Older Computer User

ABSTRACT

Physical and cognitive issues associated with aging can affect the use of technology of older adults. The fastest growing demographics in developed countries are older adults (65+ years old). Technological exclusion due to the low usability can cause a variety of issues for this group doing their individual, social and business-related tasks. This, provides many design opportunities and challenges for Human-computer interaction (HCI) researchers to develop simple, flexible and recognizable technologies for older users. For example, as people age, memory capabilities are reduced, thus reminder system can benefit older adult users.

1. INTRODUCTION

The older adult population is increasing ever year. Today, aging population is a major concern in most of developed countries. As reported in the World Population Aging: 1950-2050, "The older population is growing faster than the total population in practically all regions of the world – and the difference in growth rates is increasing" [4]. As an example, 17% of the population of the UK was over 65 years old in 2010. And this ratio is predicted grow to 23% by 2035 [1]. In addition, the 'oldest old' (80+) people are the fastest growing group in developed countries, which is expected to be 19% of the global population in 2050, that is about 400 million people [2].

Older adults will likely experience some difficulties and limitations in vision, dexterity, physical function, hearing, and cognition as they age. We should also consider intensive results of the emotional impact associated with that loss of ability. Specifically, for older adults who also experience social isolation or depression. On the other hand, older adults want to be connected with friends and family but they are faced with challenges related to cultural gaps and new forms of social communication. Technologies that older adults are familiar with are almost out-dated with current innovative technologies, especially technologies for social networks. Also despite their positive attitude towards technology, they find the interfaces too complex and confusing or sometimes expensive. As a result, technology divides older adults from the rest of the society which means traditional design methods may not be sufficient to develop successful and adoptable products for this group [3].

Besides the difficulties described above, UX designers generally ignore older adults learning methods and whether the learning methods required by the current app design work well for older adults. Older adults apply different methods of learning on mobile devices than younger adults which then will affect whole their experience of using such devices. In a 2009 UK survey, 2905 people age 16+ were asked how confident they felt about using mobile phone [5]. The results show a significant number of mobile phone owners age 60+ could not confidently use their phone; 47% could not take a photo, 22% could not send a text message and so on. The difficulties that older adults experience in learning to use existing mobile phones may have contributed in part to the lower adoption of mobile phones by this population [6].

Mobile computing devices, such as smart phones, digital cameras, and digital media players have variety of benefits for older adults. For example, smart phones can provide applications which helps them remain independent, such as software apps for connecting with friends and family, exploring the news pages, personal calendar and reminders and diabetes trackers. Blood glucose meters help many older adults manage their diabetes individually, and innovative memory aids may help older adults remember important dates and events [6]. With the significant size of older adults in the near future, HCI researchers have shown an increasing interest in design and development of technologies with usable interactive system for older adults, which I will mention to some of them in section four.

In the rest of this paper, section two will discuss the nature of problems and difficulties that older users are faced with use of technologies and the current attitudes towards them. Section three will address to a framework for technology design for older users. Section four will mention some recent tools and technologies which were designed and developed for older users. Section five will discuss the issues in technology adoption for older users regarding usability and accessibility testing, and suggesting some solutions for that. Section six is wrap up and conclusion.

2. Older adults and technology

In 2012 the Pew research center reported about half of older adults use Internet while in 2013 this number raised up to 59% of seniors. The number of seniors owned cell phone also raised up to 77% and older adults with broadband Internet connection at home increased up to 47%. Figure 1 compares number of adults with older adults using these technologies in 2013.

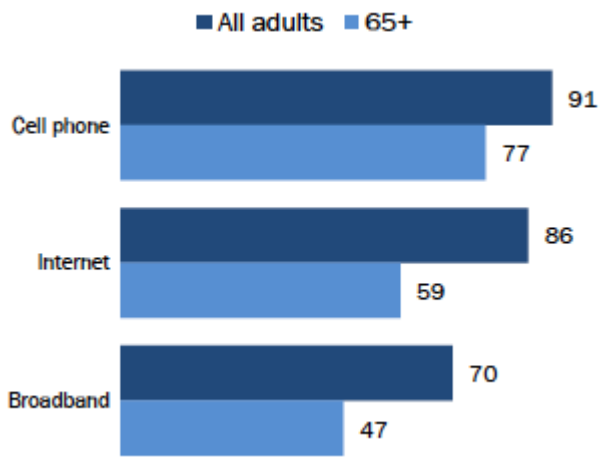

Figure 1. Older Adults (65+) vs. Adults (18+) in using technologies [7]

Yet after all these progresses, there is a significant gap between older and younger adults in technology adoption. For example 41% of seniors do not use Internet at all. There are several reasons affecting seniors technology adoption, including [7]:

1. Income 90% of seniors with annual income of more than $75,000 use Internet. This number for seniors with annual income of less than 30,000 is 39%.

