Elderly and Tablets: Considerations and Suggestions About the Design of Proper Applications

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Abstract. In this paper, the authors support the idea that tablet is the ideal tool to assist and enhance the elderly living by providing them with value-added services. Currently the risk is that a poor design interface may exclude this substantial part of the population from using useful technologies because of their specific age category requirements. So, after an analysis of the related academic literature and an assessment both of elderly needs and tablet limits and potential, the authors select a set of considerations and suggestions for the design of tablet applications for elderly, in order to facilitate the interaction.

Keywords: Elderly · Tablet · Interaction design · Design considerations and suggestions

1 Introduction

Nowadays, the adoption and the usage of technologies are increased. Specifically, due to the size decreasing and computational power increasing of devices, technologies permeate people lives and enhance their abilities regardless of their level of technology confidence. At the same time, the economical affordability of the large part of devices has enlarged the ICT customers base. As a consequence, a large set of services is made available through these devices. However, a large share of the population is still on the fringes of this trend: the elderly. Several surveys, including one conducted by the United Nations [1], show that the world's population tends to aging. In addition, a study of the European Union [2], back in 2012, states that in 2030 30 % of the European population, a percentage that corresponds to more than 150 million people, will be over 65 years old.

Technologies can really assist and enhance the old people living by providing them with value-added services, but a poor design interface may impede it. Indeed, ignoring the requirements for this specific category of users usually regarded as fragile and in need of support may intensify the risk of excluding a substantial part of the population.

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So, the challenge is to make this part of population able to fully and consciously use technologies for their own needs by designing apps and devices with the goal of creating systems that facilitate the interaction.

First of all, designing an interactive service for the elderly involves a choice on the device on which the service is delivered. The authors agree with the idea shared by the academic literature that tablet can be a particularly suitable device for get elderly close to the "digital services" and provide them with applications tailored on their age category requirements. This consideration further arises from a reflection about the comparison between two studies. In detail, altough the Audiweb statistics report that 25 % of 40 millions of Italian Internet users (age range: 11–74 years old) access through tablet, a study conducted by the authors of this paper on elderly healthcare shows more positive results. In effect, on a sample of 192 respondents with an average age of 71 years, 32 % access to the Internet through tablet. In consideration of this, it can be affirmed that elderly have a predisposition towards the use of the tablet.

Obviously, although tablet is not the panacea, the problems generally occurring in the interaction between the elderly and other type of devices decrease by using tablet. However, a proper design in user interfaces is needed, in order to assure high service usage. So, in this paper the authors aim to select a set of considerations and suggestions to design tablet applications for elderly.

In detail, in the following section, the authors investigate the proper design features for elderly-oriented tablet applications that emerged by the analysis of the related academic literature, while Sect. 3 focuses on elderly needs and tablet main strengths. Thus, in Sect. 4, the authors identify a selection of design considerations and suggestions in order to create applications actually usable by the elderly.

2 Overview on Elderly-Oriented Design in the Academic Literature

The evident difficulties of elderly in using general digital interfaces led user interface designers to find more inclusive solutions. One of the first challenges in the interface design for elderly is to engage old users who infrequently use technologies. Old people view themselves as being "too old" to use certain technologies. In detail, they believe technology offers no benefits or it is too difficult to learn, avoiding it as a consequence [3]. This attitude by the elderly population depends on the *level of technology understanding* that can directly and proportionally affect the *level of confidence* in the face of technology [4, 5]. In addition, old people may be reluctant to adopt technologies that do not meet their needs [6]. So, in order to promote the use of the device as a support rather than as a constraint, it is fundamental for designers to understand the common difficulties that elderly face when using new computing devices (e.g.: tablets), following a proper design method from the very beginning of the design process.

