Web Accessibility for Older Users: A Southern Argentinean View

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***Abstract*—Older Web users are now facing one of the most difficult challenges of their lives. The Web changes every day and they cannot keep up with it. As older age comes, individuals experience gradual and fluctuating decline in capabilities. These physical impairments make usage of the Web even more difficult. Web accessibility is an area devoted to solve accessibility problems of disabled people. However, as older people suffer disabilities, although less severe ones, they can profit from Web accessibility solutions. In this article, we review some of the most common impairments that affect older Web users, we analyze how these impairments are considered by Web Accessibility standards, and explore different approaches that improve Web user interface. Finally, we introduce our ideas to overcome unsolved Web accessibility barriers for older users describing an experience carried out at our University in Argentinean Patagonia.**

Keywords - Web Accessibility; Older Web users; User Interface (UI);

I. INTRODUCTION

Most older adults experience age-related changes to their functional abilities (vision, hearing, cognition and mobility). These changes may complicate Web use [7], particularly for poorly designed sites. In Table I, we show some common functional impairments affecting older Web users, which we extracted from the literature review published by the W3C [21].

TABLE I. FUNCTIONAL IMPAIRMENTS AFFECTING OLDER WEB USERS

Ability	Impact	Difficulties
Vision	Screen Keyboard	1. Decreasing ability to focus on near tasks 2. Changing color perception and sensitivity 3. Pupil shrinkage and decreasing contrast sensitivity
Hearing	Audio Multimedia	4. Increasing inability to hear higher-pitched sounds
Motor skill	Mouse Keyboard	5. Slowness of movement, trembling
Cognitive	Overall Web use	6. Short term memory problems, concentration difficulties, distraction, change blindness

The study presented by Sayago and Blat [2] revealed that the accessibility barriers that had a more negative effect on the daily interactions of older people with the Web were remembering steps, understanding computer jargon and using the mouse.

Besides, from this study, we acknowledge that older Web users desire two conditions: independency and inclusiveness. Independency is the ability to use the Web on their own and inclusiveness is the need to interact with the Web using ordinary technology, as they do not intend to be different from the rest of users.

Another problem that older people have to face is social isolation [12]. Factors like diminished personal social networks, bereavement and health problems contribute to social isolation. Using the internet has significant value for elderly people, since it helps avoiding loneliness, boredom, helplessness, and decline of mental skills and it may increase the self-confidence, ability to learn, and memory retention.

Traditional communication technologies, such as the telephone, have played an important role in mitigating social isolation and supporting group gatherings. Also, the World Wide Web offers potential benefits for older adults, but its uptake is yet extremely limited.

There are many reasons why older adults do not use the Web [11]. Firstly, they tend to see the Internet as a tool to achieve functional goals such as bill payment, and not as a social or entertainment source [3]. Besides, they need an incentive to get and stay online [4]. It is often younger people who encourage technology use by older adults. Staying connected with geographically remote grandchildren is a major motivation for older adults in using technology (such as email, Web cams and Skype). An interesting finding was reported in [25], in which it is suggested that given the right trigger many older people (even those previously uninterested) will make tentative steps towards some technology. In this case, the trigger was a disaster, the "ash cloud", which caused large scale disruption for air travel across Europe in 2010, and it motivated the need for computer usage.

Once older people are online they discover the advantages, such as being able to maintain existing social relationships and perhaps renew old ones that distance had precluded. Over two thirds of "silver surfers" say that using the Internet has improved their lives [5].

Other reasons for non-use of the Web include those involved with age-related impairments, such as the ones presented before in Table I.

In this paper, we explore different initiatives aimed at providing Web accessibility and usability properties for older users and some approaches to improve their Web interface

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experience [13]. Taking into account the state-of-the-art and the experience gained by our group while teaching computing to older people, we describe our ideas and show the improvements achieved during the delivery of the courses for elderly Web users. Since many fields are concerned on improving human-technology interaction, such as information retrieval and data mining, Human-Computer Interaction (HCI) and GUI, at this point, we have to clarify how we decided to face this work. We have been working for a while on accessible UI design to conform the W3C accessibility recommendations [26] [27]. Our knowledge gathered about UI design and Web Accessibility standards, permitted us to explore practical techniques to reinforce accessibility and usability and focus on the interaction between our seniors and the Web, using a real experience on Yahoo mail.

The rest of the paper is structured as follows: in Section II, we review Web accessibility standards and their relation with age related disabilities. Then, in Section III, we overview different useful approaches to improve older users' Web interface. After that, in Section IV, we describe an experience performed at our University and explain our ideas for improvement. In Section V, we introduce some discussion based on our experiences. Finally, in Section VI, we conclude and present some further work.