2. Education 87% of seniors with a college degree use Internet. This number for seniors who have not attended college is 40%.

3. Physical conditions and health issues around two in five seniors indicate that they have physical conditions or health issues which make common daily activities difficult. 66% of seniors without health conditions use Internet. This number for seniors with some issues is 49%.

4. Attitudes toward technology only 49% of seniors who currently do not use Internet indicated this as a disadvantage in a sense that they are missing information.

5. Learning difficulties most of seniors declared that they need assistance to use new technologies such as a smartphone or tablet. Only 18% of them are comfortable enough to use new technologies without assistance.

Among these factors, usually the first two ones are not subject to changes. But there have been many successful attempts to alleviate issues related to the other three factors, by HCI researches. In section three, I will mention to some of these new technologies and tools specifically developed to improve older user's adoption with technology.

% of those 65 and older who use the internet or email

	Total for all 65+ (n=1,526)	59%
	Gender	
a	Male (n=612)	65[b]
b	Female (n=914)	55
	Age	
a	65-69 (n=531)	74[cd]
b	70-74 (n=401)	68[cd]
c	75-79 (n=244)	47[d]
d	80+ (n=350)	37
	Education	
a	High school grad or less (n=598)	40
b	Some college (n=381)	69[a]
c	College graduate (n=537)	87[ab]
	Household Income	
a	<$30,000 (n=467)	39
b	$30,000-$49,999 (n=282)	63[a]
c	$50,000-$74,999 (n=192)	86[ab]
d	$75,000+ (n=274)	90[ab]
	Community Type	
a	Urban (n=413)	60[c]
b	Suburban (n=758)	63[c]
c	Rural (n=355)	50

Figure 2. Internet/Email usage for older adults [7]

Figure 2 demonstrates percentage of seniors using Internet/Email in each category. For example the first row of Gender denotes 65% of male seniors use Internet/Email while 35% of them do not use.

3. Sympathetic Design [3]

There are a large number of attempts in designing technologies for older users. One of the most practical methods is called "Sympathetic Design" [3]. Sympathetic design uses a framework to design technology devices for older users (Figure 3). This framework defines characteristics of an appropriate design process and the final product based on several successful projects in the recent years.

Sympathetic Devices	*Designing Technologies for Older Adults*	
Product Functionality	Simplicity	Basic Needs
Product Interface	Tangible	Contextual
Design research methods	Participatory Design	Contextual Design methods
Universal Design	Equitable Use, Flexibility in Use, Simple and Intuitive Use, Perceptible Information, Tolerance for Error, 6-Low Physical Effort, Size and Space for Approach and Use	
Product Experience	Enjoyment	Creativity
Technology Use	Current	Off-shelf

Figure 3. Sympathetic design framework [3]

4. Technologies Developed for Older Adults

4.1. Graphical Passwords for Older Computer Users [8]

The challenge of conventional passwords for older adults is that setting a strong password including a combination of lower-case and upper-case letters, symbols and numbers is difficult for older adults. But the more challenging issue is remembering a meaningless set of those characters. In an image-based graphical password, user has freedom to select a set of images as his/her password. This set of images is called "target images". And then to pass the login authentication, user needs to select his/her target images from among the proposed set of images on the screen. At the login time, target images are mixed with a set of images called "decoy images" and all are randomly placed on the screen. To increase the security, a set of decoy

images are selected and mixed up with the target images which are visually very close to the target images. This will decrease the chance of person guessing attack. Thus attacker would see a set of images on the screen, such that each of them sharing common physical attributes with some others. For example left part of Figure 4 shows the four target images. Then we see four different mixes of these target images with decoy images, on the right. Because user has chosen four target images of males in business attire, decoy images are also chosen with this appearance.

