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USABILITY IN DESIGNING A MOBILE APPLICATION FOR ELDERLY USERS

Case study: Dairo application

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Abstract

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Abstract

As the population is getting older, technologies are developed to assist people's life, particularly in terms of healthcare. With advancing age, elderly people suffer from cognitive, perceptive and sensory impairments. Designing an application for elderly users requires basic understandings of these characteristics as they affect the way elderly users interact with touchscreen devices. Therefore, the thesis studies techniques in designing a user-friendly application for elderly users by taking aging related issues into consideration.

The first part of the thesis is a literature review. This part mainly focus on user interface design elements. Regarding visual design, the studies cover methods on how to design colour, contrast, typography, buttons as well as the use of language to ensure readability and learnability of a design. The studies also suggest guidelines on using audio as an information delivery method for elderly users with visual or hearing impairments. Interactive elements such as data entry and feedback are mentioned as well.

The case study of this thesis is usability testing of the Dairo application. The application is designed to assist elderly people with their memory problems. In addition to testing the usability of the application, the purpose is to see how well the methods studied in the first section are applied in a practical case. Moreover, the findings from the case study together with literature review are considered to enhance the usability of the Dairo application.

Keywords

usability, tablet, application, elderly, user testing, mobile

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1 INTRODUCTION

1.1 Research background

Finland has one of the world's fastest-aging population. According to Statistics Finland (2018), 21.4% of Finnish population are 65 or older, and by 2030, this is predicted to climb up to 25%. Elderly people's interests towards mobile technology are not as obvious as the younger generations. However, statistics show that they often use mobile devices such as tablets. (Wehner 2012.)

As the population is getting older, mobile technology plays a crucial role in assisting the elderly's life, for example, keeping them connected with their family, and friends via social media. Digitalized healthcare service has been considered as growing business as well. In EKSOTE in Lappeenranta, online 24/7 mobile services to home have been developed to assist elderly clients with any kind of health problems they have. Clients can contact nurses or doctors via a video connection through tablets for free instructions and advice without having to visit the emergency department or health institutions. They can also make appointments without a doctor's referral. (EKSOTE 2018, 8-10.) Moreover, this mobile assistant is predicted to help reduce elderly people's expenses on healthcare (EKSOTE 2018, 32). Therefore, digital services have a big role in the healthcare area (EKSOTE 2018, 6-9).

During the past few years, studies on usability for elderly users showed that different from young adults, it is more difficult for the elder to interact with the touchscreen. For example, a study by Faisal et al. (2016, 28-30) shows that elderly users suffer from having their visions, hearings weakened and inaccurate hand movements while using mobile devices. The elderly have difficulties reading small text or using low contrasting interfaces. The limitation of hearing capability results in confusion situation in which users do not understand what is going on. Moreover, the study mentioned the issues of memorizing, which makes users hard to learn new things, causing frustration from complex things. (Faisal et al. 2016, 28-30.) This is why usability in designing an application for elderly users are current topics and worth studying. Apart from technical functionality, interface design of typography, colour, and touchable buttons are also considered in usability studies.

Theoretical studies of usability are not enough to improve user experience. An application is considered user-friendly and ready to use when it is tested. Therefore, usability testing is the key. Especially, when the application is designed for elderly users who have limitations interacting with touchscreen devices. Usability testing is an essential way to

understand their expectation and barriers. It is a cost-effective way to find out errors and risks that may come to users in practice. (Rubin & Chisnell 2008, 21-23.)

Launched in November 2018, Dairo is a tablet application designed for supporting people with memory problems and helping their relatives. The idea is developed by Pasi Haverinen. (Haverinen 2018.) As the target users of the application are mostly elderly people with limitations in memory, it is vital to carry out usability testing to see if the application works for them or if they get confused while using the application. The findings from the test and related studies are important for improving the application's usability. Moreover, the studies can be applied as references for future application development whose target users are the elderly. In addition, the application can be widely used as an assisting tool for elderly clients in home care companies.

1.2 Research objectives

Regarding elderly people and usability, there are several studies. For example, studies on website usability (Nielsen 2013), product usability (Hiroko & Hiroyuki 2004), and mobile interface usability (Barros et al. 2014). In this thesis, the main objective is to study the usability in designing application for elderly users, specifically interface design on touch devices. A user-friendly application for elderly users ensures the ease of learning in visual design. Therefore, improving interaction, readability and learnability by interface design are the main focus of the thesis.

Theoretical sections of the thesis discuss how contrast in colours works, how the fonts of texts and buttons should be designed as well as other design elements that affect the usability of an application. The practical part is a case study of the Dairo project. In the project, usability testing is carried out in order to figure out what and how the Dairo application should be improved. In addition, the aim is to find out any risks to minimize in order for the application to be user-friendly for elderly users.

The thesis aims to answer the following research questions:

- What elements in interface design should visual designers and developers take into account when building a mobile application for elderly users?
- How the principles of visual design should be applied in order to be user-friendly for elderly users?
- What features, and elements in design should be avoided to ensure the usability of the application?

2 RESEARCH DESIGN

2.1 Research approach

There are several types of approaches that researchers follow based on the objectives of the study. A deductive approach is a testing process in order to modify or falsify an existing theory, while an inductive approach is to make a generalization of data and findings from reality. Abduction is the modification of an existing theory from incomplete data. (Saunders et al. 2012, 144-145.)

Qualitative research is concerned with collecting and analysing information on many forms and words samples. It is likely associated with the inductive approach, which generates theories, develops and interprets qualitative data to understand the social world. In qualitative research, studies focus deeply on understanding insider of the field, which is beneficial to researchers who examine forms of knowledge. Qualitative research is based on non-numeric data, presents deep understandings of the phenomena and explains how individuals or certain group experience in a specific context. Starting from collecting data from observations, interviews, literature review or case studies in an iterative process in order to provide an insight description of studied cases. (Greener 2008, 17-35) On the other hand, quantitative research analyses through statistical techniques, which is based on critical interpretation of data in forms of numbers. Quantitative method is suitable for researcher aiming at studying how things are changed in number, by time series, and casual explanation and deductive reasoning. (Greener 2008, 80.)

This research discusses previous studies and then applies the studies to a case study to improve the usability of a particular application. The data collected from usability testing is analysed to answer the research questions. The research data is in non-numeric form. Thus, a qualitative approach is followed. As qualitative research will answer to explanatory questions, a deeper understanding of the phenomena will be obtained.

2.2 Research methods

In order to give a solid theoretical foundation, the thesis applies literature review as a research method. A literature review collects relevant research to be used as background data for a study. Reviewing literature is valuable for researchers whose purpose is to see how studied methods work in practice, as a result, critical evaluation is formed. Literature review as a research method is not only about summarizing collected literature, it is important to analyse then synthesize them as well (Myllärniemi 2015). Figure 2 presents how to conduct a literature review in research. The databases collected for analysing play

an essential role in a literature review, which will determine the quality of the research. The literature review presented in the thesis collects literature on usability, usability testing, guidelines user interface designs on the mobile application for elderly people.

