

Report

User experience with the smartphone case EziSmart

Testing by seniors in two months

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ABSTRACT

This report summarize the experience from testing the EziSmart solution. The solution consist of the smartphone casing with physical keyboard, the Ezi-Pad, and a suite of applications. Nine seniors, some experienced smartphone users some not, started to evaluate the system in June 2016. Five out of those continued to use the system for more than two months. Four users chose to end the testing during the first month.

The feedback from the users continuing for two months were very positive, and implies that for many users the EziSmart system will makes the phone easier to use, especially as motoric skills and vision is decreasing with age. Those ending the test before the two-month test period ended had different reasons for leaving the trial. In the group, we did however see that the need for help and willingness to engage in "error and trial processes" necessary to learn to use a smartphone, decreased with age and development of disease.

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APPENDICES

None

Summary

This report summarizes the experience from testing the EziSmart solution. The solution consists of the smartphone casing with physical keyboard, the Ezi-Pad, and a suite of applications. Nine seniors, some experienced smartphone users some not, started to evaluate the system in June 2016. Five out of those continued to use the system for more than two months. Four users chose to end the testing during the first month.

The feedback from the users continuing for two months were very positive, and implies that for many users the EziSmart system will make the phone easier to use, especially as motoric skills and vision is decreasing with age.

A keyboard integrated in a casing will make a standard smartphone easier to use for several groups. Using a smartphone through gestures is intuitive also for seniors, but small screen touch buttons are challenging, and several users emphasize especially writing text as easier with Ezi-Pad. This is not only the case when writing text in messages and mail, but also using other applications where text entries are needed, e.g. input of passwords, directory etc. The results of our tests implies that a combination of physical keyboard and touch screen usage is a good approach.

The seniors not used to a smartphone, or with vision or motoric impairment appreciated the simplification of the launcher with one-touch calls to the most frequent contacts. The possibility to easily share their GPS position was valued for the extra safety and security provided. All the users that was former non-smartphone users started to use several application, and reported that this gave added value compared to the feature phone

It is clear that the senior (+65 upwards) group can be divided into many sub-groups. As a person ages, each have their special problems both physical and mental to contend with resulting in many sub-groupings. There is no homogeneity, which means that one size does not fit all. This is clearly shown within the group of test participants. In choosing the test group, a conscious choice was also made to have a varied group of users. From the test results, we draw the conclusion that the EziSmart is not suitable to cover all senior users but it is worth noting that the EziSmart's flexibility and agility does cover a wide range of user segments. This is clearly demonstrated by the senior participants ranging from Parkinson sufferers to severely sight impaired (blind).

A system, like the EziSmart, can be helpful for several groups of seniors wanting to use a smartphone. The testing indicates that the following groups will especially benefit:

- Smartphone users who develop motoric impairment, minor or pronounced due to age or illness
- Users with vision impairment, with or without prior acquaintance of smartphones
- All persons excluded from the use of smartphones due to motoric impairment
- Younger seniors not acquainted with smartphones but motivated to start using one even though a little daunted by the technology.

1 Introduction

The project "EziSmart: a way of social contact and support for elderly living at home"¹ is supported by the "Regionale Forskningsfond (RFF) Hovedstaden". The project owner is EziCare Tech AS, and SINTEF ICT is research partner in the project.

The project has evaluated how seniors manage to start using the EziSmart solution, which consists of a smartphone casing with physical keyboard, the Ezi-Pad, and a suite of applications. The EziSmart system is developed by EziCare Tech AS. This report summarize the finding from a two-month test with volunteer seniors. The findings in this test have been compared with findings in published literature.

The project group want to thank all the participating volunteers for very valuable feedback during the testing.

1.1 Motivation

Christopher Isaac "Biz" Stone, co-founder of the social media platform "Twitter" said "The mobile smartphone is the hyperlink of humanity". Many seniors are excluded from participating in this interaction due to decreased motor skills, cognitive impairment, or, for a large proportion, due to (unfounded) fears that this is too difficult. The EziSmart solution is developed to help seniors and other with similar impairments, to overcome these barriers to use smartphones.

2 Background on seniors adoption of smartphones

To get an overview on seniors adoption of smartphones scientific literature and statistics has been studied. The number of articles with the topic smartphone and elderly increased significantly from 2012 to 2013, but the number of articles focusing on "User barriers" or "User interface development / evaluation" are rather limited. Most of the literature focus on application specific usage and surprisingly few try to understand in depth why many elderly are reluctant to go from a feature phone to a smartphone. This is also pointed out in the Mohadis and Ali in their "A study of Smartphone Usage and Barriers Among the Elderly" (2014). The main group of articles are the one that uses the integrated accelerometer to monitor activity and fall.

2.1 Statistics about use of smartphones and internet

2.1.1 Percentage of seniors having a smartphone.

Medienorge² reports data from Statistisk Sentral Byrå (SSB)³ on the number on smartphones in Norway, and data from 2012-2015 is shown in Figure 1. We see that the percentage with access to a smartphone is much lower for the 67-79 group than the younger groups. However, the number is rapidly increasing. The Pew Research Center monitors the US population use of internet and smartphones. In the US, 13% of age 65+ owned a smartphone in February 2012, 18% in 2013 (Smith,