The academic literature has largely investigated the elderly user problems and needs in order to identify the most suitable kind of support that technology may offer. Williams et al. [4] identify several categories of impairments (cognition, auditory, haptic, visual, and motor-based troubles) that ideal and complete human-computer interface solutions for the elderly should take into account. Several studies focus on

touch screen as the best interaction method for the elderly, considering pen or fingers interaction, one or two hands, single or multi-touch gestures. Still, according to Williams et al. [4], touch screen proves to be a more useful interaction method than keyboard and mouse in computer interaction (e.g.: because of possible problems caused by arthritis and swollen fingers). Favilla et al. [7] identify touch screen technologies as suited to be used by users affected by memory, cognitive, behavior and emotion diseases, since they are more portable technologies and easier to use than a computer. In addition, touch screen technologies have been continuously improved in touch resolution, multitouch interaction, luminance and high resolution screens, resistive and capacitive technologies, and gestures recognition, more and more meeting elderly requirements [8].

Some authors take into account the use of the tablet to overcome elderly impairments and support them in their activities. In detail, the use of a capacitive touch screen tablet is recommended as it causes less apprehension by avoiding the interaction with intermediary devices, such as pen [8]. So, the capacitive touch screen tablet can be considered a direct input device to interact with, since it only needs a direct contact on the display screen. According to Vasconcelos et al. [6], the tablet is better suited for novice users or those that do not want to memorize commands, as it demands less training and it is easier to use, since it requires little hand-eye coordination and minimal spatial (cognitive) demands. So, it is a suitable device for older people.

In other studies, some of the tablet features are considered in comparison with similar devices, such as smartphone. As the latter, the tablet is a mobile device. This allows old people to use it in a comfortable place and position, especially meeting the needs of users with physical impairments or who are bedridden [6]. But older users encounter great difficulties in using smartphone [9], e.g. because of the small size of buttons and display [5], while the tablet offers a larger display than a smartphone and the possibility to have labeled icons and larger fonts. However, the previous use of a smartphone make easier for the elder the use of the tablet, since she/he is already confident with settings that are similar [4].

The tablet could present even constraints. For example, Favilla et al. [7] report the difficulty encountered by elderly in making capacitive contact with the touch screen surfaces. Moreover, capacitive touch screen tablet does not offer any haptic response for users [4], while a traditional resistive panel is based on a logic of interaction closer to the interaction modes used in the physical world (e.g.: to push a switch button, or to lean a finger against a surface). Therefore, old people could be more used to exert pressure, rather than to swipe the fingertip, and even the difference can be hard to be understood by older adults, especially those affected from dementia [10]. Due also to elderly poor physical coordination [5] and slowed ability to combine motor and cognitive skills, multi-touch interaction, typical of capacitive touch screen, is not recommended for the elderly people (e.g.: rotate and zoom actions get diffculties for them) [11]. At the same time, resistive touch screen requires to exert and sustain a certain pressure that could represent a problem for older users [8]. Device inclination is another important element to consider, because of the glare on glossy screens. Since their dimension and weight, tablets are poor handling, so they may require the support of a table or a stand [10]. Regarding audio feedback, the sounds from the application or the device could be another hindrance for old people, startling or confusing them, or being

unheard due to hearing loss [10], even if usually it is possible to adjust the levels of the sounds produced. Finally, one of the major risks with touch screen device is to accidentally give an input to the system in use. The risk may be higher for older people.

Otherwise, for a great part of the problems reported, a proper design methodology can offer an easy way out and create consistency. In this regard, tablet offers the possibility to give elderly applications with rich design interfaces. It is a very important feature, since a poor interface design may prevent elderly from using it. Several works proposed suggestions for designing mobile devices for older people, focusing on motivational and usability issues [6, 9, 12]. In addition, a participatory design involving the users in the ideation process represents an essential approach to create more useful and relevant services [13, 14].

In evaluating the suitability of the tablet for elderly, not only the technology, but also the social context they are used to has to be considered. Although mobile devices are generally designed for personal use, they can be usefully used in group activities, too (e.g. in collaborative music and game activities), to successfully engage the target audience [15].

In concluding, elderly could benefit from tablet (and technology in general) in order to be supported in a great number of application fields and everyday activities, achieving a more independent living [5, 15–17].