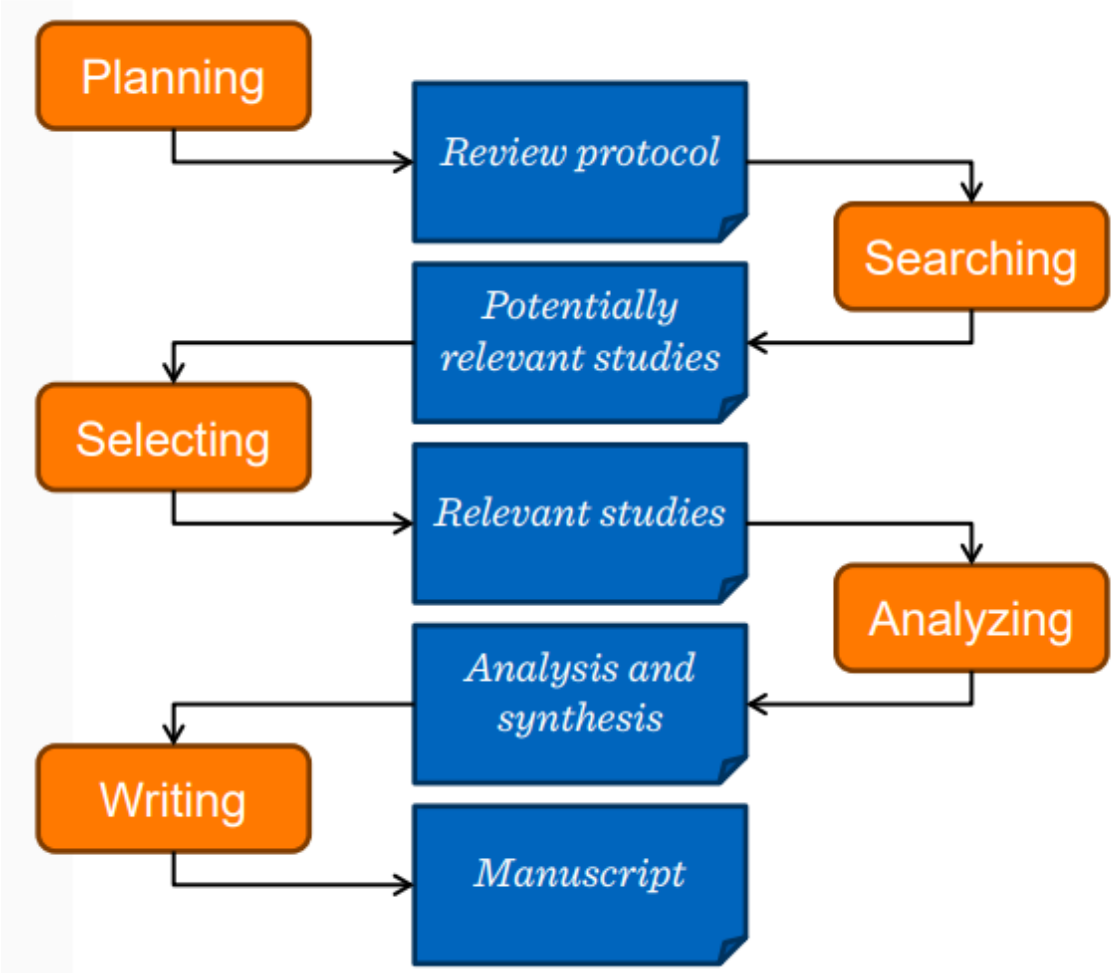

Figure 1. Conducting the literature review process (Myllärniemi 2015, 12).

In qualitative research, there are several research methodologies such as: action research, case studies, life history, interviews, and structured observation (Greener 2008a, 81). The usability of the Dairo application is analysed based on theoretical studies from previous works. Thus, case study is the second research method. A case study involves examining of a studied subject within its real-life context. A case study can be implemented by observing a single or several cases, collecting, analysing documents or collecting data techniques providing us with qualitative information about the researched case. (Greener 2008b, 81.)

2.3 Data collection

In qualitative research, data can be collected from interviews, observations, documents, and artefacts (Greener 2008, 17-35). As the first research method is literature review, data is collected from potential literature related to usability in mobile application and designing interfaces of application for elderly users. There are a huge number of sources on the Internet, so it is important to choose which are trustworthy and which are not. Sources from published books with transparent citation, readings from previous researchers are considered. Articles are also parts of sources in literature reviews. Articles are retrieved carefully from websites that specialize in providing information, lectures on user experience and usability, for example, Nielsen Norman Group, Interaction Design Foundation.

For the case study, the thesis applies theories from the literature review part with the interviews carried out in the Dairo Project. Interviewees are users testing with the Dairo application. They are elderly people as first group users, and relatives who are second group users. The chosen interview type is qualitative interview which focuses on users' thoughts and ideas about the user-friendly elements of the Dairo application. Besides visual designs, the interview also focuses in interaction elements and functionality of the application. In order to get precise evaluation results and a deep understanding of user experience, the interview questions are open questions. The interviews are recorded and translated to be used as data of the research. Moreover, data for analysing the usability of the Dairo application are direct screenshots from it by author and interviewees.

2.4 Sensibility and ethics of the research

In the usability test of the case study, users' personal information is kept private, and no information is made public. There are three groups of users that only share their personal information together and with Pasi Haverinen. During the interview and tutorial sections, there are only main test users who are elderly users, their relatives and the author of the application.

2.5 Research limitations

Usability in designing mobile applications for elderly users is a wide topic. The thesis covers the basics in visual and interactive design of the application. Concerning the literature review, the review is based on a limited number of available sources. Some of the sources may be outdated for the current situation as technologies have been changing in the past ten years. Therefore, the guidelines suggested in theoretical parts of the thesis are used as references for the case study of the Dairo application.

Regarding the case study of the thesis, the participants speak Finnish, so the interview questions need to be translated properly from English to Finnish. Translation mistakes are unavoidable. Moreover, test users live in different places and everyone has their own schedule. Thus, the interview was conducted through an online survey so that it is flexible for test users to submit their responses when they can. Since the interview was done virtually and technical words are used, interviewees may misunderstand the questions. In addition, user experience may not be investigated deeply as interviewees only answered to given questions. Though, interview questions try to cover most of the possible issues with consideration from studies in the literature review.

3 THEORETICAL FRAMEWORK

3.1 Usability

"Usability" is the basic standard in evaluating a product, or service. According to ISO 9241-11, usability refers to the effectiveness, efficiency, and satisfaction that a user achieves when using a service or product (ISO 1998).

According to Nielsen (2012), there are five quality components for usability evaluation, which are learnability, efficiency, errors, memorability, and satisfaction. Learnability is about how easy it is for the user to accomplish basic tasks for the first time. Efficiency is about how fast the user performs the task after learning. Memorability is how smoothly the user can perform their task after a while without any interaction. Error is about how well the system can handle the user's mistake as well as how effectively the recommended solution works. And satisfaction is the pleasure during and after the user journey.

Moreover, utility plays an equally important role as usability. Utility is about the functionality of a design. No matter how user-friendly a design looks like, the functionality of a design decides whether it is worth using. Usefulness is a combination of usability and utility. (Nielsen 2012.) The navigation menu in web design provides an example. Some websites use hamburger menus (three horizontal lines) instead of a navigation bar or a tab bar for both desktop and mobile screen size, which possibly causes backfire result. On such a big screen size like some desktops, it is hard to make sure if visitors can find that small icon easily or whether they interact with it. There is no need to hide a navigation bar if there are only a few menu items. This takes the user more time than they are supposed to spend to find a menu placed somewhere not easily visible is not a good practice. Though, placing a hamburger menu for mobile screen size is a common practice of website usability in designing navigation.

Nielsen (2012) discusses the importance of usability in web design. Good usability increases the traffic of a website, increase the number of registered users, and doubling sales and key performance indicator (KPI). If a website fails to tell visitors what it is about, or what the company offers, visitors will move on to a better site. If an application does not align buttons and texts interactively, users will have trouble doing what they are supposed to do. Even in physical industry, usable software or physical products help employers spend less time on training their employee. (Nielsen 2012.)

Usability study aims to improve the usefulness of design, bringing satisfaction during and after the user's experience. Usability studies vary depending on age group, environment, and purpose. (Nielsen 2013.) With the objectives of this thesis, studying usability for

elderly users who have limitations interacting with technology design is considered. Elderly users are people aged 65 or over. However, in some contexts, 65 is not totally considered as senior when life expectancy keeps rising. As in some countries, people keep working until they are 70. Studying usability for elderly people is to make sure whether a design meets the standard of interfaces interaction and functionality with basic consideration of design issues, behavioural issues, and age limitations. (Nielsen 2013.)

3.2 Interactive user interface design

In order to make it easier for users to achieve their goals while using an application, interaction design is an important component within the user experience. Interaction design is about creating interfaces with the consideration of user's behaviours, understanding how they interact with the product. According to Crampton Smith and Kevin Silver (as cited in Siang 2019), a design that is interactive when words are easy to understand, visual presentations can enhance what information words deliver to users. Media such as videos, sounds, or animation effects are quick enough to inform the user how their actions have been processed. Physical objects, spaces through which user interacts with the products are considered in interaction design as well. (Siang 2019.)

