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Note

Universal Mobile Device (UMD)—Methods, Inventory, and Dissemination

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Abstract

As mobile devices gain more functionality and power; it is possible to imagine a mobile device that can be used to help solve many accessibility problems that affect users. For example, it can act as a GPS orientation and mobility aid for people with vision impairment or as an accessible interface between the user and an electronic service such as an ATM. This is summarized in the idea of a Universal Mobile Device (UMD). Norwegian Computing Center's e-inclusion group has spent 2009 studying the idea of universal mobile devices and what it would take to study, design, and test universal mobile devices. The group also gathered information to ensure personal data from fieldwork is handled correctly in accordance with legal guidelines. Another question the e-inclusion group investigated was what sort of equipment is needed to build a usability and accessibility lab. Dissemination activities include this note, an article about inclusive identity management, and an article and an interview for a sub-project that dealt with locating lost people with dementia using GPS/GSM-based devices.

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Project	UMD
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1 Introduction

The Universal Mobile Device (UMD) describes the idea of a multifunctional mobile device that can be used for activities in the daily life of a user. The term "universal" refers to the device being accessible and usable by people with disabilities. This includes persons with impairments in vision, cognitive, hearing, movement or other anything else that impedes function. "Universal" also means that *one* device will suffice as a universal aid instead of needing several devices to achieve the same purpose. UMD combines the concepts of ubiquitous computing and convergence of technologies. Smart phones are an example of a convergence of communication technologies. The iPhone 3GS and iPod Shuffle are examples of devices that take an accessible technology—the VoiceOver screen reader—and make it a mainstream feature that all users can use (Jana, 2009). The question remains how accessible and usable these and future devices will be.

This note is an attempt to catalog the pieces that have come out of the UMD project and to describe them in one document. We will look at the methods that are available for developing UMD's in section 2. Since accessibility and usability research on UMD's requires user testing and input or assistance from real people, information regarding handling and using personal data from users and informants is included in section 3. We also list the lab facilities and equipment we currently have and what we wish to have in section 4. In Section 5 we discuss the dissemination activities in the UMD project. Some parting thoughts are included in section 6.

2 Relevant Methods

Universal mobile devices must be designed. There are many challenges in designing a device that is universally accessible. Fortunately, there are techniques that are available both on the side of the person writing the software and creating hardware and also for designers trying to gather requirements, create prototypes, and evaluate designs.

2.1 Software Techniques

We can look at the current crop of mobile devices and see what their recommendations are for writing accessible applications. We'll start by looking at the operating systems of various mobile phones. With software, there are two sides to examine. One side is those that are making assistive technology (AT). These developers need access to events in order for the AT to be used. The other side software developers who might need to include extra metadata in order to make sure that their applications are accessible.

Some subsubsections below discuss the use of guidelines and standards in building an accessible application or website. These guidelines and standards are necessary to make accessible applications and websites as it makes it possible to know what should be done to make something accessible. However, they are not sufficient. Sometimes developers follow guidelines and standards too strictly without properly understanding the accessibility and usability issues. The results may be ineffective or unusable solutions. As will be expanded on below, these guidelines and standards are not sufficient to ensure that the solution meets the needs and challenges of various user groups (Babu and Singh, 2009; Blas et al., 2004; Clark, 2006; Lazar et al., 2007; Leuthold et al., 2008). This is why user research and user testing is important.

It is also the case that different user groups may have conflicting design needs. Touch screens and graphics may be of great assistance to persons with cognitive impairments, but are of little use and may exclude persons with vision impairment. This requires creating flexible designs that allow for the diversity of needs for the whole population. This may not necessarily be achieved by only adhering to guidelines and standards.