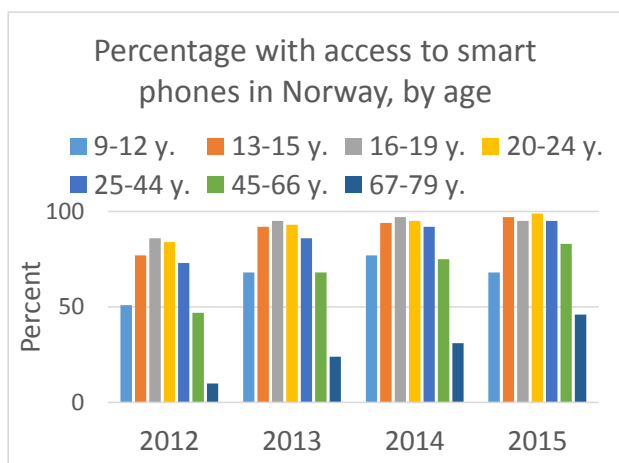


Figure 1 Smartphones in Norway by age group

¹ In Norwegian RFF application "EziSmart: En vei til sosial kontakt og støtte for hjemmeboende eldre"

² <http://www.medienorge.uib.no/statistikk/medium/ikt/388>

³ <http://www.ssb.no/>

2013) and in 2015 this was increased to 27% (Smith et al., 2015). Probably the trends and numbers are quite similar also in other developed countries. With an increasing number of smartphones among friends and family in their own generation, the psychological barriers described below may change. Even though the number of elderly owning a smartphone is increasing, it is still well behind the number for the overall population.

2.1.2 Use of internet by age groups in Norway

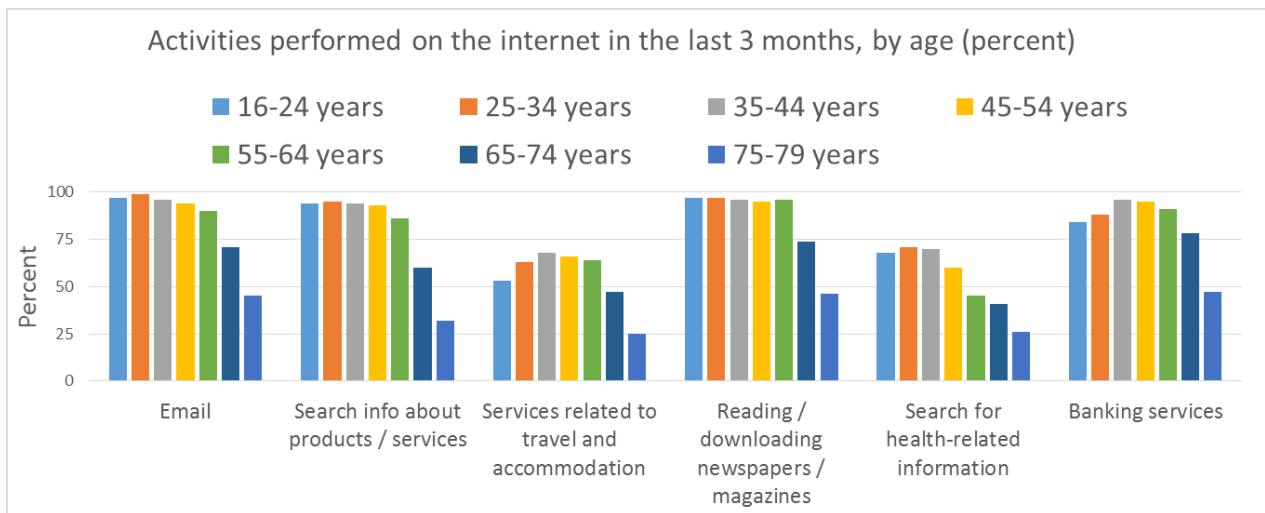


Figure 2 Use of internet by different age groups in Norway (from SSB⁴, published setp 6th 2016)

Figure 2 shows how the use of internet varies between age groups in Norway (data from SSB⁵). This shows that the oldest groups generally uses internet significantly less that the other groups. It will then probably be even harder to see the usefulness of having this functionality available at the phone. Also, the threshold to start using internet on a small screen will be even higher, even if they should see the usefulness of it. The biggest increase between adjacent age groups is from 65-74 to 75-79, and probably the use by the oldest group will increase more than the other groups the coming years.

The SSB numbers shows that less than 30% of the population between 75-79 years have used a smartphone to access internet in Q2 2016. In the group 65-74 years, some more than 50% had done that and approximately 75% in the 55-64 group. So even in this age group 25% do not access internet using a smartphone.

Ipsos tracks the use of social media networks in Norway⁵. Their statistics from Q2 2016 shows that Facebook has most users with 81.1 % of the populations, 69.8% of the population above the age of 18 uses Facebook daily. 64% of the population above 60 has a profile. The percentage of users in the group 60+ is lower than for other age groups as shown in Figure 3. Other social media networks monitored (LinkedIn, Snapchat, Instagram, Twitter, Google+ and Pinterest) show the same. There have been some variations, but the last quarters it has been increasing.

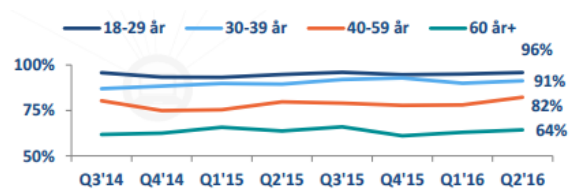


Figure 3 Percentage with a Facebook profile, for different age groups. Data from Ipsos

⁴<https://www.ssb.no/statistikkbanken/selecttable/hovedtabellHjem.asp?KortNavnWeb=ikthus&CMSSubjectArea=teknologi-og-innovasjon&checked=true>