In 1995, Nielsen introduced ten principles for interactive interface design. On the system side, the product should keep the users informed about its status, as what is going on instead of making them guess. A progress bar which shows the percentage of completing the download process is an example of the visibility of the system. Error handling and help or support section should be available to give user solutions and instructions in case something goes wrong. For example, when a user signs up for a new account, there will be a short text saying whether the password is acceptable or not. It is important for a website to speak the language of target userbase, in simple and understandable phrases. If an error happens, the information should be in plain language. In terms of interface design, consistency of layouts is crucial. The contents and information should be relevant and minimize the number of loads the user has to memorize as much as possible. Usable design is what brings the chances of freedom and controlling for their user, makes sure of its flexibility and functions efficiently. (Nielsen 1995.)

Shneiderman (as cited in Wong 2019) introduced eight golden rules of interface design. The first rule is consistency in design, which makes the user familiar with the product. A consistent-looking design is which has its contents related to each other from icon, colour, menu, etc. The second element is the availability of shortcuts, by which users can navigate and operate easily. For example, a website places a sticky header on the top of the page including main functioning options such as search tool, menus, shopping cart,

enables the user to access the section no matter which page, or which section they are on. The user does not have to scroll the mouse up or down many times. Thirdly, it is recommended to have informative feedback, by which user can be informed how their task is processing as well as in which page they are surfing. The fourth principle of Shneiderman is the effectiveness of dialogue in user experience. For instance, showing a welcome message when the user successfully signs up for an account. Also, if errors are handled or some clues are given to deal with when users perform their task incorrectly will improve the user's experience with the application. Another rule mentioned in Shneiderman's rules for enhancing usability is to have a reversal option, such as a "back" button by which the user can go back to the previous section. The seventh golden rule of Shneiderman is to offer users full control and convenience of the application. A confirmation box on user's submitted option is an example. Finally, it is about minimizing the memory load of the user. Human has a limitation of short-term memory, that is why design should be a simple design with relevant information is recommended. Taking autocomplete search as an example, this tool assists the user to complete their searching by suggested results so that they do not have to remember the exact name of a product. (Wong 2019.)

According to Fitts' law, in mobile interface design, size and distance, vertical and horizontal design are considered. Size and distance are about how the buttons should be designed. On mobile screen, the button, firstly, needs to be large or small enough to be clicked probably without affecting the other button next to it. Secondly, there should be a space in between to separate them. In a section with more than three buttons next to each other without any distance in between, one part of the buttons covers each other, which may become massive looking when the sizing view minimizes. Moreover, Fitts' law is applied within the motion of the thumbs. An interactive design is when it is responsive both vertically and horizontally, certain elements should be positioned in which the thumbs from both hands easily access. (Smith 2012.)

3.3 Aging issues

In general, older people have their body flexibility and muscle strength more restricted. Their physical and psychological changes have affected the way they move and control their movements. Diminishes in perceptive abilities cause problems in performing movements, making it less precise and more error-prone. (Farage et al. 2012.) This section discusses how sensation, perception, and cognition have changed and affected elderly people.

3.3.1 Sensation and perception

As people get older, their sensory capabilities, such as vision, haptics, and hearing will get weakened. Visual impairment is very common in elder people. The lenses become more yellow and stiffening causing more difficulties in discrimination of cooler colours (i.e., violet, blue, green) than warmer colours (i.e., yellow, red). In addition to the lens, the pupil gets smaller and contrast sensitivity reduces due to changes in the neural circuitry of the retina and the brain. Thus, design for the elderly needs to be brighter and more contrasting. (Farage et al. 2012; Fisk et al. 2009, 17; Sardegna et al. 2002, 6.)

In terms of haptics, elderly people have problems sensing and recognizing the vibrations of objects in their hands and feet due to weaker touching pressure and vibration sensation. Sensing high-frequency vibrations is more difficult for the elderly than sensing low frequencies. (Farage et al. 2012.)

Similarly, older people find it difficult to perceive pure tones and low intensity sounds as they get older. According to Davis (1991), sixty percent of people aged 55 and above have suffered from hearing impairments. It is difficult for them to recognize words with high-pitched consonants (e.g., “ch”, “sh”), particularly in men. Elderly people also experience loss ability to distinguish the speech from background noise and distinguish variant concurrent sounds. Therefore, they require audition sound with appropriate intensity and volume. (Farage et al. 2012.)

3.3.2 Cognition

Although elder people can learn new things, they need more time to get used to it and more chances to practice due to cognition problems. Memory, attention and spatial cognition are cognitive functions that are negatively affected when people get older. The ability to focus on a certain thing or an event reduces by ages. Thus, elderly people are willing to ignore competing for sensory information. Older people are slower to process information that is switching from one to another. Elderly people also experience a decline in spatial cognition. (Farage et al. 2012.)

In terms of memory, there are four different types of memory, such as working memory, semantic memory, prospective memory, and procedural memory. Working memory is known as short-term memory. By the time people get older, the length of time they receive information and process it in active memory has decreased. Semantic memory is long-term memory, which refers to the ability to remember knowledge. For people with advancing age, it takes more time for them to recall the knowledge. Prospective memory is the

ability to remember something to do in the future. Generally, the action that should be performed at a certain time is easily forgotten by elder people than action that is reminded by alarm or prompt. Procedural memory is about how to carry out an action or perform a task. Elder people can have trouble performing that action if the context is changed. (Farage et al. 2012; Fisk et al. 2009, 20.)

Besides mentioned cognitive functions, language understanding is also considered problematic for older users. Low memory capacity makes it challenging for the elderly to recognize or understand syntactically complex language as sarcasm and ironic expressions. (Farage et al. 2012; Fisk et al. 2009, 23.)

3.4 Usability testing

3.4.1 Overview of usability testing

The term “usability testing” refers to methods, tools, which are applied to evaluate the usability of a product, analyse user satisfaction from their experience with the product. Usability testing is a process in which test users as representatives of the target audience participating in the test. Test users will perform provided task according to instructions, or they will be interviewed on how their experience with the product. (Rubin & Chisnell 2008, 21.)

Usability testing does not only improve the profit of a product but it also benefits users greatly. The goals of usability testing are to identify usability deficiencies, minimize design problems and frustration for users, maintain usability standards of a product in a cost-effective way. All in all, the design can meet user-friendly criteria, ensure the usefulness, effectiveness, and efficiency of the product. (Rubin & Chisnell 2008, 21-23.)

There are a variety of testing techniques, the basic steps are starting from formulating the hypothesis, collecting participants with experimental conditions, collecting qualitative or quantitative data from the test, then analysing the test result. Using the product development lifecycle is recommended in choosing identical testing methodology. (Rubin & Chisnell 2008, 27-29.)

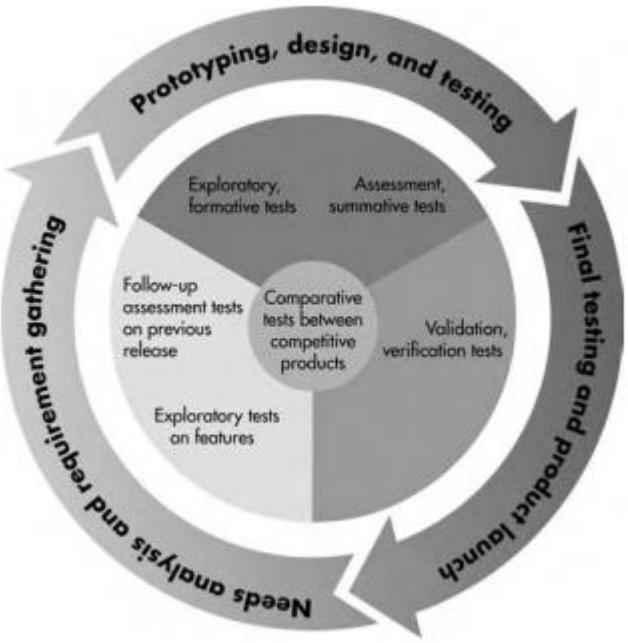

Figure 2. Usability testing throughout product lifecycle (Rubin & Chisnell 2008, 28).