2.1.1 The World Wide Web

While there is a focus on applications for these devices, they also have access to the Internet and the World Wide Web. That means that Web developers must also work to make their web pages accessible. The first place to look is the Web Accessibility Initiative's Web Content Accessibility Guidelines (WCAG) (W3C Working Group, 2008b) and the Accessible Rich Internet Applications (ARIA) (W3C Working Group, 2009a). If you want to target browsing on mobile devices, it is worthwhile to also consult the Mobile Web Best Practices (MWBP) (W3C Working Group, 2008a) and an additional document that explains how they relate to each other (W3C Working Group, 2009b). There are also many articles and information available at the Web Accessibility in Mind (WEBAIM) website (2010).

As mentioned above, following the WCAG and ARIA guidelines might not be enough to make a website accessible. As detailed by Hailpern et al. (2009) and Leuthold et al. (2008), even sites that use these guidelines can still result in an inaccessible web site. Using toolkits can help when creating a website (Lunn et al., 2009), but using these toolkits can still result in accessibility errors (Mikovec et al., 2009). Hailpern et al. (2009) points out that extra work on ARIA and presenting new modes for these applications to access the Web could help in the future.

Thankfully, there are several tools that are available to test accessibilty and some are accessible

from the web. The WEBAIM site mentioned above includes a web accessibility evaluation tool called WAVE[1]. This tool will show the webpage with embedded icons and indicators that show the accessibility of the page. Another tool—eAccessibility Checker—is being worked on by the eGovMon project[2]. Although it is primarily tuned to Norwegian municipalities, it can still be useful for other sites. A longer list of sites that provide validation services is available at the W3C[3]. If a developer uses Internet Explorer or Opera, it is possible to use the Web Accessibility Toolbar provided by Vision Australia[4]. The Firefox Accessibility Extension offers similar functionality for Firefox[5].

There are also tools that are available on the desktop. One is the Accessibility Designer described by Takagi et al. (2004). This tool tries to visualize how a web page is seen by coloring the page. The darker an area on the page, the longer it takes to reach that area of a page. This functionality is now part of the Accessibility Tools Framework (ACTF) in the Eclipse project[6]. The new features in the framework include the ability to view images like those with low vision might perceive them. Another idea that is discussed by Tonn-Eichstädt (2006) is to use the GOMS model introduced by Card et al. (1983) to measure the accessibility of the websites.

An advantage with designing accessible websites is that it is possible to test websites first on the desktop and use the various ATs available there. If it's accessible with several of these, one would suspect that the website would work with AT on a mobile device. Most of the ATs that are mentioned below work with the web browsers on the devices, so it is possible to test on the phone as well.

2.1.2 iPhone OS

When Apple released the iPhone 3GS in Summer 2009, it also included VoiceOver, a technology from its desktop operating system. As detailed on Apple's Website (2009b), VoiceOver allows people who are unable to see to use the services and applications on the device. For the iPhone, the focus is on application developers, there is no API for writing your own AT. However, Apple Inc. (2009a) provided an interface so that 3rd party programmers can also make their applications accessible. The information includes what needs to be done with the standard UI elements and what extra things are needed for custom UI elements.

Apple also provides two ways of checking accessibility of an application. One is using the accessibility inspector included in the iPhone simulator. This allows you to pick an item in the GUI and see its accessibility information. The second method is testing it with VoiceOver itself. Since many of the people using this method may be sighted. Apple also has a "screen curtain" feature that disables the screen, requiring the user to only use the information provided by VoiceOver. This provides a good test, but Grieves and Maneko (2009) note that:

> . . . beware that ATs can be complex, and you can very easily misinterpret the information you receive from them. So, it's a good idea to get users of AT to interact with your application by using the AT devices to (1) alert you to problems that your test tools might have missed and (2) to asses your users' experience with your product (Grieves and Maneko, 2009, p. 50).