⁵<http://ipsos-mmi.no/some-tracker>

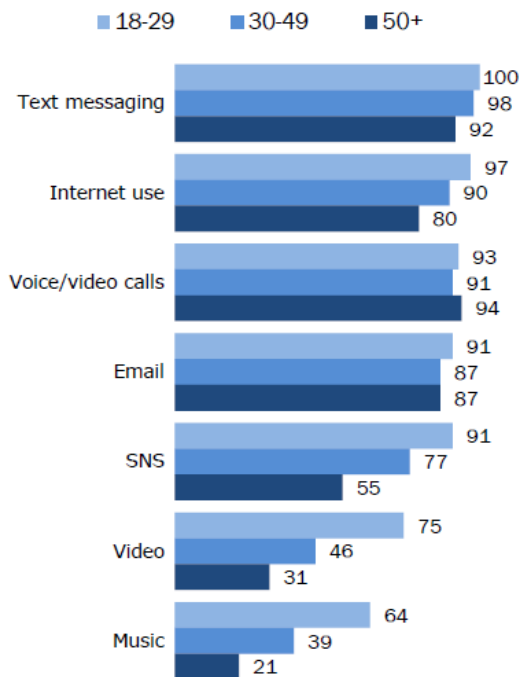


Figure 4 Functionality used by smartphone owners in the US, data from Pew Research Center report (Smith, 2015)

Table 1 Features used by participants in the study by Mohadi and Ali (2015)

	Feature phone % of group (N=12)	Smart-phone % of group (N=6)
Call	12	6
Read SMS	9	6
Reply SMS	4	5
Camera	6	6
Photo Gallery	6	6
Alarm	3	3
Calculator	0	1
Games	3	0
Calendar	1	1
Torch Light	2	0
Social Networking	0	0

2.1.3 Use of smartphone features by age group in US

Figure 4 shows data on use of smartphones in the US from Pew Research Center Report (Smith, 2015). Even though they report all above 50 as one group, we see that this group uses services like social networking (SNS), music/podcasts, watching video and even internet, less than younger users. With a separate 65+ group this would probably be even more pronounced.

2.2 Smartphone usage and barriers

One of the few studies that focus on the barriers to use smartphones are Mohadis and Ali, "A study of Smartphone Usage and Barriers Among the Elderly" (2014). This study is from Malaysia and the result from a study in a western country may have different results. The sample size in the study is relatively small, 12 with feature phone and 6 with smartphone (as well as 3 with the intermediate multimedia phone). They find that the elderly with smartphones mainly use the same features as the one with feature phones, but smartphone users tend to report to use more features. The numbers are given in Table 1. None of the participants used the phone for social networking. (Internet was not listed as an option). The smartphone users do also report to use the phone more frequently than the feature phone users.

Table 2 summarize the reasons listed by the participants in Mohadis and Ali's study (2015) for not switching from a feature phone to a smartphone, or for not using more features if they already have a smartphone. Except the cost and interest, smartphone users give the same reasons for why they do not use more advanced functionalities as the feature phone users give for not switching.

Table 2 Reason given by participant in Mohadis and Ali's study (2015) for not switching to a smartphone from a feature phone, and for the smartphone users, why more advanced functionalities are not used.

	Participants that listed this as a reason for not switching to smartphone from feature phone (N = 12)	Participants that listed this as a reasons for not using more advanced functionalities on the smartphone (N = 6)
Not affordable	75 %	17 %
No interest	50 %	17 %
No necessity	50 %	50 %
Lack of knowledge	42 %	67 %
Impairment		
Vision	42%	50%
Cognitive	17%	0%
Hearing	8%	0%
Motor	0%	33%

2.2.1 Cost

The development and changes in smartphone technology have been fast, and the cost for smartphones has decreased, even though the high-end phones are still expensive. However more manufacturers are focusing on low cost smartphones, and older models are made available at a lower price, the cost is probably a decreasing issue and will not be discussed further. This will however always be a problem for a part of the population and it is important that a "senior phone" is not less value for money than a standard phone.

2.2.2 Perceived usefulness

Two important factors found is "no interest" and "no necessity", or in other words the lack of perceived usefulness. As shown in Figure 4, even the elderly with a smartphone mainly use the phone for calling and text messages. The elderly often do not see that they gain anything from the new technology, e.g. they do not want an internet bank, they prefer the personal contact they get when walking to the bank to pay their bills (Culen and Bratteteig, 2013), (Culen, 2015). (In Figure 2 we see that the "use of banking services" on internet is lower than the "reading newspapers" for the 75-79 years old, while equal for 35-74). If your intentions are to use the phone for calls and text messages only, there is no need for a smartphone. One of Cluen and Bratteteigs (2013) informants stated that the smartphone was easy and intuitive, but at the same time, the smartphone was not needed. Some may also have a negative bias towards the new technology because they feel that smartphones often interrupts or destroy the face-to-face contact "*When I am with my son, he often plays with his phone. Sometimes there is too little human contact*" (Culen, 2015).

As shown in Figure 2, the seniors use internet in general for much less activities than other age groups, thus they probably do not see the need for this on any platform. While younger adults shift to smartphone technology due to self-demand or personal preferences, older adults of 60+ is more likely to use smartphone due to family encouragement (Pee et al. 2014). Pang et al. (2014) did however report in their study, where they gave elderly living alone in Singapore an iPhone, that the respondents found the smartphones useful and entertaining to the extent that some expressed they were not willing to have the iPhone taken away from them.

A Swedish study by Ranad and Hagaberg (2015) finds that the elderly are reluctant to buy new things in general not only new technology. This applies even to the former "early adopters". *"Even Kjell, the youngest (72 years old), who, when we interviewed him six years ago was proud to be, and always had been, an early adopter of new technical objects, concluded that he had become less and less interested in acquiring new things, but of course, he said, he replaced broken objects if they were vital for him or his wife."* Even he himself was surprised about this and stated to the researchers *"The desire for new things is gone, I'm not the same freak any longer. When you become older the desire is weaker in a way..."*.