II. WEB ACCESSIBILITY INITIATIVE GUIDELINES AND AGING

The next few decades will see an unparalleled growth in the number of people becoming elderly compared with any other period in human history. The United Nations estimates that by 2050 one out of every five people will be over 60 years of age, and in some countries the proportion will be much higher than this [1].

There are some initiatives that provide advice addressing Web accessibility and usability for all people. As regards older users, many requirements are already considered by these initiatives.

The World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI) [16] brings together people from industry, disability organizations, government, and research labs from around the world to develop guidelines and resources to help make the Web accessible to people with disabilities including auditory, cognitive, neurological, physical, speech, and visual disabilities.

Among these series of guidelines developed by WAI, widely regarded as the international standard for Web accessibility, are: Authoring Tool Accessibility Guidelines (ATAG), User Agent Accessibility Guidelines (UAAG) and Web Content Accessibility Guidelines (WCAG).

- The Authoring Tool Accessibility Guidelines (ATAG) documents define how authoring tools should help Web developers produce Web content that is accessible and complies with Web Content Accessibility Guidelines.
- The User Agent Accessibility Guidelines (UAAG) documents explain how to make user agents (Web browsers, media players, and assistive technologies) accessible to people with disabilities, particularly to increase accessibility to Web content.
- The WCAG documents explain how Web content can be made accessible for people with disabilities. The WCAG 2.0 [19] has twelve guidelines, grouped in four fundamental principles of accessibility: perceivable, operable, understandable, and robust. Each guideline is in turn decomposed in a set of success criteria, which are classified within three levels of conformance: A (lowest), AA, and AAA (highest).

Another WAI project, Web Accessibility Initiative: Ageing Education and Harmonization (WAI-AGE) project [17] analyzed the Web accessibility requirements of older Web users based on the research and investigation of many people.

WAI-AGE has identified that the existing WAI accessibility guidelines address the majority of requirements of older people for Web use [10]. It also identified that many Web designers and researchers are not considering the WAI guidelines when making recommendations about Website design for older people.

Although the guidelines developed by WAI were not written with older users' problems in mind, they provide solution to many of them. In Table II, we show the results of performing a matching analysis between most common older people accessibility barriers, presented before in Table I, and the corresponding guideline in WCAG 2.0.

TABLE II. OLDER WEB USERS DIFFICULTIES AND CORRESPONDING WCAG 2.0 GUIDELINES

Difficulty	WCAG 2.0 Guideline
1. Decreasing ability to focus on near tasks	1.4
2. Changing color perception and sensitivity	1.4
3. Pupil shrinkage and decreasing contrast sensitivity	1.4
4. Increasing inability to hear higher-pitched sounds	1.2 – 1.4
5. Slowness of movement, trembling	2.1 – 2.2
6. Short term memory problems, concentration difficulties, distraction, change blindness	2.2 – 2.4 – 3.2 – 3.3

We can see that the first three difficulties, which are visual impairments, are addressed by WCAG 2.0 in guideline 1.4. The fourth barrier, a hearing disability, is tackled by guidelines 1.2 and 1.4. The fifth difficulties, motor impairments, are addressed by guidelines 2.1 and 2.2. Finally, the sixth barriers, cognitive difficulties, are considered by guidelines 2.2, 2.4, 3.2, and 3.3.

This way, we could see that WCAG 2.0 guidelines meet all older Web users' requirements. The problem is that few Websites have been designed with these guidelines in mind.

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III. DIFFERENT WEB SOLUTIONS THAT IMPROVE SILVER SURFERS' EXPERIENCE

Older people's functional impairments are very different in type (vision, hearing, mobility, cognitive) and severity, and usually change over time. Thus, it is very difficult to specify a unique Web interface that meets the requirements for all of them [6]. So, the solution could be that each individual older user would be able to select the appropriate configuration by themselves.

There are some very interesting works related with this idea such as the IBM's Web Adaptation Technology [9], which develops a browser extension that allows manipulating Web content by combining and applying a number of page transforms and adaptations according to user preferences without requiring Web designers and developers to rewrite their Web content.

Another tool is the Senior Citizen on the Web 2.0 (SCWeb2) Assistance tool [8], which is designed to assist older users as they use Web 2.0 content. For some users, dynamic content can be problematic due to the many updating components throughout the page, causing them hesitancy, stress, and frustration about unexpected situations. This tool provides help only when users require it, avoiding assistance and browsing the page in the usual manner when support is not needed.

There are many other solutions which provide Web accessibility not specifically oriented to older people. For example, Garrido et al. [24] propose improving Web accessibility in client browsers through interface refactorings. This approach is called Client-Side Web Refactoring (CSWR), it allows to automatically create different, personalized views of the same application. The refactorings proposed are compliant with W3C guidelines.