1. http://wave.webaim.org/
2. http://accessibility.egovmon.no/en/
3. http://www.w3.org/WAI/ER/tools/
4. For Internet Explorer: http://www.visionaustralia.org.au/ais/toolbar/
For Opera: http://www.paciellogroup.com/resources/wat-about.html.
5. http://firefox.cita.uiuc.edu/
6. http://www.eclipse.org/actf/

2.1.3 Android

Accessibility support was added with version 1.6 of Android and the release of the open source TalkBack screen reader (Chen et al., 2009). This feature allows users to access the GUI without looking at the screen. Since the screen reader is open source, it allows others to make their own versions and Google provides additional examples of ATs with SoundBack for producing non-verbal auditory feedback and KickBack for producing haptic feedback.

There is no accessibility programming guide for Android application developers, but Chen et al. (2009) encourage developers to follow these guidelines.

1. Ensure that all visually drawn UI controls have meaningful textual labels.
2. Ensure that users can navigate to controls in your application using the trackball.
3. Ensure that navigating controls in your application with the trackball results in a meaningful traversal order.

For ATs, Android has several accessibility events that it uses to communicate changes and control the UI. Since TalkBack, SoundBack, and KickBack are all open source, it's possible to see how these events can be used to create your own AT.

2.1.4 Symbian

In comparison to iPhone and Android developers, Symbian (Series 60) developers do not have to do much in their application development. On Symbian devices, the accessibility is provided by third party application and devices that do the majority of the work. The issue with this is that it a game of cat and mouse. When a new phone, new version of Symbian, or an application is released, the ATs must be updated to work with them. This can be seen by looking at the various releases of both MobileSpeak by Codefactory[7] and Nuance TALKS[8]. Testing applications then relies on getting access to these ATs and using them and seeing how well an application works, keeping in mind the advice from section 2.1.2. On the other hand, since there are no guidelines for creating accessibile applications on Symbian, it can be difficult to solve issues in a way that is guaranteed not to break in future releases. From online forums, it seems that to create an AT requires some sort of cooperation with Symbian in order to get access to hidden APIs.

One of the major users of Symbian, Nokia, is in a state of transition and plans to put Qt on the new mobile phones, whether they are Series 60 or Maemo. Qt has an accessibility framework that provides similar functionality to what Apple has produced. There is some form of accessibility available on Linux (Maemo) devices, but it remains to be seen what support there will be from Qt for accessibility on Symbian devices.

2.1.5 Blackberry

Blackberry has introduced an accessibility development guide and APIs for version five of their Java-based software development kit (Research in Motion Limited, 2009). Although the guide is still classified as "beta," it includes information for developers of both applications and ATs. This division is somewhat similar to what Android uses above, but is more detailed in describing and showing what needs to be done for both the application and AT technology developer.

It also goes beyond just coding and includes some guidelines for designing accessible applications. It includes guidelines for UI design, navigation, text, color and images. The information is nice to include since some designers may not be aware of these issues when designing an application. However, the information provided only spans one page and other sources provide more

7. http://www.codefactory.es/en/products.asp?id=24
8. http://www.nuance.com/talks/

comprehensive information about this subject.

2.1.6 Windows Mobile

It is hard to find correct information about accessibility with the Window Mobile environment. There certainly are screen readers and other ATs available for these devices as the same companies that offer items for Symbian also offer them for Windows Mobile. On the other hand, it is difficult to get a genuine answer on which APIs are available. Searching on Microsoft's developer website[9] seems to say that the Active Accessibility API is not available and offers no alternative. It does list various items that can be adjusted on the device to make it more accessible, but not what can be done to create an AT nor accessible application. As it is, the developer of either an AT or an application will probably have to do some digging to figure out what to do.

One good thing to point out that Microsoft does seem to take accessibility seriously. They have created a book (Grieves and Maneko, 2009) that describes different aspects of designing applications to be accessible. While the book is targeted at the desktop environment and talks up the latest version of its accessible API, the information provided could be applied to mobile devices.