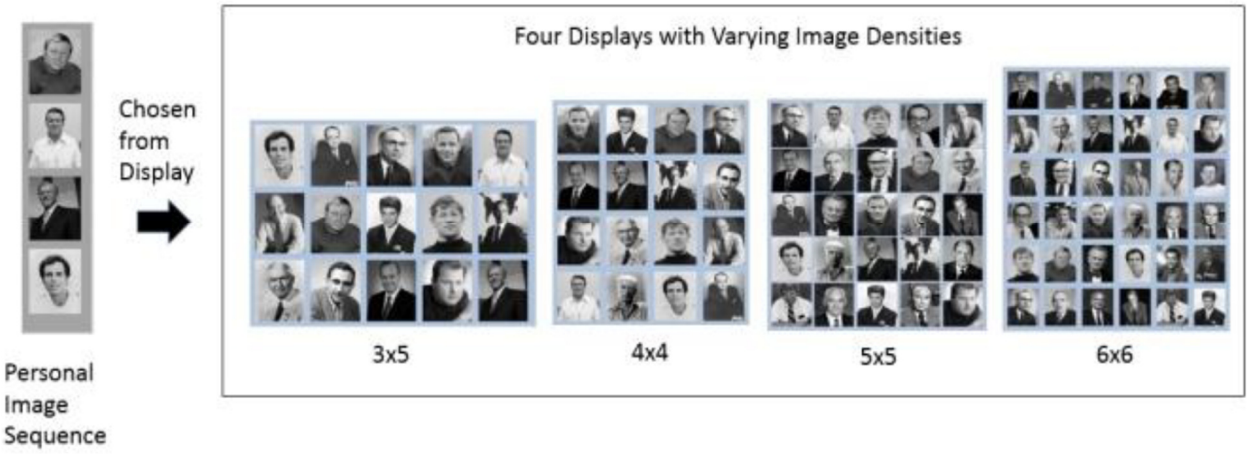

Figure 4. Left: four target images selected by user for authentication. Right: four sample combinations of randomly placed target and decoy images [8]

User need to select their target images in the correct order to login successfully.

Pros and Cons

Advantages

1. Volunteers expressed that they can make a personal story for the set of target images they have chosen [8]. So it would be easier for them to remember an image-based password.
2. For those users with less experience of using keyboard and its functions ("Caps Lock", "Num Lock"), choosing from among a set of images would be more comfortable than dealing with difficulties of entering combination of lower/upper case letters and symbols.

Disadvantages

1. Although this method claims to be effective for older adults with memory limitations, its efficiency for those with visual limitation is debatable. Especially that this method promises to use the most-visually-similar decoy images to the target images, all in black and white. This may result in choosing wrong set of images and login failure. Although methods like vocal passwords or finger print are more complicated from implementation point of view, but still easier to use for seniors.
2. For security concerns, apparently number of cases when choosing eight characters out of lower/upper case letters, symbols and numbers is significantly more than choosing eight images (target) out of thirty six images (target + decoy). This method seems to be more vulnerable than the traditional one.

4.2. A Gesture Enhanced Keyboard for Older Adults [1]

Using smartphone's keyboard is necessary for many tasks such as texting, emailing and social networks activities. Yet, most smartphones offer touch-screen keyboards than physical keyboards. On the other hand, older adults are faced with visual and memory limitations that reduce their accuracy in using normal (QWERTY) touch-screen keyboards. The gesture enhanced keyboard, is a touch-screen keyboard designed for seniors which is a combination of standard QWERTY keyboard and physical gestures. This new keyboard increased the size of keys which is derived from wide format of standard QWERTY keyboard (twice of the width of the screen). Users of this keyboard would see only one half of the keyboard at a time, but they can shake the phone to see the other half (Figure 5).

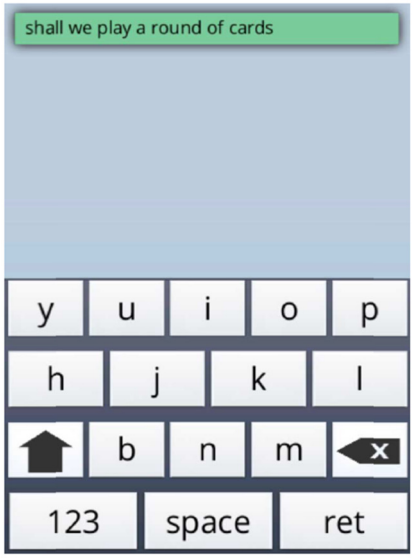

Figure 5. Gesture keyboard, shake the device to see the other half of the keyboard [1]

Because of using larger buttons, the accuracy of seniors using this keyboard is significantly increased. Figure 6 compares the percent of inaccurate key presses of older adults using standard QWERTY keyboard with the new gesture one.