3 Framework

In this section, the authors intend to define the main characteristics about the subjects of this study: elders and tablets. The emerged elements will be useful in order to define the considerations and the suggestions for designing proper tablet applications for elderly in Sect. 4.

3.1 Users

United Nations define “older persons” as “people aged 60 years or over” [1] and predict that by 2050, the share of older people as portion of world population will reach 21,1 %. Among them, the share of persons aged 80 years old or over will reach 19 %. In this section the authors focus on the peculiarities and habits of this age group, considering its prevalent impairments, since they can affect the user interfaces of tablet applications.

Older people are a highly heterogeneous group regarding interests, preferences, skills, experiences and abilities, but they have in common the emergence of impairments affecting both physical and mental activities [4, 6, 7, 18].

The main impairments in physical activities concern *movements* (e.g.: difficulties in moving and controlling arms, hands, and legs; low coordination and flexibility; difficulties in maintaining movements; loss of tactile sensitivity; motor tremors), *vision* (e.g.: partial or poor vision; amplitude reduction of visual field; difficulties in visual perception of colours, contrasts, brightness, dark adaptations, etc.), and *hearing* (e.g.: reduced hearing, firstly of hear high-frequency sounds).

The main cognitive difficulties concern *memory* (i.e. working, spatial, and long-term memory), *attention* (e.g.: decrease of the selective attention and difficulties in managing information, causing confusion and disorientation), *response time* (to the stimuli), *executive functions* (e.g.: planning and executing tasks aimed at a purpose; problem solving; decision making), *motivation* (i.e. the older people need to be strongly motivated to do something), and *learning processes* (e.g.: difficulties in learning new information and in adapting himself/herself to new situations).

Physical and cognitive conditions not only affect the daily activities (e.g.: in mobility, shopping, personal care, etc.), but also the *emotional state* of older people, creating the needs of being encouraged and comforted, in order to do not let them give up their self-sufficiency.

Even the *relational* aspects of their lives are certainly compromised from being retired and having lost a more active social role. For these reasons, they need to build or strengthen their social networks, also as relief for loneliness and boredom.

However, elderly are usually considered wise, because of their gained experience and knowledge allowing them the identification of patterns and models: wisdom is here seen as the ability to improve problem solving and finding solutions.

The elements above discussed could be seen under different points of view: as needs (e.g.: social, security, and care need), as elements to be trained and improved (e.g.: the cognitive abilities can be kept constant with exercise, allowing continuous learning), and as elements to be considered in designing architecture, communication, and content aspects of interactive systems (e.g.: difficulties in color perception affect the use of colours in a mobile application user interface).

Older people are considered as "digital immigrant" [19], having a generalized difficulty in using new technologies and interactive systems. Indeed, in respect of "digital native", older people need to understand how an artefact works, before using it.

3.2 Tablets

Due to its own intrinsic features, the tablet is considered by the authors of this paper as the device better suited to enable the inclusion in the digital world of those categories of users who have little or no familiarity with technologies, such as the elderly.

In this section, the authors try to give evidence of what these features are, focusing on characteristics, potentialities, and limits of the technological devices usually known as "tablets".

First of all, a clarification on the terminology is needed. A tablet PC is commonly a laptop that allows a direct interface with its screen through fingers (or a pen). In other words, it is a Personal Computer with additional input modes than mouse and keyboard.

This definition lead to a form-based classification, which consists of at least three categories:

1. *Slates* are devoid of a physical keyboard, so for data entry a software keyboard or other forms of insertion (such as speech recognition) are required. Since 2010, when the Apple iPad was first marketed, the term "tablet" is commonly associated with

these devices, although improperly. Within this category, another distinction concerns the screen size: mini tablets are devices with a smaller screen (usually about 7 inches), while standard slates screen size is 9–10 inches. Mini tablets are the result of a hybridization process with smartphones. The same process has led more recently to the creation of the so-called Phablets (phone plus tablets), i.e. (mini) tablets that integrate telephone features.
2. *Convertibles* are real laptops with one main difference: thanks to a special swivel joint, their screen can be rotated and folded over the keyboard, so that it disappears. The keyboard, usually "hidden", can be extracted at any time, in order to make the data entry easier or to enable the interaction with applications not designed for touch screens. Due to its flexibility of use, convertible was the most popular type of tablet, until the advent of the iPad and similar devices.
3. *Hybrids* have a keyboard that can be attached or detached depending on the needs. This category had not a wide diffusion, since slates often have keyboards that can be connected via USB or Bluetooth.