2.1.7 WebOS

It seems that there are no accessible technologies that are available for Palm Pre at the moment. Though, since WebOS applications are based on HTML and JavaScript, it should be possible to apply the skills used in making web pages accessible as described in section 2.1.1 to ensure that future versions applications are accessible when ATs do become available for the WebOS devices. On the other hand, it may be difficult for a developer to justify trying to make an application accessible when they aren't sure how accessibility will be implemented on a WebOS phone.

2.2 Designer Techniques

There are not many widely-available design techniques that target mobile devices. The closet is from the device companies' accessibility programming guides (Apple Inc., 2009a; Grieves and Maneko, 2009; Research in Motion Limited, 2009). There are some though. For example, Hellman (2007; 2008) describes guidelines from universal design that can be used in designing mobile devices. Using audio on mobile phones as demonstrated by Fuglerud (2007) shows that there are different ways to design applications than to only rely on visual information.

There are also guidelines that are available from organizations. The Royal National Institute for the Blind (TIRESIAS) (2009)has information about the problems that disabled and aging people may encounter and recommendations for designing devices . The National Disability Authority of Ireland (2010) also has a set of accessibility mobile phone guidelines for Telecoms. Finally, the Trace Research and Design Center presents a mobile phone design that would meet all the requirements of the U.S. FCC proposed access requirements (2007).

There is lots of information available for accessibility in general though and use technology in particular. One example is the work of John Gill and the Royal National Institute of Blind People (TIRESIAS) in the U.K. For example, Gill (1998) discusses things that need to be done to make public terminals, such as for transportation tickets and ATMs accessible. The advice includes information on fonts, sizes, and colors. UMD designers can use this information as well. One report by Gill (2007) detail how technology like smart cards, RFID, mobile communications, etc. can be used to make travelling and getting around for mobility impaired, visual impaired, dexterity impairment, speech and language impairment, cognitive impairment, hearing impairment, and aging. Gill (2008) also discusses the idea of "ambient intelligent systems." These are systems that

9. http://msdn.microsoft.com

deal with devices that are wearable or handheld and devices in the environment that change based on the profile of user that is transmitted between the devices. This information can be public or private and can help the user in a variety of situations both at home and when they are traveling. While none of these reports deal explicitly with mobile devices, it certainly shows how these technologies can be used to help everyone.

3 Privacy and Ethical Issues Related to Research in e-Inclusion

This section discusses legal and ethical requirements in connection with conducting research in e-inclusion. Focus is on the collection, processing and storage of the interview data, as well as audio and video recordings in connection with fieldwork and user studies.

3.1 Legal requirements in Norway

The *Personopplysningsloven* (2001) (POL) specifies the legal requirements for doing research when personal data about individuals are collected and processed.

Details and guidelines about POL can be found in two parts of guidelines from the Data Inspectorate (*Datatilsynet*). The first part describes the legislation concerning the obligation to report handling of personal data (Datatilsynet, 2005a), and when to obtain a permit from the Norwegian Data Inspectorate to handle such data. The second part (Datatilsynet, 2005b) describes the legislation that regulates use of personal data within research projects, such as:

- Responsibility; who is the controller and processor of personal data. As a general rule the controller would be the institution that is financed.
- Consent: any freely given, specific and informed declaration by the data subject.
- Objective: Requirements to a relevant and matter-of-factly purpose
- What and how to inform the research object (participants in interviews and field studies)
- How long to keep the personal data
- Control procedures to ensure that the legislation is complied with and that the responsibility in relation to this is clear (the institution that handles personal data must have such control procedures). The Norwegian Data Inspectorate has worked out checklists for control procedures
- Information security (must comply with the POL)

3.1.1 Personal Data

Personal data (*Personopplysning*) is data that may directly or indirectly be connected to a physical person, such as:

- Name
- PIN
- IP-address

3.1.2 Sensitive Personal Data

Sensitive personal data is data that reveals

- Racial or ethnic background
- Political, philosophical or religious opinion
- Criminal record
- Health related information, including a disability
- Sexual relations
- Membership to trade unions

3.2 Reporting and Permit or License

3.2.1 Reporting to privacy ombudsman for research

The main requirement is that all research involving personal data needs to be reported on a special form to Privacy ombudsman for research (*Personvernombudet for forskning*). The form can be filled online at:

http://hetti.datatilsynet.no/melding/

Reporting is compulsory if one is recording or processing information about individuals by electronic means, or creating a manual register containing sensitive personal data.