As in the product lifecycle from Figure 2, there are three tests: exploratory test, assessment test, and validation test. An exploratory study is to test the effectiveness of a preliminary design. For example, testing an interface design of a web application to see whether it is easy for the user to navigate, how they think about the design. The assessment testing is, then, studying the findings of the exploratory test in order to understand specific usability problem of the design. Validation test is about making the comparison of the current product with a certain usability standard, to ensure that earlier usability problems have been addressed appropriately. These test types are effective when it is done with the iterative design process, which is about testing and redesigning of product from empirical evidence so that the product can reach end users' expectations. (Rubin & Chisnell 2008, 27-37.)

3.4.2 Qualitative usability testing

Qualitative research can be conducted at any time of the product lifecycle, in the redesign phase or at the final stage of the product. Qualitative study is the most appropriate method for usability test with a small size group of users (from five to eight) and in the redesign phase, where test users have a formative role. Researcher and designers can collect data quickly and cheaply. The test aims at finding which elements in the design are problematic and which work well from interviews or surveys with the participants. In qualitative interview, the researcher asks the participants follow-up questions, then gets into specific issues from their experience. Choosing the correct participants is crucial in qualitative

testing, since participants are representative for the whole user population. The outcome of the test is a set of findings identifying the strengths and weaknesses of the design in general and specific user interface element as well. The findings, however, are based on the researcher's knowledge, level of experience and interpretation, which possibly influence the results and the findings of the test. (Budiu 2017.)

4 LITERATURE REVIEW

4.1 Visual design

Visual design is a general term for interpreting the appearance of the application and website with the combination of user interface design and graphic design. A successful visual design enhances the usability of the product as well as user experience. (Interaction Design Foundation 2019.) This section of the thesis covers basic elements of visual design of the application in terms of touchscreen devices, such as: colours, contrasts, button and typography based on previous related works. The study also takes the aging characteristics of elderly users into consideration.

4.1.1 Colours

Colour is an important element in interface design. According to Kurniawan and Zaphiris (2005), colour is used to transport information to users, grouping elements, and signalling events. Using a large variety of colours without considerations results in constant refocusing and quickly tiring the eyes. (Boustani 2010a, 6-9.) Hence, colours should be used for relevant and important purposes (Boustani 2010b, 34).

Due to vision impairment, the lenses of human eyes yellow with age, which makes it difficult for them to distinguish colours with short wavelength in the spectrum, such as violet, blue, and green tones. Whereas, warm tones colours, from red to yellow, can pass the lens without any restriction (Farage et al. 2012; Sardegna et al. 2002, 6). Therefore, colours with a long-wavelength and fewer blue tones are recommended when the colour is used to transport information to users (Farage et al. 2012).

In order to increase readability of texts, the contrast in displaying colours should be considered as well (Farage et al. 2012; Fisk et al. 2009, 17) Dark and patterned backgrounds should be avoided because they can distort the texts in the foreground (Caprani et al. 2012, 102). Especially in touch devices, dark or black colours can increase glare or reflection, cause irritation in the eyes of elderly users (Sardegna et al. 2002, 6).

4.1.2 Contrast

Contrast sensitivity decreases when people get older due to changes in the retina, smaller pupil and the brain’s ability to define contrast. The perception of certain colours reduces, which makes it difficult for them to notice the contrast between the two colours. (Sardegna et al. 2002, 6.) For example, elderly users are not able to recognize blue texts on a dark background. Therefore, Farage et al. (2012) recommended that the contrast between

texts and background should be as high as possible, for instance, black text on white background is considered as the highest contrast.

The World Wide Web Consortium (W3C) has published its Web Content Accessibility Guidelines 2.0 which mentions the ratio for contrast calculations of elements. According to the guidelines, for people without vision deficiencies, in order to enhance the texts or images of the texts, the contrast ratio should be at least 4.5:1, and the contrast ratio of headlines is 3:1. Whereas, for people with visual impairment, the recommended contrast ratio of texts and images of texts is 7:1, and the contrast ratio of large-scale texts is 4.5:1. However, for inactive user interface components and texts of logos or brand name do not have contrast ratio requirements in both cases. (W3C 2008.)

4.1.3 Typography

According to Chadwick-Dias et al. (2002), it is essential to consider the design of text when displaying on the screen. Since the ability to focus sharply on objects within a distance reduces, it takes more time for them to read the texts and instructions on the screen. (Farage et al. 2012; Chadwick-Dias 2002, 30.) In typography, for the font types, using sans serifs, such as Arial or Verdana, are preferably recommended than serif font types. This is applicable for the computer screen and mobile devices as well. (Holt 2000, 3.)

A study by Chadwick-Dias (2002, 36) shows that font size does not affect too much on the readability of texts. However, older people with visual impairment find it difficult to read too small characters (Kurniawan and Zaphiris 2005, 1). Choosing an appropriate font size depends on screen size and resolution. Too large texts result in fewer characters per line, more line breaks and taking more time for users to read. A study by Darroch et al. (2005) indicates that font size from 8pt to 10pt is preferred by younger people, while older users feel positively comfortable with 9pt for small screen size and 12pt to 14pt for larger screens. (Darroch et al. 2005, 7-11.)

In terms of font styles, extravagant texts are not recommended for designing a typeface. For example, italics makes the letters look wobbly, underlining may make them blur as well. (Holt 2000, 3) Another point to consider is uppercase texts. Although uppercase texts are commonly used to catch user's attention, overusing them results in cluttering, tiring and reducing the readability of texts. (Farage et al. 2012.) Therefore, uppercase should be used for highlighting keywords and so as bold, italics and other font styles (Holt 2000, 3; Farage et al. 2012).

Moreover, the amount of characters per line also influences the readability of text. The recommended number of characters per line should be ranging from sixty to seventy-five characters. This number varies depending on the font size of characters. (Bringhurst 2012, 25-27.) If the font size of texts is too big to be displayed on the screen size at once, the content becomes scrollable. Elderly users have difficulties and confusion with scrolling and moving texts. In this case, the font size should be decreased slightly to ensure static displaying of texts. In addition, for paragraphs and multiple lines, left-justified style is suggested, and centred-justified is for displaying big headings. If a paragraph is justified centrally, there will be unequal spacing in between characters, which makes it uncomfortable for users to read. (Kurniawan and Zaphiris 2005, 3-6.)

4.1.4 Button

Since elderly users have their movement control less precise and more error-prone, it is difficult for them to interact with tiny buttons or elements. Increasing the size of these elements is a positive way to improve the usability of a design. (Caprani et al. 2012.) However, with small screen size, proper spacing between them are needed, especially when there are more than two buttons at a row. The size of a button depends on the availability of spaces and level of movement control of users. Button size should be big enough to capture fingertip actions. (Jin et al. 2007.)

For a single button on the touchscreen, increasing the size of that button does not cause any measurable effect on pointing accuracy. In the study of button size and spacing on touch devices for elderly users, Jin et al. recommended the proper size for an isolated button is 11.43 mm square. This size is considered as the minimum size a button should be designed as well. (Jin et al. 2007.)

In terms of adjacent buttons, the size should be a bit larger for higher accuracy. For example, 16.51 mm square is suitable for adjacent buttons with limited screen space. For faster and more accurate performance in elderly users, the button’s size of 19.05 mm square is suggested. Moreover, in order to ensure the interaction and less incorrect inputs, proper amount of spacing between them is considered. The size of spacing depends on the manual dexterity of users. The spacing of 3.17mm to 6.35mm is sufficient for people without motor impairment. Due to weaker motor control, a button spacing of 6.35mm to 12.7mm is better for elderly users. Button spacing smaller than 3.17mm results in lowest accurate performance. While button spacing larger than 12.7mm is too large and may take users more time to touch the target button. (Jin et al. 2007.)

4.2 Language and wording

Elderly users are noticed to be more careful with what action they are going to perform. They usually wonder what will happen if they click on a link, a button or an unclear-labelling element. It takes time for them to consider if they should input something. Thus, using active voices, displaying explicit labelling of buttons and links are important in user interface design for elderly users. For example, instead of using “OK”, it is better to use “Save password” for more clarification. (Chadwick-Dias et al. 33-36.) Holt (2000, 6) also recommended using icons, symbols that are familiar with users as hyperlinks or buttons for a better understanding of the labels and links. The use of these icons, symbols possibly make it easier for users to recognize the context. However, they should be used when needed, overusing of them causing confusion for users and troubles updating the page for later. (Holt 2000, 6.)