2.2.3 Refusal of new technology and lack of knowledge

Thinking they are too old to learn new technology is one concern (Mohadis and Ali, 2014). Leung et al (2012) have done a thorough study on how older adults learn to use mobile devices. They found that those of age 65+ preferred the user manual or device help while younger tend to prefer "Trial & Error" or "Internet". Older respondents also preferred task steps instead of general understanding. The producers focus on quality of technical manuals have decrease over the year as turnover in products has increased and main customer groups focusing on "Trial & Errors" and Internet, instead of traditional user manuals. There has been an increasingly use of automatic translation programs and the readability of user manuals has significantly decreased over the years.

Ishihara et al.'s study "How Unfamiliar Words in Smartphone Manuals Affect Senior Citizens" shows that seniors often have lower familiarity with computer terminology and that comprehension was highly correlated with their familiarity with the specialized vocabulary (Ishihara, 2013). Experiencing problems reading and understanding user manuals for technical products, probably affect their willingness to learn new technology. Ishihara et al. also reports that it may be difficult to learn from younger due to the same reason, the lack of the terminology that is known and frequently used by younger people.

The amount of information available may also be overwhelming to the elderly. Compared to the younger generations they are less used to the overflow of information, and thus less prepared to sort out useful information. E.g. a search on "Senior citizen apps" at Google Play (23.10.2015) listed 256 applications, "senior launcher" listed 50 applications and to find and identify good and relevant applications among so many may seem impossible. This may be one of many reasons to why even those with a smartphone only uses few applications and features.

2.2.4 User problems due to age

Another aspect of the refusal of new technology is the how easy the technology is to use. In Table 2 we see that impairment is a major reason found in Mohadis and Ali's study (2015). For feature phone users it is a major reason for not switching to a smartphone, and for those having a smartphone it is a reason for not using functions that are more advanced.

Kobayashi et al (2011) concluded that mobile touchscreens were generally easy to use for the elderly and a week's experience generally improved their proficiency. They found that even the participants who had never used touchscreens, performed the gesture-based operations reasonably well. The exception was for tapping on small targets. Based on the problem with tapping on small targets, they also found that the elderly implemented an error correction strategy that was unfortunate and lead to confusion, e.g. increasing the length of the tap, thus interpreted as a "hold", or increasing the pressure as well as the hold, turning the tap into a moving gesture. The normal smartphone keyboard usually consists of small buttons, and is one of the most frequent features used by the elderly, since they frequently send messages (SMS).

Motti et al. (2014) studied the drag and drop performance, and found that this was age dependent, see Figure 5. They also found that performance was better using a pen as interaction instead of the finger especially for 80 plus.

2.3 Smartphones in the market, designed for seniors

There are special smartphones designed for the elderly, from e.g. Doro⁶, Jitterbug⁷ and Emporia⁸. These special phones are based on adapted versions of the Android OS, which do not have all the functionality as in the standard Android OS, and often the technical specifications for the hardware are not as good as in standard phones. LG has also announced a smartphone similar to the foldable feature phones⁹. Special designed phones are often not well accepted by the elderly (Culen and Bratteteig, 2013), because it is a sign of lost abilities. Also, these phones usually have less technology for money, e.g. low performing cameras. In addition to the special phones, there are many launchers for elderly that intend to make the interface easier.

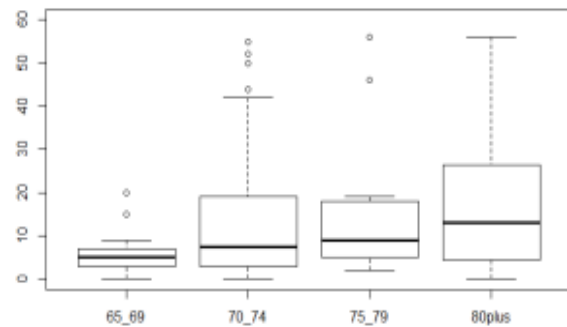


Figure 5 Drag and drop retries before succeeding for different age groups (Motti et al., 2014)

3 The EziSmart solution in test

The EziSmart solution consists of the Ezi-Pad that is a casing with a keyboard and a frame for the phone, as well as an application (app). There is also a crib for charging the Ezi-Pad and the phone simultaneously. All these elements are shown in Figure 6. The user may choose to use only the Ezi-Pad or only the application or both together.

3.1 About the Ezi-Pad

Keystrokes and information from the Ezi-Pad are sent to the phone using a Bluetooth link (Bluetooth Smart/Bluetooth Low Energy). At the top of the front cover, a window allows the user to see who is calling when the cover is closed. Below the window is a SOS button, normally covered by a lid (Figure 6 shows the lid closed, Figure 7 open). The SOS button will initiate the Ezi-SOS functionality in the application and is further described in section 3.2. At the bottom of the front cover there is a row of buttons with the following functionality (from left to right):

- 1) Answer the phone
- 2) Start the recording app
- 3) Turn on the flash as a torch
- 4) Hang up



Figure 6 EziSmart Launcher user interface (upper left), Ezi-Pad with phone in charger crib (lower left) and Ezi-Pad with phone ready to use.

⁶ <http://www.doro.co.uk/mobile-devices/smart-phones/doro-liberto-820.html>

⁷ <http://www.greatcall.com/products/jitterbug-touch-details>

⁸ <http://www.emporia.at/produkte/uebersicht/emporiasmart>

⁹ <http://www.lg.com/no/mobiltelefoner/lg-Easy-Smart-H410>

The three LEDs below the buttons show the Bluetooth connection with the phone, the battery status of the Ezi-Pad as well as the charging status. On the inside, the phone fits into a casing which will be the part that changes for the individually phone model. The keyboard part of the assembly is standard and will be similar for each selected phone model.

The Ezi-Pad Keyboard has large concave buttons. Activating pressure can be applied on one of four sides. The buttons are designed to stabilise the finger if the hand is trembling. In addition to letters and numbers, there are editing and navigation buttons and dedicated function buttons. Figure 7 shows the details of the front cover and keyboard.