Remember that electronic means digital in this context. Analog recording is not considered to be electronic for legal purposes.

3.2.2 Getting a Permit or License

Getting a permit is required if sensitive personal data is recorded. However, a permit is not required if:

1. The first time contact to selection of respondents is based upon, either
   - publicly available data
   - a responsible person at the institution where the respondent is registered
   - initiative from the respondent
2. The respondent has given informed consent to all parts of the research.
3. The project is terminated at the time agreed upon.
4. All material collected is destroyed or anonymized when the project is terminated.
5. The project is not joining data from more than one register or database.

3.3 Ethics in Field Studies

The National Committee for Research Ethics in Science and Technology (NENT[10]) in Norway has published ethical guidelines for research in science and technology (NENT, 2007). The guidelines include the researchers obligations and responsibilities. First, the research must respect international human rights and conventions (It is referred to CODEX 2005[11] and UNESCO 2005[12]). Other responsibilities include respect for the environment, peace and democracy and to spread knowledge equally among other countries or regions.

10. http://www.etikkom.no/Engelsk/NENT
11. http://www.codex.vr.se/sh/anonymitet
12. http://unesdoc.unesco.org/images/0013/001395/139578e.pdf

The guidelines also deal with the need to respect the requirement of informed consent. For example, it is important to present the information in a form that that the person can perceive and understand (e.g. oral in addition to written).

Information about persons who participate in research projects is to be handled with care. The researcher should inform participants about how the information will be protected and preserved. The researcher will also give those who want it, confidentiality or anonymity. Confidentiality means that the information and materials are non-identifiable, meaning that no outsider can know who has given what data to the researcher. However, the researcher may have the opportunity to connect people and data. When anonymity is required, the researcher does not know from which individual the material comes from. This means that the researcher must respect privacy in the form of making the data non-identifiable or anonymous (NENT, 2007).

In connection with the DIADEM project, NENT, advised us to rethink the need to store personal data at all within the field investigations. We may aggregate the data from interviews and user tests sufficiently such that it is not possible to identify any natural person. As a rule of thumb; if the data is generalized in such a way that it cannot identify a person, and it may apply to at least 5 natural persons, it is not personal data. Then we do not need any permit or license from the data inspectorate; however, there is still an obligation to report the project.

3.4 Norway—EU

The Norwegian Personal Data Act has implemented the EU Directive 95/46/EC (1995). Therefore, if a project has concession to handle Personal Data in Norway, it also fulfils the EU regulations. Chapter V in the Norwegian Personal Data Act regulates the issue of transferring Personal Data to other countries. Personal data may only be transferred to states that assure a safe handling of the information. Countries that has implemented the EU Directive 95/46/EC (1995) completes this requirement. Thus it should be unproblematic to transfer data between Norway and EU countries.

3.5 Handling Personal Data During Projects

At Norwegian Computing Center, we have a secured disk area with limited and restricted access—only members of e-inclusion group handling such data in projects have access. This disk is used to store necessary personal data. Personal data is deleted when the project ends.

3.6 Security and privacy in prototypes

In addition to securing that all our research, tests, etc. will be carried out in compliance with established ethical, privacy and security regulations, the same compliance must be built into prototypes if the prototype will be handling personal data in any way. Consequently, securing that prototypes and the use of prototypes in research projects comply with established privacy and security requirements is a key issue in defining the total set of requirements.

4 Lab Facilities and Equipment

The e-inclusion group wishes to establish lab-testing facilities to be better equipped to conduct usability and accessibility testing. Both a stationary and mobile lab facilities are desirable. We have obtained some relevant equipment that is detailed below, and we have further included a wish list of other items that we would like to obtain.