Similarly, error message, confirmation texts, and alert boxes should have positive phrasing and not too technical (Holt 2000, 6). Since elderly users are not comfortable with trying new things and things that they are not sure about. By using positive phrasing, it can motivate the user’s intention to take action without any suspicion (Nielsen 2013; Holt 2000, 5-6). Nevertheless, in some cases, technical terms cannot be avoided, such as healthcare applications. Holt (2000, 6) suggested providing a glossary of terms to explain technical texts.

4.3 Auditory information

Apart from visual information, auditory information is also a way to deliver messages to users, especially with those suffering from visual deficiencies. When offering auditory information for older users, it is important to consider the frequencies of the sound. Elderly users have difficulties hearing audio with high frequencies above 4000Hz, while frequencies lower than 1000Hz does not affect too much. The sound of consonants has frequencies around 8000Hz, which usually lead to the misunderstandings of words. Furthermore, women and children have higher pitched voices than men, thus, it is better to use male voice to convey verbal information for elder people. Also, slower speech rate can help old people process the information easier than rapid rate speech. (Fisk et al. 2009, 57; Farage et al. 2012.)

One way to help users understand speech is to provide good contents. By this way, users can guess the information based on the context provided. Offering subtitles and descriptive texts together with verbal information is also recommended for users with hearing impairments. (Farage et al. 2012.) Avoiding music as background noise in delivering the

speech, because it is hard for elder people to distinguish speech over music (Holt 2000, 7).

4.4 Interaction

Interaction is an essential factor influencing the usability of a design. Interaction study is about understanding user's behaviours with a product. (Siang 2019.) This section discusses how elderly users interact with touchscreen application within aging characteristics. Therefore, technics on interactive design, such as data entry and feedback, are provided based on related works.

4.4.1 Data entry

Data entry is commonly considered as a difficult task for elderly users. Due to their motor and cognitive restrictions, their interaction with keyboards and keypads is much slower and less accurate. (Farage et al. 2012.) Therefore, Carprani (2012, 102) recommended applying data entry task for small data input activities. Data entry task should be reduced as much as possible or replaced with alternative methods such as selecting predefined values, using sliders, buttons. (Carprani 2012, 102.)

Currently, QWERTY-layout is widely used by users who have more typing experience with QWERTY-layout on the physical keyboard. They can interact with the virtual keyboard faster and have no problem typing long texts. On the other hand, alphabetically ordered keyboard is more suitable for novice users. Users with less typing experience need more time to search for letters on the keyboard. (Nicolau & Jorge 2012, 130.)

As elderly users have their motor control reduced by age, Nicolau & Jorge (2012, 134) suggested that designing of keyboard should have keys wider rather than higher. This will prevent users from input errors by touching neighbour letters due to space constraints on small screens. In addition, providing language-based correctors and suggesting words is a considerable practice to reduce cognitive errors in elderly users. (Nicolau & Jorge 2012, 134.)

4.4.2 Feedback

One of the keys to improve the interaction of a design is to keep users informed about the current state of their experience by giving feedback (Nielsen 1995). Particularly elderly users who might despair a task that is hard for them to perform (Nielsen 2013). Giving descriptive and positive feedback can motivate their intention to take action (Holt 2000, 6). Feedback can be visual, tactile, auditory signals or a combination of them. Due to visual,

haptic and hearing impairments, when giving feedback, the considerations of these characteristics are crucial.

For elderly users who have their motor controls decreased, touching the intended target accurately is difficult for them (Farage et al. 2012). In this case, giving visual feedback which indicates the exact touching location is considered (Kobayashi 2011, 17). In addition, the feedback should be designed according to colour, contrast and language standards so that elderly users with weak vision can perceive the information properly (Caprani 2012, 103; Farage et al. 2012; Holt 2000, 6).

In terms of auditory feedback, the recommended frequencies of the sound should be from 500Hz to 2000Hz. Higher frequencies than 2000Hz can be used for sound localization with a longer duration than 0.5 seconds. Furthermore, male voices are better to convey information than female voices due to lower frequency. (Fisk et al. 2009, 57; Farage et al. 2012.)

Vibration signals is a common way to give feedback on touch devices as well. However, elderly users have problems detecting high frequency vibration due to changes in muscles. Frequency vibration from 60Hz and above is less sensitive than low frequency vibrations, for example 25Hz. Therefore, tactile feedback should have frequency vibrations in between 25Hz and 60Hz. (Farage et al. 2012; Fisk et al. 2009, 16.)

Nevertheless, providing tactile feedback solely can distract elderly users. Thus, multi-modal feedback, which is a combination form of auditory, tactile and visual, is considered to enhance interaction of the design. Through multi-modal feedback, impairment of one sensory channel can be compensated. (Motti 2014, 18.)

5 CASE STUDY

5.1 Background summary

Dairo is an application released in November 2018. Intended users of the application are elderly people with memory problems and their relatives. The purpose of the application is to help elderly people with their routines in the simplest way. The application includes three phases. The first phase is the setting of reminders where information on activity (name, time) are set. The second phase functions as an alarm reminding the elderly user to perform a specific task at a set time with an audio announcement. The announcement should be simple and easy to understand. The third phase is sending the notifications to the relative of the main user if an activity is completed. The first and second phase of application is conducted on a tablet, and the third phase works on a mobile phone. (Haverinen 2018.)

Since one of one of the intended user group is elderly people who suffer from memory problems and issues in perception and sensation, usability testing is vital. Examiners of the test are the author of the thesis and Pasi Haverinen, who is the author of the application. The test is conducted to study the usability of the application in terms of visual design, interactions as well as its functionality. Also, one of the purposes of the application is that the elderly can set the reminder by themselves. Thus, the test investigates which elements should be improved so that elderly users can interact with the application properly. In addition, the findings from the test will be used as references for future development of the application. When the usability of the application is ensured, it can be widely used as an assisting tool in homecare units.

Before the test, users are introduced about the application and how it functions. Tutorials on how to use the application are explained and guided individually by Pasi Haverinen. (Haverinen 2018.) After that, users have two weeks experiencing the application at their homes. Personal opinions and problems during experience are recorded individually. Finally, they will fill in an online survey on how satisfaction of their experience with the application.

5.2 Methodology

Qualitative method is applied in usability testing in order to have deep understandings on the user's experience with the application. There are only five groups of participants in the test, thus, qualitative is an appropriate method. The questions in the interview are based on studies from previous related works together with personal experience with the

application of the thesis' author. Questions of the interview are divided into three parts according to phases of the application: "Main" section, "Reminder setting" section and "Notification" section. For the "Main" sections, the interviewees are users from group one, who are elderly people with memory problems. Interviewees of the "Reminders setting" and the "Notification" sections are users from group two, who are relatives, or friends of the users in group one.

In the "Main" section, the two first questions are about the user's age group, which is under 65, from 65 to 70 and above 70. The aim is to see if users in group one are considered as elderly users, and if there are any differences in the way of interacting with touch device by age. The next four questions are concerning users' previous knowledge in using touch devices. This information is obtained in order to evaluate whether the level of experience in touch devices has impacts on how they handle the application. Secondly, questionnaires focus on their point of view in terms of interface design such as contrast of design, readability of texts. In addition, the survey investigates users' satisfaction with their experience, whether they get confused when the reminder came. Finally, the functionality of the application is examined.

In the "Reminder setting" section, the purpose is to see how easy it is for users to set a reminder and whether the users in group one can complete the task by themselves. Specifically, the questions are related to navigating and button interactions as well as whether users understand the logic of the design. Moreover, technical problems and users' opinions for improvement are also considered. In addition, the question related to users' age is included. The purpose is to see how aging affects the way people interacting with touch devices.

In the "Notification" section, the questions are related to how users in group two handle notifications. Whether receiving too many notifications makes users annoyed. Users' opinions on which way is better for receiving notifications are discussed in the survey as well.

5.3 Test results

There are five groups of participants in the test. Four of them have completely tested the whole application and one of them did not finish the test with the Notification phase because she does not have relative. Most of the users in group one, who interacts with the Main section, are aged over 65 which are considered as elderly users. Users in group two are aged under 65. Two out of five users in group one had experienced with touch devices. They have used social media occasionally. Though, none of them have used a

reminder application before. The table below shows information of test users and the sections they interacted with.