Figure 7 Front cover and keyboard of Ezi-Pad

3.2 EziSmart Application

The EziSmart Application package consist of different functionalities

- 1) EziLaunch: The start/home screen, where contacts and most frequent applications are displayed. The EziLaunch interface shown in Figure 6, and is an all-in-one user interface. Calls can be done by one touch on the image. Messages or e-mails can be sent by two touches.
- 2) EziPage: A page for less frequent used applications, accessible from the EziLaunch interface.
- 3) EziGPS: Allows regularly and automatic sending of GPS position to pre-programmed contacts, as well as allowing the same contacts to request the position at any time.
- 4) EziSendGPS: Allow the user to send a SMS with the GPS position to any telephone number.
- 5) Ezi-SOS: Generates and sends a SOS message or places a call, to one or more pre-programmed contacts. The SOS alarm can be activated with the screen button in EziLaunch or the SOS button on the front cover of the Ezi-Pad.
- 6) Ezi-ICE: Interface for storing information about next of kin, doctors, health and medications.
- 7) EziAutoAns: Allow automatic answering of calls from preselected contacts.
- 8) EziSwitch: Switch to another launcher installed on the phone.

3.3 Legal and Research approval

For persons acquiring the applications and key pad on it's own initiative there are no privacy issues that are regulated, since no data is sent from the phone without the user actively asking or allowing it. In the research project some information related to health is recorded and for the research project, SINTEF had applied for and received approval (due to the personal data to be collected) from NSD - Norwegian Centre for Research Data to conduct this study. The NSD that is Data Protection Official for Research for SINTEF advised the study to be done in accordance with the standard prescribed protocol and data storage restrictions. A data processing agreement was signed between SINTEF and EziCareTech AS, also allowing EziCare Tech to collect the personal data under the SINTEF NSD notification.

3.4 Smartphone models

In the user test two smartphone models from Samsung was used; S6 and A3.

3.5 User manuals

Three user manuals were developed for the testing: "Phone basics with EziSmart", "Using EziSmart Application" and "Using Ezi-Pad". The manuals had an extensive use of illustrations (screen dumps) and step by step descriptions, as was recommended by Leung et al. (2012). Emphasize was put on avoiding unfamiliar technological terms as recommended by Ishihara et al. (2013).

3.6 Delays and technical issues

According to the first planned test protocol, the Ezi-Pads should arrive in November 2015. Due to necessary changes in the design and delays at the manufacturers, the first version was not available for the user test until June 2016. This gave little time for testing before handing the equipment to the user. Several of the pads for S6 phones turned out to have problems with charging, after some weeks one pad was not able to charge at all. New versions of the Ezi-Pad was given to the users with S6 phones approximately one month into the test. It turned out that for these new Samsung S6 pads the manufacture had used a battery with less capacity than specified. To make the situations worse, the batteries did not fulfil their specification. Thus, these S6 Ezi-Pads had to be recharged more often than the Samsung S6 phones, which was an extra inconvenience. In addition, the LED that should indicated low battery of the pad did not work according to specification so no warning about low battery was given.

The Ezi-Pads for the A3 phone was a 3D printed version and not injection moulded. Printed versions are less durable than the injection moulded, and one of the users had to mend the Ezi-Pad after dropping the pad.

4 Research method

4.1 Test plan

The test plan for the user test was developed to ensure that the users got all the necessary information they needed for giving their informed consent for participating before test start, and for collecting their information and their experiences on a regular basis during the test. It was also essential to motivate the users to explore and use some of the possibilities of the smartphone. The test plan is given in Table 3.

The users were informed about the project in an initial information meeting. In this meeting they also received the informed consent document, which they returned signed later. Some of the participants in the information meeting chose not to continue in the user test, but no structured work was done to understand why they did not want to continue. However, several explained that they did not see the need for a smartphone.

In the start-up meeting, the user test participants got the phones with Ezi-Pad, as well as user manuals on smartphone basics (e.g. gestures to use, contact list, camera.), on Ezi-Pad and on EziSmart application. As this was a research project, we encourage them to keep a twin (second) SIM in their old phone as back up, but to keep their old phone turned off. The reason for encouraging using a twin SIM, which generally will make the transition harder and longer, was to avoid situations where they needed the phone, but was not able to use it. In the start-up meeting, they also got tasks to perform and report on every day for the next ten days. The tasks were simple, for instance to send a SMS or to call the project manager to tell the progress, to look at the weather forecast, take a photo and send an MMS and to open Google Maps to find the current location. The purpose was to force and motivate use of the phone. After the start-up meeting, the project manager was available for questions through the WhatsApp application on the phone and through personal visits.

Table 3 Test plan for user test

What	When	Short description
Information meeting	1 to 2 weeks before test start	Gave information about the project to make an informed assessment if the attendants wanted to participate. Handed out a consent statement for the willing participants to read, approve and sign.
Start-up interview	Before test	The focus was on their current use of the today and for what they would like to use the smartphone.
Start-up meeting	Test start	Giving out the phones and Ezi-Pad and show the users how the system work.
Simple tasks to report on	First 10 days of test	
Informal meeting on status of testing	After 1-2 week	Open for questions and give assistance.
Mid group interview / conversation	After one month use	Focus on how they use the system and their experiences.
Final interview	After two months use	Focus on experiences with EziSmart. In addition discussion on their thoughts about future use of a smartphone in general and the EziSmart system in particular.

4.2 Individual interviews

The start-up and final interviews were performed one to one by a SINTEF researcher to allow the users to speak freely about their experiences. The interview was semi-structured with some predefined questions asked to everyone. The users were encourage to speak freely about all their experience and got follow up questions from the researcher outside the protocol. The feedback from all users in these interviews was perceived open and truthful by the researcher, and all participants gave both positive and negative feedback

4.3 Recruitment of users

The recruitment of user test participants has been through two different channels.