4.1 Existing equipment

We have one license for Morae. Morae is a suite of programs from TechSmith Software that can be used for usability testing and market research. It can be used for usability testing, focus groups, or mobile and hardware testing. It works by capturing information from a testing or data gathering session. This includes information about what is on the computer screen, what is being said, and what people do. You can also set up parameters that Morae should look for and have it calculate and graph effectiveness, efficiency, and satisfaction. All the information that is recorded is combined into one project that can be used later for presenting findings. Morae consists of three parts, the Manager, the Observer, and the Recorder. The Recorder captures everything with help of cameras and microphones. The Observer allows people to watch a session in realtime (not necessarily being in the same room). It is possible to add comments and tag the collected material in real time both on the Recorder and Observer. Finally, the Manager is used to handle and analyze the final data and help in presenting the findings.

We have purchased a Dell laptop computer capable of running Morae Recorder and a digital video camera for recording the sessions. Since the information that is collected is personal information it must be handled as outlined in section 3. In addition to the equipment detailed above, we also have two digital audio recorders and a Nokia N73 mobile phone.

4.2 Wish List

Whlie we have some items for a lab, we can always be better. The UMD project was an opportunity look into what an ideal lab would be. We also wanted to gather together promising mobile devices that could be UMD's. The summary of these wish lists is presented below.

4.2.1 Usability and Accessibility Labs

During work in the UMD project, discussions were made for a lab. This resulted in several meetings with GlobalID who also wanted to build a usability lab. The planned labs and budgets are presented in the tables below. Table 1 shows the budget for stationary lab and table 2 shows the portable lab.

An additional desire was to get a Tobii Eye Tracker and accompanying software. Eye tracking can be used to find out how a person experiences a website, a product, and more. It can be useful tool in both usability and accessibility testing. Tobii's describes how it works on their website:

> Eye tracking works by reflecting invisible infrared light onto an eye, recording the reflection pattern with a sensor system, and then calculating the exact point of gaze using a geometrical model. Once the point of gaze is determined, it can be visualized and shown on a computer monitor. The point of gaze can also be used to control and interface with different machines. This technique is referred to as eye control (Tobii Technology, 2009).

The eye tracker and the two labs constitute the entire package. The spreadsheet is included as appendix A.

4.2.2 Mobile Devices

There was an evaluation of currently available mobile phones to figure out what sort of mobile phones might match as a universal mobile device for testing purposes. There were lots of different criteria that matched the "would be nice to have" for these devices. The final list of hard requirements included the following:

- Bluetooth
- GPS

Table 1. Stationary Lab Budget

Equipment	User Area
Stationary Windows PC	Basic Equipment
Touchscreen	Basic Equipment
Various keyboard and mouse solutions	Basic Equipment
USB-docking	Basic Equipment
Speakers	Basic Equipment
Printer	Basic Equipment
Projector	Demonstartion/Education
Video camera	Recording/Documentation
Tripod	Recording/Documentation
Still photo camera	Recording/Documentation
Microphone	Recording/Documentation
External Hard Disk	Backup
Digital recorder	Recording/Documentation
Webcam	Recording/Documentation
Morae	Recording/Documentation/Analysis
Snagit	Recording/Documentation
Adobe Acrobat	Recording/Documentation
Various electrical equipment	Basic Equipment
Screen Reader/Screen Zoomer	Accessibility Testing
Desk, chair, etc.	Basic Equipment

Table 2. Portable Lab Budget

Equipment	User Area
Portable Windows PC	Basic Equipment
UMD including accessibily equipment	Basic Equipment
Various keyboard and mouse soluctions	Basic Equipment
USB-docking	Basic Equipment
Video camera	Recording/Documentation
Tripod	Recording/Documentation
Still photo camera	Recording/Documentation
Microphone	Recording/Documentation
External hard disk	Backup
Digital recorder	Recording/Documentation
Webcam	Recording/Documentation
Morae	Recording/Documentation/Analysis
Snagit	Recording/Documentation
Adobe Acrobat	Recording/Documentation
Various electrical equipment	Basic Equipment
Suitcase	Basic Equipment