Besides, there are tools that allow users to change the way Web content is presented. GreaseMonkey [20] is a Firefox extension that allows writing scripts to alter visited Web pages. It can be used to make a Website more readable or more usable, Web applications can be modified by adding content and/or controls to them. For instance, Mirri et al. [23] describe GAPforAPE (GreaseMonkey And Profiling for Accessible Pages Enhancement), an augment browsing system based on GreaseMonkey, which allows Web users to set up their preferences at client side and thus modifying content on the browser interface. This application includes a profiling system and a client side content transcoding system, based on a collection of scripts. In order to enhance the accessibility of Web content and to provide the best adaptation to each user by meeting their needs and preferences, scripts allow the transcoding of Web pages, by modifying the CSS rules, the HTML DOM, and also other scripts which are used by them.

IV. EVALUATION OF OLDER USERS' EXPERIENCE IN PATAGONIA

Since 2009, the National University of Patagonia Austral and the National Institute of Social Services for Pensioners (PAMI) have signed an agreement [18] for teaching computing, music, and theatre courses to older people.

These courses are taught twice a week and last three months. Computing courses are the most crowded, having about 20 pupils each.

Older people who assist to computing courses have expressed that they come to learn computing because they want to keep in touch with their families, with their grandchildren who live in other country regions.

Here, in Patagonia, distances between cities or towns are extremely long; besides, we are 1242 miles away from the capital city, Buenos Aires. Moreover, the weather is a critical factor, too. Winters are very long and cold, and strong winds blow. As a result, older people spend most of their time inside their houses, and they often feel lonely. Thus, getting online can have positive benefits for them. Tools like Email, FaceBook and Skype can empower older adults to stay connected with their friends and family.

In this study, the purpose is to find out which are the accessibility failures that the email's Web interface has got and evaluate if a more accessible interface would allow older people to utilize it more frequently and without suffering frustration for not remembering how to use the application.

A. *Experiment 1*

During the second half of 2012, teachers taught email classes. At the beginning of 2013, when computing classes started again, teachers noticed that most pupils did not use this communication tool. When asked for the reason of not using it, most pupils said that they did not remember how to use it, a few said that they were not interested in sending or receiving mails, and the rest, only some of them, said that they still used it. So, the purpose of this experiment is to investigate what accessibility difficulties has got the email's Web interface design.

1) Participants:

Eighteen older adults ranging in age from 64 to 73 years old (eleven women and seven men) were recruited for this activity. All of them took computing courses between April and June of 2013 and also during the second half of 2012.

2) Materials:

For this experiment, we used Yahoo mail application (Figure 1) which was also used during email classes.

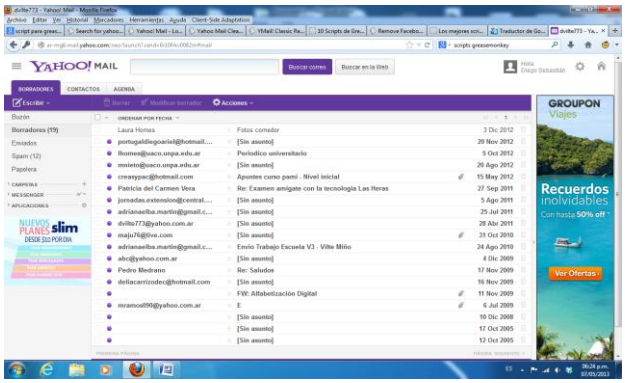

Figure 1. Yahoo mail inbox.

It is important to highlight that the courses are taught in a 25 desktops Lab equipped with 15 LCD monitors of 19-inch

and 10 LCD monitors of 17-inch, whose resolutions are WXGA 1366 x 768 and XGA 1024x768, respectively. Although changing terminals settings (font sizes and colors) is posible, the Lab is used intensively every day to adopt this practice as usual.

3) Procedure:

Usability testing with the think-aloud method was conducted [14]. The evaluations were pair-based because older people feel more relaxed and confident about their work. Each evaluation was recorded, in order to analyze participants behavior and comments.

4) Tasks:

Five tasks were proposed to explore the interface usability:

a) Read an email
b) Reply an email
c) Write a new email
d) Delete an email
e) Close user session

5) Results:

Of the 9 couples of participants, all could finish Tasks a) and c), 6 could not complete Task b), 2 could not conclude Task d) and 8 could not end Task e). These results are detailed in Table III.