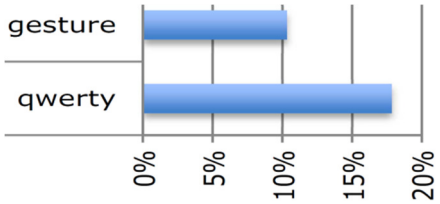

Figure 6. Percentage of invalid key presses [1]

Pros and Cons

Considering the ultimate goal of this project; to increase the typing accuracy of older users when employing a touch-screen keyboard, this was a successful attempt since the results show almost double accuracy using gesture keyboard. In addition, the better the typing abilities, the more sense of independence and confidence which results in more activities in social networks and making new friends. This fact makes using this new technology more enjoyable which is a

principle of design. On the other hand, because users need to perform a combination of taps and side-swaps, it takes more time/attempts to enter the input rather than using a standard keyboard which may be boring for them. Although accuracy of key tapping is increased because of the bigger keys, maybe they still cannot correctly remember and spell words when the suggested keys are only one half of the keyboard and they try to adopt their thoughts with the offered letters (Choose only from among the shown keys in one screen). This could cause misrepresentation of their feelings and thoughts.

4.3. TV User Interfaces for Older Adults [9]

Enhanced Complete Ambient Assisted Living Experiment (eCAALYX) is a TV-based system for older adults with the mission that seniors resolve their medical needs with more independence. This includes a TV and set-top-box, blood pressure Bluetooth sensors and a router to communicate to the server. Designed user-interface for this TV offers multiple functions to seniors (Figure 7), so they can:

1. Monitor their health condition by looking at some simple graphical measures such as: weight, blood pressure and so on.
2. Directly talk to their caretaker
3. Review their prescriptions; time to take medicine, appointment with caretaker, time to measure their blood pressure, etc.
4. Learn how to manage issues related to their age and diseases using instructional videos
5. Send information to their doctor who tracks their health condition
6. Make an emergency call

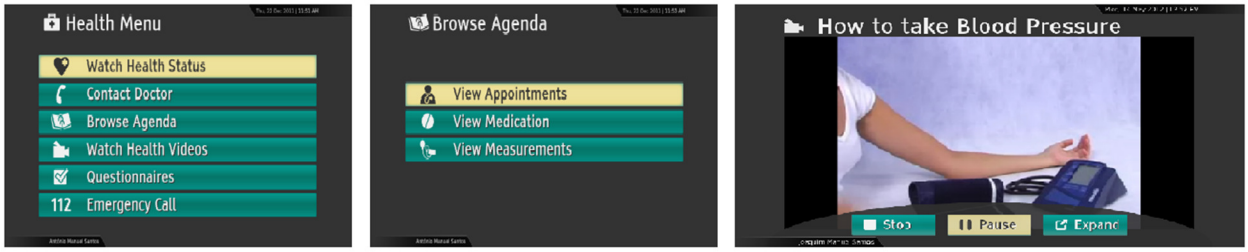

Figure 7. Some applications of user interface of eCAALYX [9]

This user interface is tested with ten senior attendees. Results are shown in appendix 1. Table 1 lists some recommendations to design an applicable TV user interface.

Pros and Cons

Advantages

1. One of the difficulties that older adults are faced with is going to medical centers periodically, especially for some basic routine check-ups such as blood glucose measurement. This interface could alleviate their need of going to these places. Consequently, it meets principles of “Basic Needs” and “Tangible” in the sympathetic design framework.
2. Also it increases the sense of independence in seniors, especially if they need assistance to go to the medical centers. Consequently, it meets the principle of enjoyment as well.