Table 1. Table of participants and the sections they interacted with.

Sections	Main	Reminder setting	Notification
Group 1	Main user 1	Relative	Relative
Group 2	Main user 2	Relative	Relative
Group 3	Main user 3	Relative	Relative
Group 4	Main user 4	Friend	
Group 5	Main user 5	Relative	Relative

In general, the application is considered useful. Four out of five groups said that they had satisfied experience with the application although it is a bit difficult for them at the beginning. Minor technical problems reported. However, there is one user wanting to stop the testing after three days of trying because she did not get used to new technology as well as not being willing to learn. The diagrams below summarize users' opinions on the application according to sections.

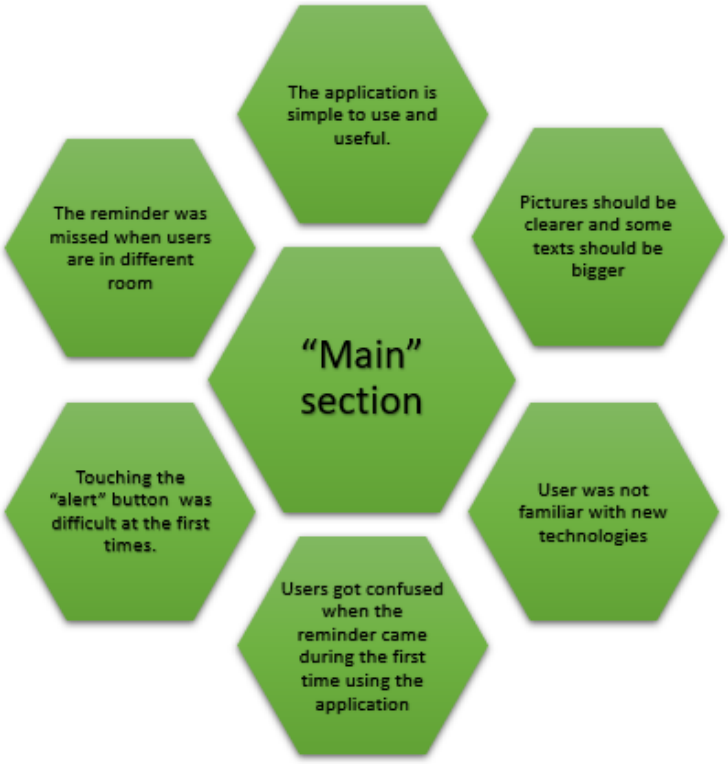

Figure 3. Summary of the test results on the "Main" section.

The Main section is said to be easy to use with a simple task. The user only needs to touch the pop-up notification when it appears. However, for the first time using the application, users were afraid to touch the button or the reminder notification. One user did not know how to tap the button, instead, she pressed it like a physical button on a machine. Another problem is that some users pressed the return button of the tablet accidentally, which caused the application closed. Also, the notifications were missed sometimes when users were in another room. These problems happened for the few first times. After users got used to it, they found it nice.

Figure 4. Summary of the test results on the "Reminder setting" section.

In the "Reminder setting" section, the setting of reminders is supposed to be done by users in group one. However, they found it difficult to do by themselves due to being less experienced with mobile applications and found problems pressing buttons on the touchscreen. Therefore, the setting tasks were completed by users in group two with the presence of users in group one. The responses of the survey are answered according to the opinions of the users in both groups. Though the logic of this section is clear to some users, the others found it easy to forget what reminder was already set.

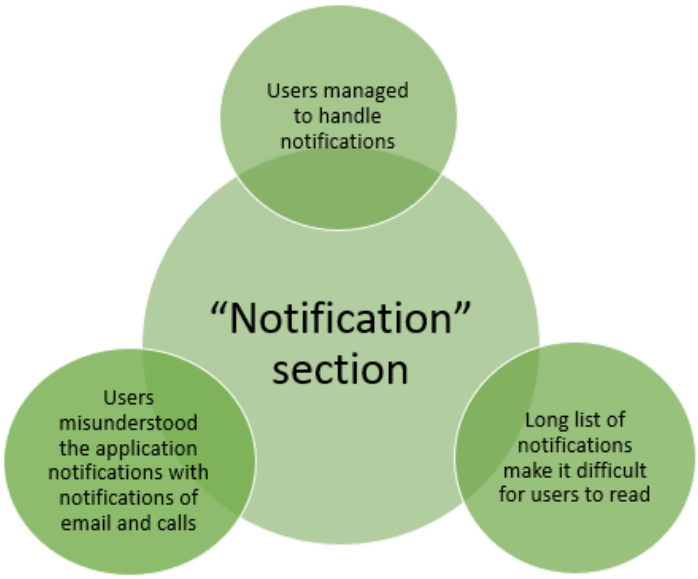

Figure 5. Summary of the test results on the “Notification” section.

For the “Notification” section, users in group two managed to handle notification when it came. However, after a few days of a too long list of notifications, they found it difficult to read the information separately. In addition, one user was confused the notification of the application with emails, messages, and calls.

5.4 Findings and discussion

5.4.1 Visual design

In terms of colour and contrast, users in both groups said that they like the look of the application with relaxing pictures and enough contrast. There is one comment on the pictures and graphics, saying they look a bit off and should be sharper. Nevertheless, there is one section that a dark background is used when the colour of the text is black (Image 1).

Image 1. Section of the application where a dark background is used with black text (Dairo 2019).

As mentioned in the theoretical parts of the thesis, patterned or dark background can make it difficult for elderly users to see the texts in the foreground (Caprani et al. 2012, 102; Sardegna et al. 2002, 6). Displaying dark texts on a blue background is an example of low contrast.

Regarding typography, typeface design of the application is simple and not too decorative. The font colour is black in general, and the font style is normal without italic or underlined. However, some texts are not readable enough for users in group one. For example, the texts that display details of the reminder in the pop-up box (Image 2).

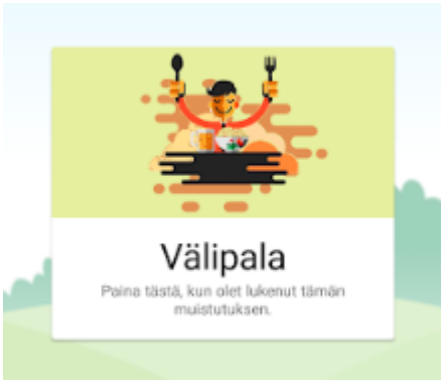

Image 2. Texts that display detail of the reminder box (Dairo 2019).

Users prefer the texts to be bigger and clearer as they cannot see them well. Moreover, as it can be seen from Image 2 that the texts are a bit light, which does not stand out from the white background. In this case, it is recommended to make the texts darker or bolder. Similarly, in the “Reminder setting” section, although the texts are readable for users in group two, they are too small for users in group one (Image 3, Image 4).

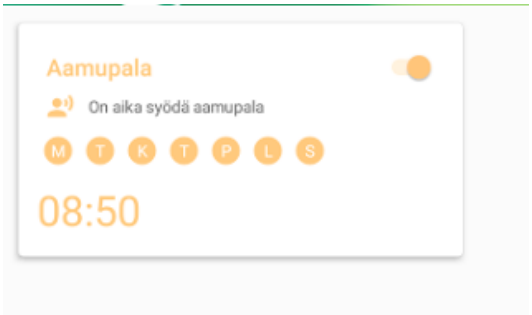

Image 3. Reminder’s information in the “Reminder setting” section (Dairo 2019).

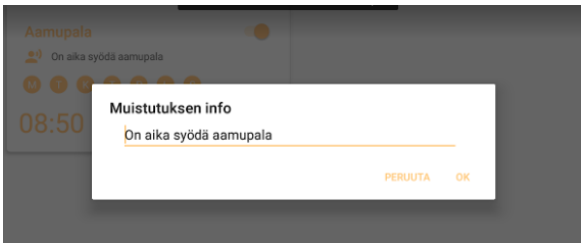

Image 4. Inputting box in “Reminder setting” section (Dairo 2019).

Recommended font size in user interface design for elderly users is from 12pt to 14pt (Darroch et al. 2005, 7-11). Moreover, the font colour of “day” options should be more contrasting to its background so that elderly users can recognize them better.

