seen as the most promising way to bridge the Digital Divide” (Boyera, 2007).

Conclusion

During this project we have become familiar with some alternative technology that can be used for authentication, learned more about how visually impaired and blind people interact with mobile devices and about the existing mobile technology in general. We have learned that blind and visually impaired is a diverse user-group. If the technology is universal designed and supports accessibility, they would rather make use of these, over design specially adapted only to them. This emphasizes the importance for developers to make universal design so information is available to all - not only for people with good vision. The law that takes effect in June requiring universal access is therefore an important step in the right direction.

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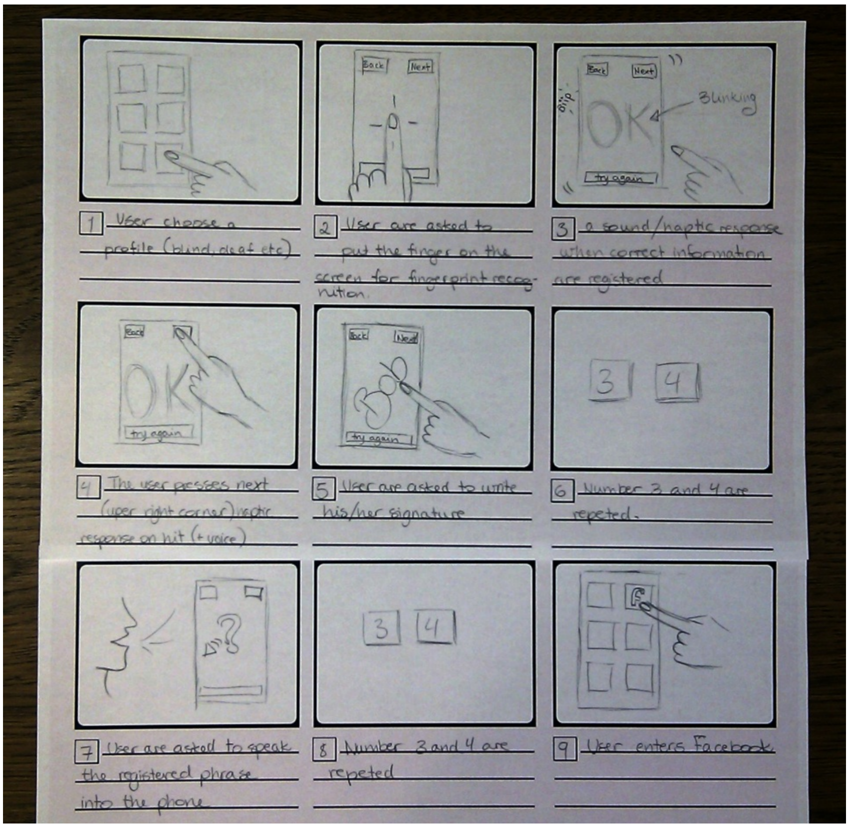
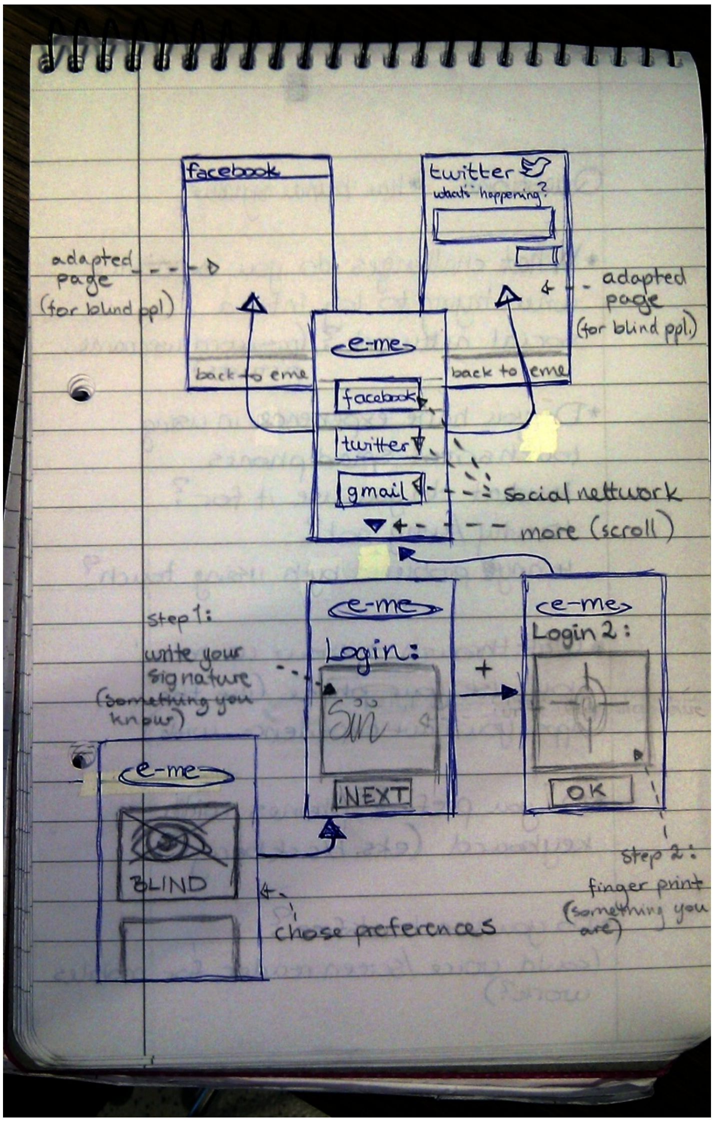
Appendix