4.3.1 Through a municipality nurse

The project manager got response from a nurse working in a municipality after coverage of the project in media¹⁰. She was eager to recruit some of the elderly in her municipality to participate in the testing. Due to the delays and issues described in 3.6 several of the persons she had recruited was no longer interested when the user test should start. Few additional elderly were recruited, but they got limited information before the information meeting. In the first information meeting four elderly women participated, two of them aged around 90 withdrew just after the meeting because they judged the project not suitable for them due to too much technology. Another woman aged around 70 withdrew because of recent illness in the family putting a heavy burden on her. The last woman, aged 86 was eager to continue and even recruited a friend, another woman aged 82.

4.3.2 Through family and friend network

Due to the delay and uncertainty of the start date, it was difficult to go out publicly to recruit users. Attempts were made to recruit from an IT related voluntary senior organisation at the national level as well as local

¹⁰ <http://gemini.no/2015/10/smart-telefonhjelper/>

branches. These attempts were unsuccessful within the timeframe of the project. Thus, the network of friends and friends of friends of the project manager was used. This link to the project might give the users a positive bias, and the method for interview was chosen to minimize the impact of this.

4.4 Overview users

Table 4 gives an overview of the study participants and their experience.

For a subset of this group, the SINTEF researcher performed only the final interview. This subset is given as group 2B in the table. Questions that for the others were included in the start-up interview was then asked in the final interview. This group gave their feedback during the test to the project manager.

Table 4 Overview of participants in the user test

Participant ID	Recruit. Group (see 4.3)	Gender (Female / Male)	Age	Relevant health information	Phone type	Former experience with smartphone	Completed the two month test period
A	1	F	86	None	S6	No	No
B	1	F	82	None	S6	No	No
C	2A	F	70	None	S6	No	Yes
D	2A	M	64	Severe trembling	S6	Yes	No
E	2A	M	70	Slight trembling	S6	Yes	Yes
F	2A	M	64	None	S6	No	Yes
G	2B	M	66	Severe trembling	A3	No	Yes
H	2B	F	70	Severe vision impairment	A3	Yes	Yes
I	2B	M	67	Severe trembling	A3	No	No

4.5 Limitations

The number of participants is limited. Some participants have no age or health related problems while others have a clear reduction in function. The test will give no definitive answers only indications that have been compared with other findings reported in litterateur.

5 Experiences from the group completing two months testing

Five out of nine recruited users completed the two-month test period. Two of the five had former experience with smartphones. They had both experienced some problems handling the smartphones related to health issues; severe vision impairment and slight trembling. All of the five users were familiar with computers, and some of them with tablets (iPads). None of the participant had been early adopters of any technology, but they were not and had never been afraid of technology. They have and will adopt technology when they see the use of it".

The three users that did not have a smartphone before the test said the reason for not buying a smartphone was that they did not really need it, as they only used the phone for calling and sending SMS. They did however answer "it sounds fun" when asked why they wanted to participate. In addition, smartphones are used by "everyone"; they said they did see the value of using apps like Google Maps, weather forecast, a good camera, and other functionality - even though they did not need it.

All the participants started to use several applications during the first period of the test. Generally, they did not have any problems handling the smartphone or the Ezi-Pad and applications.

5.1 General impression Ezi-Pad

Most of the participants were very satisfied with the Ezi-Pad. Writing was much easier using Ezi-Pad.

The youngest participant (64) did despite the advantages of Ezi-Pad feel that the size was a big disadvantage and he would probably not continue to use the Ezi-Pad after the test. He was however positive to use Ezi-Pad in the future if aging and impairment would constrain his use of the smartphone.

One of the participants had used a smartphone for several years before the test started, but had experienced problems with the regular smartphone due to slight trembling. He started the final interview by reporting that he was pleased with the solution, because he had not been locked out from the banking application after he started using the Ezi-Pad. With the standard smartphone, he was easily locked out because he often hit the wrong keys when typing the password using the screen keyboard. This user reported that he now used the phone more than before, because the Ezi-Pad gave him better control.

All the users used the touch screen keyboard and navigation for some tasks and the Ezi-Pad keyboard for others. For writing text and numbers, they all, except the youngest participant, preferred the Ezi-Pad.

Some users emphasized the opportunity to answer calls from the buttons on the front cover as a very nice feature. None of the participant thought that the Ezi-Pad made learning of using a smartphone easier, but it made writing easier, and hence the smartphone more useful. The participants had some minor suggestions about changes in the layout of the Ezi-Pad.

The participants were asked about whether they felt that using an aid like Ezi-Pad was stigmatizing and made them feel old. None of the participants did bother about that, but some informed that they had comments from family and/or friends, and that they could see that being a potential issue for others. Since none of the participants were early adopters, and being skilled in technology was not an important part of their self-image, it was probably easier to accept an aid like this.

5.2 Size of the Ezi-Pad

The major negative experience several participants mentioned was the size of the Ezi-Pad, both the size of the phone itself, but especially of the phone with the Ezi-Pad. Some mainly used the system indoors, bringing their old phone outside because the Ezi-Pad did not fit in their pocket. This was especially mentioned as a problem when doing physical work like carpentry, wood cutting etc.