Designing of buttons is also mentioned in the survey. For the Main section, users in group one judged the buttons and clickable areas to be good enough and did not want them to be larger. Most of them are first nervous to tap the button and need time to get used to it.

The other problem they have is that they pressed the buttons too much like mechanical buttons, so they need to practice a bit. One user would prefer the “Alert” button to be rounded instead of square shape so that it will look like a button.

Apart from the “Alert” button, in the Main section, the “Settings” button is displayed as an icon shown in Image 5. The icon is on the right top corner of the section and looks quite small compared to recommended size in designing buttons for elderly users, which should be 11.43 mm square (Jin et al. 2007).

Image 5. Settings button (Dairo 2019).

Since users in group one did not interact with “Reminder setting” section directly, buttons and clickable areas are tested according to opinions of users in group two. Buttons and clickable areas are commented to be small and difficult for them to click. Therefore, increasing the size of them is needed. Especially if the aim is to let users in group one do it on their own, the size increase is definitely needed with the consideration of recommended button sizes in section 4.1.4.

5.4.2 Navigation

In addition to the visual design of colour, contrast, typography, and buttons, navigation of the application is also investigated in the “Reminder setting” section. Users confirmed that they did not have problems navigating as they can see it from heading and on the top bar.

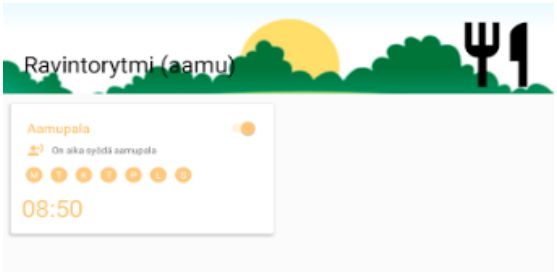

Image 6. Heading of section (Dairo 2019).

Caprani et al. (2012, 103) suggested that providing a menu is needed to help the user navigate better between sections. Kurniawan and Zaphiris (2005) also stated in his guidelines that navigation should be clear and inform the user on their location on the current page. Although this application does not provide a visible menu, name and location of the section are provided in heading in order to ensure the ease of navigating for users.

5.4.3 Language and wording

The language used in the Dairo application is Finnish and English. All of the test users are Finnish, so the Finnish version of the application is tested. Labels of buttons, as well as the title and headings, use short and easy to understand phrases. Together with texts, the design also uses icons to indicate the meaning of the element. For example, using the "speaker" icon for voice testing button, the "plus" icon for adding a new reminder. Moreover, there are no technical terms in the application as well as foreign language. No problem relating to language and wording is reported.

5.4.4 Interaction

Data entry is considered as a difficult task for elderly users (Farage et al. 2012). In the Dairo application, there are not many data entry tasks. "Reminder setting" section is the one that requires two inputting tasks. Users are asked to give information on reminder by textual input. The other tasks in this section are selecting options. Moreover, all the interactions done in "Main" and "Notification" sections are to tap on the buttons and no data entry task. The application manages to minimize the number of data entry so that it is easier for users in group one to do the setting by themselves. However, the keyboard layout is QWERTY, which will take elderly users or users with less typing experience more time to complete the task. Nicolau & Jorge (2012, 130) recommended using the alphabetically ordered keyboard as a solution for this problem.

In terms of feedback, the Dairo application manages to give feedback when users perform the tasks correctly. For example, when the user taps on reminder pop-up, the system confirms that notification is sent. However, the application fails to handle null input value in the data entry task of "Reminder setting" section. Specifically, a reminder without information and title can be set successfully without any error informed (Image 7).

Image 7. Null reminder (Dairo 2019).

Similarly, if the user taps on "Alert" button by accident without any reminder, null notification is still sent. This practice may result in annoyance for users in group two.

Furthermore, one user reported that she accidentally shut down the application due to pressing the “return” button on the tablet. In this case, before the application shuts down, there should be a confirmation pop-up to prevent the mistake.

5.4.5 Auditory

Since the hearing ability of users and the frequencies using in this application are unknown, thus, audio frequencies are not evaluated. Though, in the survey, users reported that they could not hear the reminder when they are in another room. For example, when the user was in the living room and tablet was in the kitchen.

In addition to frequencies, the speed of sound and voice play a crucial role in auditory information. The audio of the application has slow speed, which is loud enough for elderly users to listen. Even so, the speech is delivered by a female voice, which is not recommended for users with hearing impairments. Using the male voice is better to convey information than female or children voice. (Fisk et al. 2009, 57; Farage et al. 2012.)

Another finding in delivering auditory information is that users like having music in the background of the speech. However, Holt (2000, 7) suggested using music as background noise should be avoided as it is difficult for users with weaker hearing ability to recognize the speech over music.

5.4.6 Functionality of application

Usability of an application is not only about visual design, but the utility of it is also important (Nielsen 2012). That is why in the survey, technical problems and functionality of the Dairo application are also investigated.

Apart from the null variables mentioned in section 5.4.4, there are some problems happened in the setting of reminders. Users reported that when two reminders are set at closed intervals, the reminder functions incorrectly. The speaker also speaks faster than how it speaks when the reminder comes. Moreover, at the first time of using, the application was crashed, and users needed to sign out and sign in again. These mentioned issues should be handled to ensure the usability of the application. More testing on technical problems should be done as well.

5.4.7 Other findings

In the survey of the “Notification” section, users in group two said that they preferred to be informed when users in group one tapped the reminder. One user also got confused when

notifications come because she supposed that they were an email, a message or a call. Moreover, the logs became too long and difficult for them to read separately after a few days. In this case, the logs should be divided into groups or only the logs of a day are visible.

Regarding users' journey, during the first time of using the application, users in group one got confusion several times when the reminder came. There was one user that even wanted to stop using the application after three days because she felt like someone was following her. Also, during these days, some users are afraid to touch the alert button, one user needs to practice touching the button, and one user did not remember to touch it. Moreover, although the aim of the application is to let users in group one set the reminders themselves, they could not do it. One user is afraid that she might break something if did it by her own. These findings prove that elderly users still have trouble interacting with new technology and they need time to practice. Data entry task still seems to be challenging for elderly users. In this case, using voice recording to input data is a considerable way to replace typing input. In addition, there should be a helper, an assistant or supporting section in case they need help during the experience.

Although the original purpose of the application is to help elderly users with memory-loss problems, four out of five users find it helpful while there are only two of them suffer from severe memory-loss problems. This means that the Dairo application is a useful assistant for elderly people. In addition, four out of five users were satisfied with their experience. They felt nice when there was someone talking to them after they got used to it. This is the proof that the application does not only work as a reminder, but it also helps elderly users relieve their loneliness.

5.5 Conclusion of the test

In general, the application has received positive feedback on usability, and four out of five test groups were satisfied with their experience although they need time to get familiar with the application. Users in group one may need more time and training so that they can set the reminder by themselves. Even users in group two, who have more experience with touch devices, still made errors and mistakes in setting reminders. The findings demonstrate that elderly users are not familiar with new technologies and it takes more time for them to learn how to use them. When designing a mobile application for elderly users should take aging into account.

Concerning the visual design of the application, the colour, graphics of the application should be sharper and need to be more contrasting. The texts in "Main" and "Reminder

setting” sections should have larger font sizes to be readable for users in group one. Also, the buttons in the “Reminder setting” section should be bigger so that users can target accurately. In addition, language and labelling of buttons are simple and easy to understand. Auditory information is successfully delivered with slow speed sound. Moreover, the interactions are ensured by minimizing the number of data entry tasks and giving feedback when users perform the tasks correctly. However, the application still has technical problems to be handled.

All in all, compared to earlier research, the Dairo application meets the basic requirements in designing mobile applications for elderly users in terms of interactions, language and wording, and auditory information. The application still needs to be improved in the font size of texts, and size of buttons so that the elderly manage to set the reminder on their own as one of the goals of the application.

6 RECOMMENDATIONS

Recommendations for improvement of the application are based on findings of usability testing and literature review from previous works. The table below summarized the problems in the design and functionality of the Dairo application that need to be improved.

Table 2. Summary of recommendations for improvement of the Dairo application.