- GSM
- Hardware keyboard
- Assistive Technologies available
- Multimedia support
- NFC/RFID
- Still photo and video camera
- WI-FI/WLAN capability

After the list was created, several phones were selected and run through the sets of requirements to find which phones worked out best. The resulting sheet can be seen in appendix B. The final recommended phones were the following:

- Samsung Omnia HD
- Nokia N97
- iPhone 3G
- HTC Hero

It is interesting to note that the devices recommended do not necessarily have all the hard requirements. The reason for this is that there wasn't time to finish up the work on these devices and it was impossible to find a device that fit all the requirements at the time. The devices, when taken together, cover almost all the requirements.

5 Dissemination

There have been several dissemination activities as a result of the UMD project. Besides this note, there are several subprojects that fall under the UMD umbrella and we list their dissemination activities as well. There may also be a white paper that may be released at some point, but its fate is currently unknown.

One of the projects that fell under the UMD project concerned the use of GPS/GSM-enabled devices for locating people with dementia who are lost (Dale, 2009). This project was lead by Øystein Dale and besides the project report and an interview on Demensnytt, the project should also generate a conference article and an interview on Norway's research web magazine, forskning.no.

Finally, Lothar Fritch, Ivar Solheim and Kristin Fuglerud have written a workshop paper about inclusive identity management (Fritsch et al., 2008). This paper has been improved and extended and has been sent to the IDIS Journal.

6 Conclusion

The idea of a universal mobile device is promising and could be a way to solve many accessibility problems that affect people with different abilities. The e-inclusion group would have liked to have investigated these topics closer and had made headway in purchasing some more equipment for the usability lab. While the work for the various wish lists is good, they should be followed up if the information is to remain relevant. The handling of personal data is also

useful information that will be used in many future projects. In addition, the work that has been done here has also been useful in other EU projects, and been used for background information in several EU and Norwegian Research Council applications.

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A Spreadsheet for Usability Lab

Labfasiliteter for usabilitytesting NR

Mobil lab:

Utstyr:	Type:	Bruksområde:	Antall:	Ca pris NOK inkl. moms:
Bærbar PC med standard programvare	Maskinvare	Basisutstyr	1	15000
UMD m/programvare (inklusive hjelpemiddel)	Maskinvare	Basisutstyr	1	10000
Diverse tastatur/museløsninger	Maskinvare	Basisutstyr	N/A	2000
USB-docking	Maskinvare	Basisutstyr	1	1000
Videokamera	Maskinvare	Opptak/dokumentasjon	1	6000
Tripod	Diverse utstyr	Opptak/dokumentasjon	1	500
Stillbilde kamera	Maskinvare	Opptak/dokumentasjon	1	5000
Mikrofon	Maskinvare	Opptak/dokumentasjon	2	1000
Ekstern HDD	Maskinvare	Backup	1	1000
Digital lydopptaker	Maskinvare	Opptak/dokumentasjon	1	3000
Webcam	Maskinvare	Opptak/dokumentasjon	1	1000
Morae	Programvare	Opptak/dokumentasjon/analyse	1	10000
Snagit	Programvare	Opptak/dokumentasjon	1	350
Adobe Acrobat	Programvare	Opptak/dokumentasjon	1	5000
Diverse elektrisk utstyr	Diverse utstyr	Basisutstyr	N/A	2000
Koffert	Diverse utstyr	Basisutstyr	1	2000
TOTAL				**64850**

Stasjonær lab:

Utstyr:	Type:	Bruksområde:	Antall:	Ca pris NOK inkl. moms:
Stasjonær PC med standard programvare	Maskinvare	Basisutstyr	2	20000
Berøringsfølsom skjerm	Maskinvare	Basisutstyr	1	5000
Diverse tastatur/museløsninger	Maskinvare	Basisutstyr	N/A	2000
USB-docking	Maskinvare	Basisutstyr	1	1000
Høytalere	Maskinvare	Basisutstyr	1	500
Skriver	Maskinvare	Basisutstyr	1	1500
Projektor	Maskinvare	Demonstrasjon/pedagogiske anliggende	1	10000
Videokamera	Maskinvare	Opptak/dokumentasjon	1	6000
Tripod	Diverse utstyr	Opptak/dokumentasjon	1	500
Stillbilde kamera	Maskinvare	Opptak/dokumentasjon	1	5000

Mikrofon	Maskinvare	Opptak/dokumentasjon		2	1000
Ekstern HDD	Maskinvare	Backup		1	1000
Digital lydopptaker	Maskinvare	Opptak/dokumentasjon		1	3000
Webcam	Maskinvare	Opptak/dokumentasjon		1	1000
Morae	Programvare	Opptak/dokumentasjon/analyse		1	10000
Snagit	Programvare	Opptak/dokumentasjon		1	350
Adobe Acrobat	Programvare	Opptak/dokumentasjon		1	5000
Diverse elektrisk utstyr	Diverse utstyr	Basisutstyr	N/A		2000
Skjermleser/skjermforstørrer	Hjelpemiddel	Tilgjengelighetstesting		1	30000
Innredning lab (pult, arbeidsstoler etc.)	Diverse utstyr	Basisutstyr	N/A		10000
TOTAL					**114850**

Komplett usabilitylab:		**Ca pris NOK inkl. moms:**
Mobil lab		55000
Stasjonær lab		115000
Tobii Eye Tracking m/ programvare	1	350000
TOTAL		**520000**

B Mobile Phone Evaluation

Evaluation of Mobile Phones

Ufravikelig krav | Anbefaling

Krav	Device											
	Samsung Omnia HD	HTC Magic	Nokia N97	Samsung SGH-i200	N95 8G	N96	N85	N79	Palm Pre	Apple iPhone 3G	E75	HTC Hero
Audioutgang		SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN
Berøringsskjerm	SANN	SANN	SANN						SANN	SANN		SANN
Bluetooth	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN
DLNA												
Dobbel kamera			SANN	SANN		SANN	SANN	SANN			SANN	
God batterikapasitet												
God høytaler												
God minnekapasitet												
GPS	SANN	SANN	SANN		SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN
GSM	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN		SANN	SANN	SANN
HW-tastatur			SANN						SANN		SANN	
Mulighet for AT												
Kalender-sync									SANN		SANN	
Kraftig prosessor												
MM-støtte	SANN	SANN	SANN		SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN
Mulighet for Java	SANN				SANN	SANN	SANN	SANN			SANN	
Multitasking OS												
NFC/RFID	SANN											
Oppkobling til hørselapparat												
Overkommelig pris												
Quadband												
Sensorer		SANN	SANN					SANN	SANN	SANN		SANN
Solid												
Stillbilde- og videokamera	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN	SANN
Stor skjerm	SANN	SANN	SANN						SANN	SANN		SANN
Utviklervennlig		SANN				SANN						SANN
WI-FI/WLAN	SANN	SANN	SANN			SANN	SANN	SANN	SANN	SANN	SANN	SANN
OS	S60	Android	S60	WM 6.1	S60	S60	S60	S60	webOS	MacOS	S60	Android
Skjermstørrelse	360x640	320x480	640x360	230x320	240x320	240x320	320x240	320x240	320x480	480x320	320x240	320x480
Kamera	8 MP	3,2 MP	5 MP	2 MP	5 MP		5 MP	5 MP	3 MP	3 MP	3 MP	5 MP
Disponeres av andre prosjekter			SANN		SANN							