1	Minimize the number of steps it takes to reach a given Screen
2	Use consistency to facilitate recognition
3	Make error recovery as painless as possible
4	Reduce the information presented so users can focus on a single concept at a time
5	Clearly indicate the current location
6	Show the current selection clearly
7	Use meaningful icons and labels
8	Concentrate information at the center of the screen
9	Use scrolling with caution
10	Use a high contrast color scheme
11	Use large, sans serif, left-aligned text
12	Use simple language
13	Give users time to read

Table 1. Recommendations for user interface design for older users [9]

Disadvantages

1. This interface works with TV remote, so technically it inherits all the issues related to applying remote.
2. Because this interface works in a safety critical area, any failure in the interface itself or misunderstanding of instructions or ignorance of the provided cautions/notices may cause serious problems. For example, they may send incorrect information to their doctor, and he/she accordingly will write new prescriptions based on them.
3. Because this interface works on top of a series of technologies such as: TV, set-top-box, testing devices, router, power and communication facility (like Internet), its application relies on responsiveness of all of them. Meanwhile, it is not reasonable to expect seniors having knowledge/ability of troubleshooting all these technologies in the case of failure. Also this package may be unaffordable for them.

4.4. Some other useful gadgets for older users

4.4.1. Altruist [3]

Designed to encourage seniors to go social and make friends. Whenever one of the connected friends of the user of Altruist shows up in a common place, such as retirement communities, this tool informs the user. The gadget is a base station and an object like a keychain (Figure 9), each friend carries one of them, with the ability to add new friends to your circle by pairing them for some seconds. After connecting, if one of your friends in your circle presents in a specific location, the base station plays music.

Figure 9. Altruist device [3]

4.4.2. Forgetfulness [3]

This gadget reminds older adults to complete their tasks. It's a bracelet with color-coded plastic tags (Figure 10). User removes the tags and places them on the objects and records a voice message about the tasks to be done on the bracelet. There are lights on the bracelet to remind user that a tag is removed (related to the task to be done) and there is a button which plays the recorded message about that task.

Figure 10. Forgetfulness device [3]

4.4.3. C-Connect [3]

This gadget is a cultural-event finder for seniors. Users can search for institutions and lectures while this device remembers their previous searches and preferences. This gadget looks like a smart phone (Figure 11) but with physical buttons, easy to use by older users.

Figure 11. C-Connect device [3]

4.4.4. Madeline [3]

This gadget is an electronic photo album which shows family photos at random. It can receive photos from the server and demonstrate them in a new order, every time it is opened (Figure 12).

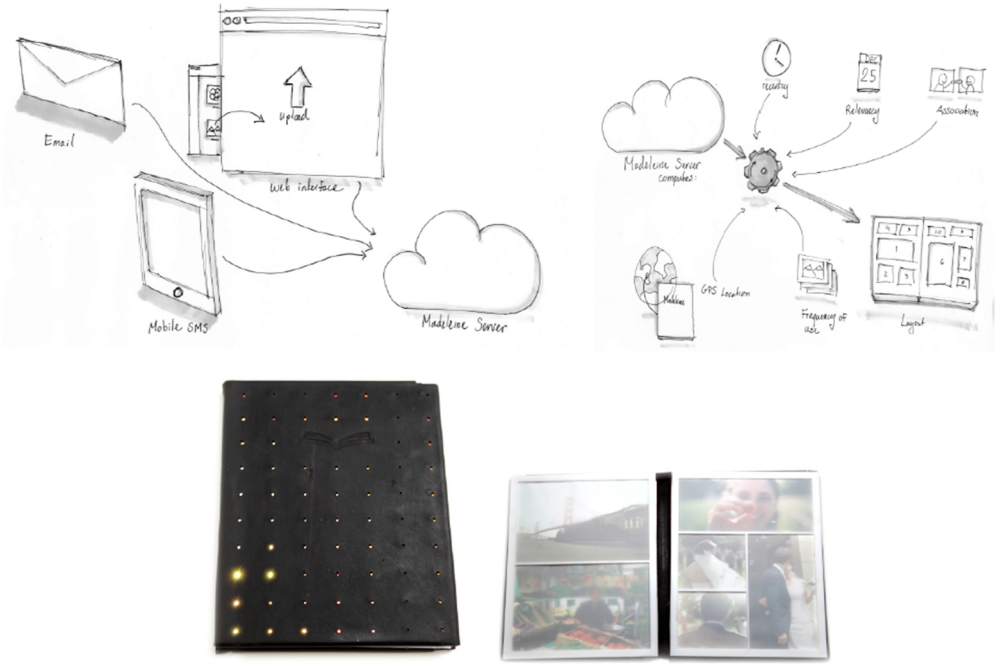

Figure 12. Madeline device [3]

4.4.5. Comments on trivial gadgets

All the mentioned gadgets are designed to properly perform one simple task. Thus, they meet the sympathetic design framework principles; “Easy to use,” “Based on the real needs of older users,” “Using physical items/hardware” and “Enjoyable” which encourages them to use the technology. The only question is: are older adults willing/able to carry one gadget for every single task?