Problems	Solutions
Small texts	- Font size of reminder information in the “Main” section and texts in the “Reminder setting” section should be bigger, for example from 12pt to 14pt.
Small size of buttons and clickable areas	- In the “Main” section, the icon of “Settings” should be bigger. - In the “Reminder setting” sections, size of clickable areas (days, speaker) should be bigger.
Navigation	- A “Back” button to the previous section can prevent users from pressing “return button” of the tablet many times, which causes the application to shut down on accident.
Interaction	- Using voice input for data entry task. - Feedback when users perform tasks incorrectly should be provided. - Confirmation pop-up when users shut down the application should be given.
Audio	- Using male voice instead of female voice to convey information. - Avoid using music as background noise with the speech in delivering messages.
“Notification” sections’ layout	- Displaying of logs should be shortened or grouped by days.
Functionality of application	- Null input should be handled. - Incorrect reminders when they are set at closed intervals should be handled.

7 CONCLUSION

It can be indicated from the studies and findings of the thesis that elderly users are novices to new technologies, specifically touchscreen devices. A basic understanding of aging issues is needed for developing mobile applications for elderly users. These cognitive and physical impairments affect the way elderly users interact with touch devices. It is important for developers and designers to take these characteristics into consideration during development and designing process. The application should ensure both usability of the design and functionality of the application in order to minimize risks during user experience.

The first section of the thesis discusses previous studies and works on the topic. The first section mainly focuses on user interface elements of design with consideration of aging-related issues. In terms of visual design, the studies cover methods on how to design colour, contrast, typography, buttons as well as the use of language to ensure readability and learnability of a design. The studies also suggest guidelines on using audio as an information delivery method for elderly users with visual or hearing impairments. Interactive elements such as data entry and feedback are mentioned as well.

The case study of this thesis is usability testing of the Dairo application. In addition to testing the usability of the application, the purpose is to see how well the methods studied in the first section are applied in a practical case. Although the application meets the basic requirements, it still needs to be improved so that usability standards are achieved. Moreover, the findings from the case study together with the literature review are considered to enhance the usability of the Dairo application.

All in all, concerning the visual design, designing mobile applications for elderly users should make sure that the contrast in design is enough and the appropriate sizes of texts and buttons are applied. Language and wording are simple and easy to understand. Moreover, if audio is used to convey information, the frequencies and speed of sound are thought of. Finally, the design should ensure the interaction between users and the application. They should be informed about what will happen if an action is taken.

8 FUTURE WORK

Regarding the guidelines on usability in designing a mobile application for elderly users, the materials are not current as technologies have changed. These techniques should be revised and tested. More principles of interaction design should be focused and studied as well.

Concerning the case study, the Dairo application should be tested with a wider range of participants with different experience in touchscreen devices. In the test, users in group one, who were elderly users, should try setting the reminder themselves. Other elements such as specific sizes that are used in texts, buttons, frequencies of sound need to be considered. Moreover, the recommendations for improvement of the application should be tested after they are applied.

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Dairo application. 2019. Dairo – Reminders. Tablet screenshot. Finland.

APPENDICES

Interview questions in usability testing of Dairo application

Main section:

1. Mihin ryhmään kuulutte? (In which group are you?)
    - Ryhmä 1: Pääkäyttäjät
    - Ryhmä 2: Pääkäyttäjien perhe/ystävät
2. Mihin ikäryhmään kuulutte? (What is your age group?)
    - Alle 65 vuotiaat
    - 65-70 vuotiaat
    - Yli 70 vuotiaat
3. Kuinka usein käytätte älylaitteita (älypuhelin, tabletti jne.)? Ja mihin käytätte älylaitteita? / How often do you use mobile devices (smartphone, tablet,..)? For which purposes of the using?
4. Minkä tyyppisiä ohjelmia tai sovelluksia olette käyttäneet? (Facebook, WhatsApp jne.) / What kinds of mobile application that you have been using?
5. Oletteko aiemmin käyttäneet muistutuksia antavaa ohjelmaa? / Have you ever used any "Reminder" applications before?
6. Kuinka helppoa oli käyttää ”tätä” ohjelmaa ensimmäistä kertaa? Oliko sen käyttäminen helppoa vai oliko siinä jotain ongelmia? Millaisia ongelmia? / How easy it is for you at the first time using this application?
7. Mitä mieltä olette käyttöliittymästä? / What do you think about the interface in general?
8. Mitä mieltä olette tekstistä (koko, väri, luettavuus)? / What do you think about the texts (size, color, readability)?
9. Oliko teillä vaikeuksia painaa jotain nappulaa tai muistutusta? Painoitteko mitään niistä vahingossa tai ette huomanneet muistutuksia? Jos näin kävi, milloin ja miksi näin tapahtui? (Did you have any problem clicking the buttons, reminders? Have you ever clicked them on accident or missed any reminder? If yes, why and when that happened?

10. Hämmennyittekö kertaakaan, kun kuulitte muistutuksen? / Did it confuse when the alarm went off?
11. Mitä olette mieltä ohjelmasta? Onko teillä mitään kehitysideoita sille? / How much do you like the application? Do you have any recommendation for better improvement?
12. Oliko sinulla ongelmia ohjelman käytössä? Millaisia? / If you had any other problem while using this application, could you please list them here?

Reminder setting section

1. Mihin ikäryhmään kuulutte? (In which group are you?)
    - Alle 65 vuotiaat
    - 65-70 vuotiaat
    - Yli 70 vuotiaat
2. Mitä mieltä olette ulkoasusta yleisesti? / What do you think about the layout in general?
3. Mitä mieltä olette teksteistä (koko, väri, luettavuus)? / What do you think about the texts (size, color, readability)?
4. Oliko teillä ongelmia siirtymisessä sivujen välillä? (Esimerkiksi nykyiseltä sivulta edelliselle sivulle) / Have you got any problems navigating? (For example, from current page to previous page)
5. Oliko teillä ongelmia kosketustoimintojen kanssa? Millaisia? (Esimerkiksi liian pienet nappulat) / How about clicking/touching function? Have you got any trouble clicking buttons? If you had, could you explain what kind of problem is it (eg. buttons are too small.)
6. Miten muistutusten muokkaus onnistui teiltä? Onko se liian vaikeaa/hankalaa? Jos niin, miksi? / What about editing an added reminder? Is it too complicated/confusing? And why?
7. Kuinka tyytyväinen olette ohjelmaan? Onko teillä ideoita/suosituksia ohjelman parantamiseen? / How satisfied are you with the application? Do you have any suggestions for improving the application?

8. Jos teillä oli muita ongelmia ohjelman käytön kanssa, voisitteko kertoa niistä? / If you had any other problems while using this application, could you please list them here?

Notification section

1. Mikä on suhteenne ohjelman pääkäyttäjän kanssa? / What is your relationship with main users?
    - Ystävä / Friend
    - Perheenjäsen / Family
    - Sukulainen / Relative
2. Mitä mieltä olette ulkoasusta yleisesti? / What do you think about the layout in general?
3. Oliko teillä mitään ongelmia ilmoitusten saannissa tai sen käsittelyssä, kun niitä tuli? Jos teillä oli, voisitteko kertoa, millainen ongelma oli? / Have you got any problem receiving, handling the notifications when it comes? If yes, could you specify what kind of problem is it?
4. Millä tavalla mieluiten haluatte ilmoituksen? / In which way would you prefer being notified?
    - Huomautus, kun tiettyä toimenpidettä ei ole tehty, muistutusta ei ole hyväksytty (vastoin päin kuin ohjelma toimii nyt)
    - Huomautus kun toimenpide on tehty ja muistutus on hyväksytty (kuten ohjelma toimii nyt)
    - Kummallakin tavalla

    Ja miksi? / And why?
5. Haluatteko mahdollisuuden poistaa vanhat ilmoitukset? / Would you like to have a remove option for old notifications?
6. Kuinka tyytyväinen olette ohjelmaan? Onko teillä ehdotuksia ilmoitusten parantamiseksi? / How satisfied are you with the experience? Do you have any suggestions for improving the notification?

7. Jos teillä oli ongelmia tai kommentteja ohjelman käyttöön liittyen, voitteko kertoa niistä? / If you had any other problems, comments while using this application, could you please list them here?