The main differences among the categories of tablet are summarized in the Table 1.

Acknowledged this differentiation, hereafter with the word "tablets" the authors refer to the slate tablets.

The exclusive use at most of fingers or of a pen characterizes the tablet users' interfacing mode.

Unlike convertibles, tablets need to run an operating system specifically designed, in order to maximize the performance of the interaction. This makes tablets much more similar to smartphones in functioning and interaction mode. Moreover they run a similar operating system, usually based on iOS or Android, sometimes in customized versions.

In a second time, Microsoft has introduced a substantial innovation with the release of its Windows 8, an operating system designed to run both on traditional PCs and all types of tablets.

Despite the differencies in operating system or manufacturer, tablets share many features that make them recognizable:

1. High-definition display with a diagonal between 7 and 10 inches;
2. Wi-Fi or 3G/4G modules for Internet connection;
3. Applications (apps) supporting the performance of different activities (reading, writing, games, social networking, video conferencing, chat, music, eBooks), available (free or for a fee) on the related store;

Table 1. Comparison of the different tablet categories

	Categories of tablet PCs				
	Slates			Convertibles	Hybrids
	Tablets	Mini Tablets	Phablets		
Screen size	9″–13″	7″–8″	5″–7″	10″–13″	7″–9”
Keyboard	Via USB or BT	Via USB or BT	Via USB or BT	Built in	Detachable
Other			Phone		

4. GPS module for navigation and geo-referenced services;
5. Camera (usually less performing than smartphones ones);
6. Multi-touch screen that supports gestures;
7. Weight of about a kilogram or slightly less;
8. Variable battery life, still quantifiable in several hours (up to 12) of continuous use.

In order to understand why tablets could be the best device to encourage an audience of elderly to use apps, the authors compare tablet with other devices able to run similar applications: desktop PCs (or laptops), Smart TVs, smartphones.

In detail, tablets belong to the same family of smartphones, namely the mobile devices. Unlike Smart TVs and desktop PCs, the context of use of mobile devices is very variable, with environment and light conditions not always optimal. However, tablets are still seen by most people as small computers rather than large phones. As a consequence they are used to a great extent in domestic contexts. The possibility of being regarded as *technological knick-knacks*, makes tablet preferred over smartphones by elderly users. Indeed, smartphone devices are seen as *cold* and complicate, easily to be lost and forgotten because of their small size. Tablets, instead, have a larger screen that makes it easier to visualize information and to enjoy services, especially for an audience with significant vision problems, remaining transportable at the same time. The elderly can thus become inclined to the use of the tablet, even in a home environment.

Actually also Smart TV could be considered as the preferred device for accessing apps by elderly, since the latter makes large use of TV set. Moreover Smart TV offers a wide screen, a control device (remote control) and a context of use (at a distance of a couple of meters from the couch) familiar to the user. But Smart TV presents significant interaction constraints when passing from watching the broadcasted video contest to using apps, first of all due to the use of the remote control, familiar only for operations such as channel switch or volume change [20]. In addition, the big screen offers a non-optimal viewing distance for reading.

Focusing on the interaction mode, the touch screen interface typical of the tablet represent a strong point over the other devices. The user is able to directly manipulate the displayed objects of the interface, as it would happen in reality, by touching the screen and moving fingers according to pre-established gestures (e.g. swiping the finger on the display to change the page, as it occur on a paper book).

The interaction mode combined with the ease of use is the main strength of tablets compared to traditional desktop PCs or laptops, which require the user to input data via keyboard and mouse. In addition, because of their versatile nature, PCs run quite complex operating systems, which require a lot of experience to be controlled by users.