5. How Older Adults learn to Use Technology [10]

To figure out older adults' learning process, six volunteer seniors are selected to learn to use reminder systems. For this purpose, they will learn Calendar and Task applications (Figure 13).

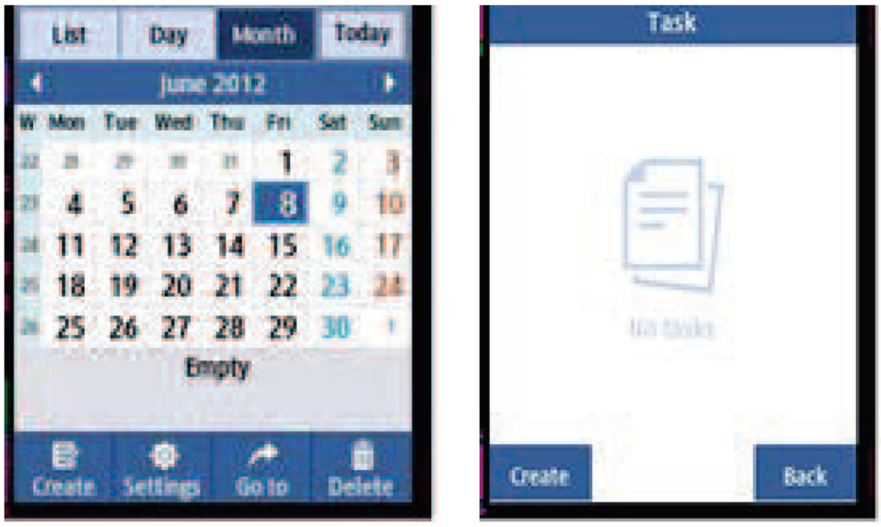

Figure 13. Android reminder applications: calendar (left), task (right) [10]

This research was done in three sessions: Get-to-know, Briefing and Testing. First, researchers and volunteers get familiar with each other. Volunteers described their conditions and researchers expressed their research aims. When volunteers felt comfortable with the researchers, they were introduced with their tasks which are creating a new event and removing an already existing event. They were shown Calendar and Task applications along with instructions and how to use these tools. Then, volunteers worked with the applications until they felt confident. Finally, for testing, volunteers are asked to create a new event and remove an already existing event. During the test researchers were next to the volunteers so they could feel more comfortable with technology. Also volunteers were asked to talk aloud, to represent their thoughts and decisions. Demographic data of volunteers along with task completion time are shown in figure 14.

Parti-cipant	Age	Sex	Occupat-ion	Highest level of Educat-ion	Mobile Phone Experience
P1	55	F	Nurse	College	More than 5 years
P2	55	F	Housewife	High school	More than 5 years
P3	55	M	Lecturer	University	More than 5 years
P4	60	M	Retiree	High school	More than 5 years
P5	60	M	Retiree	High school	More than 5 years
P6	55	F	Nurse	College	More than 5 years

Participant	Interface 1 (Calendar)	Interface 2 (Task)
P1	10 minutes	8 minutes
P2	13 minutes	11 minutes
P3	5 minutes	6 minutes
P4	9 minutes	7 minutes
P5	6 minutes	7 minutes
P6	12 minutes	9 minutes

Figure 14. Demographic data of participant (left), time to create and delete event using Calendar (interface 1) and Task (interface 2) applications (right) [10].

During the test, researchers discovered 2 major issues which increased the task completion time:

1. Volunteers were looking at all of the buttons first, and then decided to tap “Create” or “Delete”.
2. They had problems with scrolling up and down. So they repeatedly scrolled up and down multiple times.

Comments on this Research

The first issue arises because older adults are not familiar enough with such menus. Their eyes not accustomed to these menus, so they couldn’t directly select one desired among all the set. Meanwhile, it may rooted in cognitive problems, because when they couldn’t remember a button’s function confidently, they needed to compare it to all other buttons. This leads us to go one step further such that we first provide some different practical menus of this type. Only after they could do the same task using different menus confidently, we can introduce them with their real task.

We could design a screen with the only one functionality (which means as simple as possible), as mentioned in [10]. But does this solve the problem or push it to one step earlier; where the user should browse the screens to find the correct button.