5.3 Ezi-Pad applications

Everyone found the use of the EziLaunch intuitive and simple. They stated that it probably made the transition to a smartphone easier. They liked that there could be images in addition to names for contacts, and that they did not need to use several steps to call or send a message. To call the most frequent contacts only one tap on the contact image is needed. Three pages with contacts are available (indicated with 1/3, in the black bar in Figure 8). To simplify even more the EziLaucher page format can be pre-selected to have 4 images and 3 standard

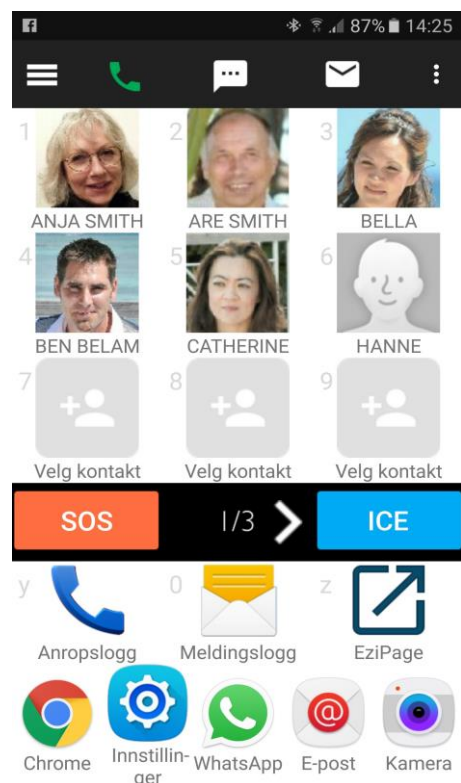


Figure 8 EziLaunch

applications. In this test, everyone preferred the 9-image option. A message or an e-mail can be sent by first choosing the required function using the icons at the top black bar of the Launcher, see Figure 8, followed by tapping the image. In the start of the testing, there were some problems with unintentional calls, mostly because several of the users put their fingers on the screen when holding the phone. This problem did seem to decrease when the users got used to the phone.

Several of the users, on their own initiative, used the Ezi-ICE application that allows storing of next of kin contact information as well as information about health and medication. Particularly they found it useful to store information about / photos of medications they used. The participants were asked about whether they had any hesitation with storing sensitive information about their health on the phone, but they did not feel that information about medication was sensitive. For this reason, they also chose to use the function without any password protection that is possible with the application.

The study participants also liked the functionality in the EziSendGPS, EziGPS and Ezi-SOS applications. These functions give different ways to share the users GPS position, see section 3.2 for descriptions. Even though none of the participants had used these applications other than when testing them out, knowing that they had this functionality available made them and their next of kin feel safer. Especially the users that liked to go for walks in the woods, often alone, felt that this functionality provided safety and thereby freedom. There was one incident with EziSOS function unintentionally initiated from the EziPad front button, even though the button was covered by the lid. This may have happened due to pressure on the lid, or that the EziPad was bent, e.g. having the phone in the back pocket when seated.

The EziPage is a page with additional applications. None of the users needed more applications in this testing, but advanced users may benefit from the possibility to have more pages in the EziPage function.

5.4 Other applications

The users started to use a range of applications. Especially the possibility to take, look at and share good quality images was highly rated by all participants. WhatsApp was installed on every phone, and was frequently used by several of the study participants to ask questions and share information. Other applications used by participants were the weather forecast application Yr, the game Wordfeud, applications to control radios/sound systems at home, newspapers, applications for general payment (Vipps and mCash), and specific payment of tickets and parking fees, apps for remote video cameras, e-mail programs, calculators, calendar and browser for internet.

5.5 EziSmart system and vision impairment

One of the participants had severe vision impairment. She was often using the Ezi-Pad application together with a speech generation application, but also without when in public places. She found the system very helpful. She had used a smartphone before she started to use the Ezi-Pad, and was able to write fairly well because she knew the layout of the keyboard on the screen. Using the pad was however much easier. She had also great use of the navigation keys on the Ezi-Pad: *"Every time I need to correct something in a text, and can use the navigation keys, I sit and smile. It makes it so easy to control moving around in the text"*. In addition, the EziLaunch application with one tap to call and two taps to text, made the phone easier to use.

5.6 Experiences from users that ended the testing

Four users withdraw from the test before the two months testing was finished, three of them within less than a week. Two of these were the oldest participants recruited; none of them had any former experience with computers or tablets. Especially the oldest of these users was very eager to start to use a smartphone. She was not any longer able to write text messages on her old feature phone because the keys were too small and it was difficult to write with the nine key layout of these phones. Both participants handled the touch screen

of the smartphone as well as the Ezi-Pad, very well in the first training session, but the willingness, motivation and patience to try things out and practise themselves was judged to be lower for these two women than for the other participants. They got a second training session some days after the first, and it was then obvious that they would need a very close follow up to continue. They also found the size of the phone troublesome, and did not feel that the benefits of the Ezi-Pad outweighed the disadvantage of the size.

One of the participants had a comment from her son that he did not think this system was suitable for her, and the impression was that this demotivated her further. Thus after the second training session it was an agreement between the project and these participants that the participation in such a project maybe was not right for them. When talking with the users a month later, one of them had bought herself a smartphone, but had not started to use it. She gave as the reason that nobody had the time to show her how to use it. The other had decided smartphones was not for her.

The two other participants ending the testing were younger, but both had advanced stages of Parkinson. They had both a technical career, had been very technically skilled and had used smartphone before the testing started. One left the test after a week. As described in section 3.6 there were some technical problems and this was the reason this user to end the testing. He said it might be interesting to try it out when it was a product to buy in the store. The last participant left after approx. 1 month of testing. He was familiar with using an iPhone, and it was difficult to switch to an Android phone. In the project, we have discussed why the two most technically skilled persons left the user group. One hypotheses is that if part of your identity is related to being a technically skilled person, and due to age and physical condition it is now harder to handle new technology than it used to be, this might be difficult to admit to oneself. Then it is easier to say this is nice, but not for me instead of admitting that learning new things and handling new technology is now much harder than it used to be due to age and illness. Participating in a project where you are expected to report on the progress did put extra pressure on these persons.