4 Considerations and Suggestions

On the basis of the elements emerged from the related research studies and the analysis of the framework (user needs and device features), the authors provide in this section some considerations and suggestions about the design of tablet applications for elderly. In detail, they identified 11 categories, providing different considerations for each of

them. Such considerations and suggestions can represent a useful reference for interaction designers during the design process for elderly-oriented tablet applications.

1. *Services/Applications* (the following is a not comprehensive list of possible application fields): gaming (e.g.: for learning, entertainment or training); information access; education; health care; working at home; community and social relations; safety; monitoring.
2. *Device:* use slate devices with a screen size greater than 9″; use a pillar in order to get users to arrange the tablet on a comfortable position to contain the glare glossy screen problem (the optimum angle is 30°); use added accessories (rubber cases with adjustable stands; screen protectors can help reduce glare).
3. *Text:* use a font size between 12 and 14 pt; use readable fonts, such as Sans Serif fonts (e.g.: Arial, Verdana); use a single line spacing; avoid bold, underlining or italics; avoid specific words (e.g. "nickname", "FAQ"); repeat contents, avoiding not key information; avoid capital letters, acronyms, and abbreviations; avoid scroll text; use calibration systems (e.g.: word prediction, swabbing and automatic correction).
4. *Graphic aspects:* use a sharp contrast between color background and text (in detail: use dark writing on clear background); use a uniform texture; adapt object and button size/dimension; use a border for pop-ups; use clear and concretes graphic elements, avoiding the ones far from reality; use metaphors close to everyday life; create coherent interfaces; design rich UI; offer an overview of the elements of the interface; avoid moving UI elements; use multi-layered interfaces; develop the applications in landscape (horizontal) view rather than portrait (vertical); maintain a stable landscape; use a combination of labelling and icons; adequately separate the different buttons; use explicit buttons rather than slider or cursor buttons.
5. *Colours:* prefer complementary colours in order to use a sharp contrast (e.g.: orange and blue, white and black); use few colours; avoid pastel colours; avoid blinding light.
6. *Sounds:* avoid sounds too quiet and blunted.
7. *Command input:* use single touch rather than multi-touch; use a voice interface; design the interaction process with a specific gesture-based method, establish a "hot area" around the buttons; use tactile input joined with haptic input.
8. *Output:* provide instant feedback (e.g.: after touching an icon, change colour); use multi-sensorial feedbacks (e.g.: tactile feedbacks joined with/rather than sounds or haptic output).
9. *Basic features:* combine touch-based and slide gesture interaction; use adaptable/customizable setting/interfaces (customizable fonts, icons, combination colours, button size, windows size, contrast level, sound level, on/off sounds, vibration/haptic effects); use social features; guide users with tutorials, frequent feedbacks, introductory videos on how use the application and the related technologies included into the device; use "help systems" (e.g.: frequently asked questions, send a message with a question); use a stable menu interface, with a not deep information architecture; focus application features and tasks; get user to set technologies into application (e.g.: GPS, etc.).

10. *Methodology:* exploit co-design and participatory design to build a service system/application; take data from users to determine the best method of grouping content categories; involve users in evaluation processes of services.
11. *Context of use:* the better context of use of tablet applications should be home, with the device on a desk and with the seated user.

5 Conclusions and Future Work

During the discussion of this paper, the authors investigated the issues concerning possible interaction between the elderly and the tablets, aiming to understand whether these devices can actually be, as many claim, the drivers that allow older adults to enjoy interactive applications, at last.

The result of this study lead to the conclusion that by following a proper design method it is possible to develop tablets applications that provide added value to users of the target audience. So, she authors identify some suggestions in order to make the design of tablet applications suitable for the elderly.

The next steps will be oriented to field test the effectiveness of the set out considerations, which will be challenged in the implementation of specific projects and applications. Moreover, will be taken into account and evaluated additional variables connected to the context that affect the way users interact, such as public contexts.

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