1: Wireframes, sketches





2: Survey

https://spreadsheets.google.com/viewform?hl=no&formkey=dFdyLUhXWkZ3SXM1S2ctUVYwRTNwNmc6MQ#gid=0

3: Heuristics

Heuristics found here: http://www.id-book.com/catherb/Mobile_heurs.php

Violation of heuristics:

This form shows how an overview over the heuristics and where the evaluators found violation of these heuristics in the application.

Gunn		**x**		**x**	**x**				**x**	**x**		**x**
Siri	**x**		**x**	**x**					**x**	**x**		**x**
Nr	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

Suggested heuristics for Mobile phones, Disabled people and All types applications. + description of violation

1. Visibility of system status

- Is status feedback provided continuously (e.g. progress indicators or messages)?
- Are warning messages displayed for long enough?

If you try to sign on to the application, but enter the wrong signature you get the message "Authentication failed". This message is only shown for a a second before it disappear by it selves. The user does not have a lot of time to read the information which is bad for the visibility of the system status.

2. Match between system and real world

- Are the words, phrases and concepts used familiar to the user?
- Does the task sequence parallel the user's work processes?
- Is information presented in a simple, natural and logical order?
- Is the use of metaphors easily understandable by the user?

In the documentation of the application it is clear that the accounts will opens in the phones default web browser, however, it is unclear that this is the action the circled symbol in the application are supposed to reflect

3. User control and freedom

- Are facilities provided to "undo" (or "cancel") and "redo" actions?
- Are there clearly marked exits (for when the user finds themselves somewhere unexpected)?

We can say that heuristic that addresses user control and freedom (3) is violated when there is no way to prevent passwords being stored in clear text in the cheat sheet. In addition to this there is no way to exit the application without clicking the round button on the phone.

4. Consistency and standards

- Is the use of terminology, controls, graphics and menus consistent throughout the system?
- Is there a consistent look and feel to the system interface?
- Is there consistency between data entry and data display?
- Have ambiguous phrases/actions been avoided?

The design is characterized by inconsistency(4) the buttons on the signature display looks for instance totally different than it does in the rest of the application, and for some reason does the cheat sheet, help page and the page where you set your master signature have another design. In terms of the feel of the application the user are forced to turn the device in when drawing the signature while the rest of the interface only works vertically.

5. Error prevention

- Is a selection method provided (e.g. from a list) as an alternative to direct entry of information?
- Is user confirmation required before carrying out a potentially 'dangerous' action (eg deleting something)?

When delete entry provides the feedback "This cannot be undone. Save changes?" which is a very unclear message.

6. Recognition rather than recall

- Are help and instructions visible or easily accessible when needed?
- Is the relationship between controls and their actions obvious?
- Is it possible to search for information (e.g. a phone number) rather than entering the information directly?
- Is the functionality of the buttons on the device obvious from their labels?
- Are input formats (e.g. dates or lengths of names) indicated?

7. Flexibility and efficiency of use

- Does the application allow for a range of user expertise?
- Does the application guide novice users sufficiently?

8. Aesthetic and minimalist design

- Is the design simple, intuitive, easy to learn and pleasing?
- Is the application free from irrelevant, unnecessary and distracting information?
- Are icons clear and buttons labeled and is the use of graphic controls obvious?
- Is the information displayed at any one time kept to a minimum?
- Is the application easy to remember how to use?

9. Help users recover from errors

- Do error messages describe problems sufficiently, assist in their diagnosis and suggest ways of recovery in a constructive way?
- Help and documentation
- Is help clear and direct and simply expressed in plain English, free from jargon and buzzwords?
- Navigation
- Is navigational feedback provided (e.g. showing a user's current and initial states, where they've been and what options they have for where to go)?