5.7 Seniors starting to use a smartphone

We experienced that all participants learned using the gestures for navigation, like tapping, swiping and zooming, very fast. All managed this very well after the first training session. This is in accordance with the findings of Kobayashi et al (2011). The feedback on the manual on the ease of use and information was good, but still several reported that start using a smartphone would have been harder, and maybe impossible, if they did not have anyone available for answering questions and helping out when in trouble. What gave the participants most trouble was all the available settings and that they sometimes changed a setting unintentionally. Leung et al (2012) found that the 65+ age group is less willing to use trial and error or to search for help on the internet, which is the strategies of most young users use if they unintentionally have changed something. The trial and error strategy is also often needed after updates of apps and internet pages. Frequently an updated also include a change of design, and therefor may appear unfamiliar after an update.

5.8 Summary of experience

The table below summarize the experience of the participants that completed the testing

Table 5 Overview of experience from participants completing the two-month test period

Participant ID	Gender / Age	Relevant health information	Summarized experience
C	F / 70	None	First time smartphone user, very happy with the solution and says she will continue to use both the Ezi-Pad and applications.
E	M / 70	Slight trembling	Experienced smartphone user. Finds the keyboard very helpful for writing text messages, passwords etc. However, he thinks that the Ezi-Pad makes the phone too big to bring in several situations. He uses a twin-SIM and will probably continue to use two phones. He will probably use the EziSmart application on both phones.
F	M / 64	None	First time smartphone user. For him the size is a considerable disadvantage, and since he has no problem using the touch keyboard the advantage of the Ezi-Pad is small. He will not continue to use the Ezi-Pad, and will test out the standard Samsung Launcher before he decides about the applications. He is however sure that sometime in the years to come, when vision and motoric skills decreases with age, he will again consider the solution.
G	M / 66	Severe trembling	First time smartphone user. He found it easy to use the smartphone, and uses several standard applications, e.g. he likes to take and look at camera images. The Ezi-Pad makes it easy to write on the phone. The size of the Ezi-Pad is however a drawback, especially when he is outside. He had problems with the durability of the 3D printed prototype Ezi-Pad, but mended it by himself to be able to continue using it. He says that he will continue to use the system.
H	F / 70	Severe vision impairment	Have used a smartphone for approx. one year. She often uses the EziSmart system together with a speech generator application, but also uses it without this application in public space. She thinks the EziSmart system with the application and the Ezi-Pad has some great advantages for her. She will continue to use both the Ezi-Pad and the EziSmart applications.

6 Conclusions

The user tests conducted in this project shows that a keyboard integrated in a casing will make a standard smartphone easier to use for several groups of seniors. Using a smartphone through gestures is intuitive also for seniors, but small screen touch buttons are challenging. This is not only the case when writing text in messages and mail, but also using other applications where text entries are needed, e.g. input of passwords, directory etc. The results of our tests implies that a combination of physical keyboard and touch screen usage is a good approach.

In addition, the simplified user interface allowing one-touch calls are appreciated by the seniors in this test. Functions that allow the user to easily share their GPS location, or allows the next of kin to request it, are valued for the extra safety and security provided. These capabilities are especially appreciated by active seniors who enjoy walking in nature where they often are alone. They feel that this will allow them to continue with the outdoors type of activities longer. The smartphone can also be a good tool for keeping track of information, for instance about prescriptions and general health information, as in the ICE application included in the EziSmart package.

Taking, viewing and sharing high quality photos with family and friends are highly valued by all the participants. Other applications frequently used are weather forecast, news and specific controls (remote camera, sound systems), internet browser, maps and more. The former non-smartphone users went from no apps usage to frequent daily engagement. This indicates that a smartphone can contribute to the daily life of a senior.

Most seniors find that all the different possibilities with settings and applications, and unintentional changes of these, make the phone difficult to handle. These issues must be handled regardless of EziSmart or not, and will become more difficult to address with age and advancing illness. Therefore many seniors, especially those with a maladies like Parkinson's disease or dementia, will get to a point where the decrease in cognitive and / or motoric skills will make it too difficult to become or to continue to be an active user of a smartphone. The results from our testing indicates that the point where a smartphone no longer can be actively used is postponed by the use of the EziSmart system as compared to a standard smartphone. However, this presupposes that the person is familiar with a smartphone and the Ezi-Pad before getting too indisposed by age / illness.

It is clear that the senior (+65 upwards) group can be divided into many sub-groups. As a person ages, each have their special problems both physical and mental to contend with resulting in many sub-groupings. There is no homogeneity, which means that one size does not fit all. This is clearly shown within the group of test participants. In choosing the test group, a conscious choice was also made to have a varied group of users. From the test results, we draw the conclusion that the EziSmart is not suitable to cover all senior users but it is worth noting that the EziSmart's flexibility and agility does cover a wide range of user segments. This is clearly demonstrated by the senior participants ranging from Parkinson sufferers to severely blind.

A system, like the EziSmart, can be helpful for several groups of seniors wanting to use a smartphone. The testing indicates that the following groups will especially benefit:

- Smartphone users who develop motoric impairment, minor or pronounced due to age or illness
- Users with vision impairment, with or without prior acquaintance of smartphones
- All persons excluded from the use of smartphones due to motoric impairment
- Younger seniors not acquainted with smartphones but motivated to start using one even though a little daunted by the technology.

Older seniors may wish or need to become smartphone users for various reasons. This might for instance be if a smartphone is needed related to home care technology (profilation of health care apps). Generally, older seniors new to smartphones will need assistance and close follow up from family / friend / carers. For such users the EziSmart suite can be beneficial to make the close follow up in the initial usage "acquaintance" stage easier.

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