Another issue also revealed the lack of experience of fundamental tasks using tablets. Thus designing a new task which needs to be done based on this un-experienced basic may not lead to satisfying results.

Consequently, not all of the seniors’ problems in learning technologies are rooted in their conditions. Yet some of them are the same with younger adults such as: need to learn step by step, need to practice, need to experience different applications of an already learned function in different situations for different purposes, etc.

6. Conclusions

1. Because of the growing number of older adults and their increasing demand to use technology, there is a high responsibility for HCI researchers to develop well adopted tools and interfaces for this class of citizens.
2. Because of the obvious differences in life condition of older and younger adults, technology could play a more important/vital role in seniors’ daily life than younger adults. They could implement technology to compensate their absence in the society/family, meet their medical needs and alleviate their limitations.
3. There are many good attempts in designing tools and technologies for senior users. While some of them only focus to improve one parameter of life, there are many other attempts which seem to be more applicable and with more chance to be well accepted.
4. It is rare to find researches in technologies that older adults are involved in design/requirement gathering process, and a project which is developed following their point of views. While they are the best people who can judge: what is their expectation and desired functionality, what is the satisfying level, what is the priority and what is affordable.

5. It seems to be impractical to design/develop interfaces for older people and consider all kinds of physical and mental limitations. For example it could be difficult to design an interface for people with both cognitive and visual problems and expect them to work with that independently/conveniently.
6. Many of older adults have a positive attitude towards using technology in their daily life, and they have fairly enough time to learn it. So one of our main tries should be to assist/ encourage them in a correct way [6]:
    a) Older adults prefer to keep their own pace in learning.
    b) Older adults experience more frustration and anxiety than others in learning new/complicated technologies. So in their learning process you should support and encourage them, as well as providing immediate feedback to their job to motivate or correct them.
    c) Provide a planned learning process for them; only some new concepts rather than many/all lessons in one session. And then practice on what they have learned.
    d) Minimize the need to memorize.
    e) Provide clues and assistance.
    f) Do not make them feel overwhelmed with too much information.
    g) Do not ask them to make complicated conclusions or put them in a situation to feel they are missing some information.

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Appendix 1. Results of TV user interface for older users [9]

Test	Key Results	Recm
A1) Watch arterial tension	5/6 understood the arterial tension chart 6/6 successfully chose Watch Arterial Tension 3/6 made errors choosing Watch Health 2/6 did not correctly choose Watch Health	5
A9) Icons for main menu	6/6 understood the telephone for Make Call 3/6 understood the clapperboard for videos 4/6 understood the calendar for See Agenda 3/6 understood the wrench for Personalize 6/6 understood 112 for Emergency Calls 5/6 understood thumbs up for Watch Health	7
A10) Icons for See Agenda and Health Videos	5/8 chose one planner for See Agenda 3/8 chose another planner for See Agenda 4/8 chose a camera for Watch Health Videos 4/8 chose a cassette for Watch Health Videos	7
A11) Icons for Video Player	5/6 did not know the standard icons for playing, stopping, and pausing video 1/6 knew only the standard icon for playing	7
Recm = number of recommendation each test contributed to		

Test	Key Results	Recm
B2) Watch Health Videos	5/10 identified Health Videos in 1 attempt 9/10 could tell the video length 10/10 easily played the video 6/10 could not select the pause button (which disappears), while 4 required several attempts 8/10 understood the goal of the full screen button	6 13
B3)Questionnaires	6/10 identified Questionnaires in 1 attempt Moving options required 2.4 reads on average	7 13
B5) Draw menu	10/10 drew something representing a menu 4/10 drew the screen title 1/10 drew the clock	8
B6) Watch Blood Pressure	5/10 identified Watch Blood Pressure in 1 attempt 10/10 identified their last measurement 5/10 understood graphics contained values for different measurements of the day The average number of attempts to reach Yesterday's screen was 1.6 (required scroll)	9
B7) Receive call from doctor	9/10 understood the goal and the available options 10/10 were able to answer the call 10/10 were able to end the call 7/10 used the back button instead of end call button	6
Recm = number of recommendation each test contributed to		

Test	Key Results	Recm
C1) Font size	100% could read text in 65pt, 60pt, 55pt, and 50pt 95% could read text in 45pt font 90% could read text in 40pt font 70% could read text in 35pt font 40% could read text in 30pt font	11
Recm = number of recommendation each test contributed to		