Difficult jargon like the message that appear in the cheat sheet when trying to delete a profile "not supported for this entry" was unclear, and maybe the wrong feedback. In terms of navigation it is most often a back-button, except when you are testing the master signature or the master password. Then the user have to enter the correct information in order to get back to the application, even though it is just a test. The navigational feedback could have been better as it don't show any traces of where you have been or what links you have pressed.

10. Structure of information

- Is there a hierarchical organization of information from general to specific?
- Are related pieces of information clustered together?
- Is the length of a piece of text appropriate to the display size and interaction device?
- Has the number of screens required per task been minimized (by minimizing use of white space and careful use of menus)

11. Extraordinary users

- Is the use of color restricted appropriately (and suitable for colour-blind users)?
- Do the buttons allow for use by older, less agile fingers or people wearing gloves?

We interpreted extraordinary users as people with disabilities, and in our case we were looking especially for problems blind and visually-impaired might meet. Several places on the application there are grey text which can make it difficult to read as the contrast is low. The text is also a bit small, for some people. The last issue we discovered was that when adding and logging in to LinkedIn the use met a Captcha, which is not suitable for blind people, it can be hard to see the letters on such a small device.

4: Prototype requirements

Functional requirements

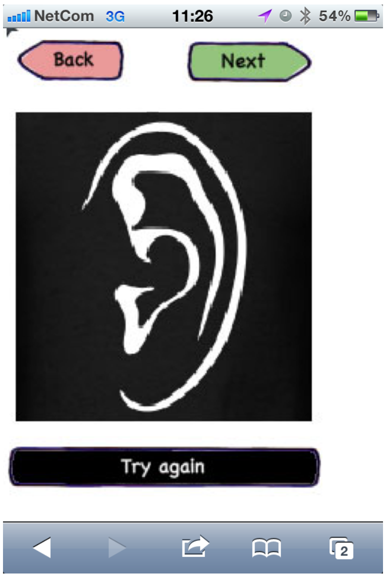
- The application must present a selection of disability profiles for the user to choose from
    - Visually-impaired and blind (our version will only focus on this selection)
    - hearing-impaired/deaf
    - elderly
    - color-blind
    - cognitive dissabilities
- The user must be able to log into the application in a secure way
    - there must be two or more steps
    - preferable three (something you know, something you have, something you are)
        - enable fingerprint recognition
        - enable voice/phrase recognition
        - enable pattern/signature recognition
- The application should enable the user to access several social media websites, for instance:
    - Facebook
    - Twitter
    - Google
    - LinkedIn
    - Youtube
    - MySpace
    - Skype
- The application must contain metadata that can be read by a screen reader (etc. TalkBack, VoiceOver, Talks)
- The application must provide feedback adapted to the users selection of profile
    - Visually-impaired/blind (our version will only focus on this selection)
        - haptic
        - speech
        - sound
        - messages with large text
    - hearing-impaired/deaf
    - elderly
    - color-blind
    - cognitive dissabilities
- There must be a strong contrast between the color of the text/images and the background
- It should be possible for the user to navigate on the screen without using the touchscreen.
    - All the user interface controls must be accessible with a trackball or directional controller (d-pad)

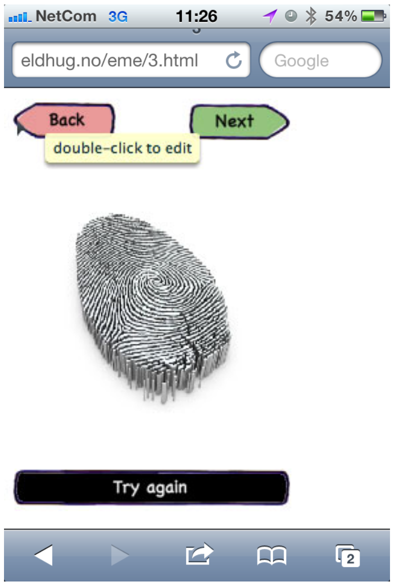
Non-functional requirements

- The interface should just have six touch points
- It should only be possible to add six social media accounts
- It should only be possible to choose from six different disability profiles
- No more than three and no less than two security steps
- An error rate on 5 sign-in attempts
- When registering the signature/fingerprint/phrase the user must repeat the step five times
- The user must hold his/her finger on the screen no less than 2 sec for fingerprint recognition

5: Prototype


NetCom 3G 11:25 54%
Back
Next
Type your Signature
Try again


NetCom 3G 11:26 54%
Back
Next
Try again


NetCom 3G 11:26 54%
eldhug.no/eme/3.html
Google
Back
Next
double-click to edit
Try again