TABLE III. RESULTS ACHIEVED BY OLDER USERS IN EMAIL USAGE *EXPERIMENT 1*

Task	Couples Error Ratio
a) Read an email	0/9
b) Reply an email	6/9
c) Write a new email	0/9
d) Delete an email	2/9
e) Close user session	8/9

From these results, we have found three problems throughout Tasks a)-e):

a) Problem 1: Advertisements

All participants complained about being distracted or even confused with the advertisements that appeared on the right side of the screen. They were afraid of clicking by error on these ads and causing an unexpected behavior of the email application, like closing, or losing the work being done.

b) Problem 2: Visual presentation difficulties

Besides, participants experienced other difficulties involving visual presentation of pages. Three couples of participants in Tasks a) and b) could not differentiate selected emails, because of light color contrast. Three couples of participants in Task a), three in Task b), and five in Task c) had difficulties in visualizing text because of font size, style, and inter-letter spacing. Also, 6 couples of participants in Task d) and 9 in Task e) made a great effort to distinguish available commands in menu bar.

c) Problem 3: Not understandable buttons

Participants also had trouble identifying buttons that represented email actions like “Reply” or “Forward”. Eight couples of participants had difficulties identifying the button to conclude Task b), and 6 couples could not complete the task because of this problem. All participants had difficulties in Task e), remembering how to leave the application or “Sign Out”, and only one couple could complete this task.

All the difficulties suffered by older users, are age-related issues like cognitive and visual impairment. Another factor involved is the lack of knowledge of technology and Web applications. Evaluating the WCAG 2.0 guidelines, we found that all these problems are considered within WCAG guidelines as we demonstrated before in Table II. Problems 1 and 3 correspond to difficulty number 6 detailed in Table II, which involves short term memory problems, concentration difficulties, distraction, and Problem 2 involves visual accessibility barriers shown as difficulties 1, 2, and 3 in Table II.

Hence, Yahoo email application is not compliant with this standard. However, this application provides solution to some of them, by setting appropriate configurations. But this is a very complex task to be performed by older users.

B. Experiment 2

The purpose of Experiment 2 is to evaluate an improvement to the email Website interface, which we developed to solve the problems found in Experiment 1.

In this improved interface, vertical banner ads have been deleted, and labels have been added for “Reply” and “Forward” buttons. Also, a button was added at the top of the form to allow users closing their sessions.

Figure 2 shows the modified interface of Yahoo mail inbox, including both adaptations: for Problem 1 vertical ads banner removement and for Problem 3 a button (“2” in Figure 2) labeled “Cerrar Sesión” to close user session, and the two labels “Responder” y ”Reenviar” (“1” in Figure 2) for replying and forwarding respectively.

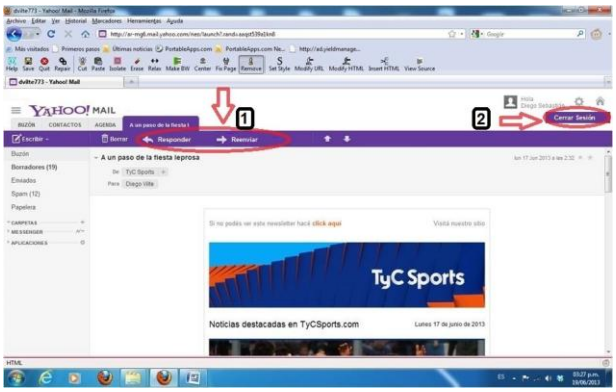

Figure 2. Yahoo mail inbox after interface improvement.

1) Participants:

Fourteen older adults ranging in age from 66 to 74 years old (eight women and six men) were recruited for this activity. All of them took computing courses during the first half of 2012, and now they are taking theatre but not computing classes. However, they were willing to participate in this experiment.

2) Materials:

We modified Yahoo interface by applying two adaptations [15]. One of them is a script for deleting vertical ad banners that we downloaded from a scripts repository and the other one is a script developed for us in JavaScript to solve problems with buttons.

a) Problem 1: Advertisements

Although this vertical banner ad can be removed, this was not a permanent solution and became an annoyance to older pupils. In order to give solution to this problem, we chose GreaseMonkey. There are many add-ins that provide a number of features for visual and navigational enhancements to Web pages, which may fill usability gaps for older users.

Figure 2 shows the modified interface of Yahoo mail inbox where the vertical banner has been deleted. This modification was achieved by the installation of a GreaseMonkey script, CleanUp 1.1 that we downloaded from the scripts repository [22].

b) Problem 2: Visual presentation difficulties

Here, there are solutions provided by the browser and also by the operating system. The browser (Mozilla Firefox) allows modifying default settings for font size and style, and the operating system (Windows 7) provides an Accessibility Center that allows improving visual presentation, mouse setting and color contrast.

c) Problem 3: Not understandable buttons

At this point, we did not find any GreaseMonkey script, which solves difficulties with buttons' understanding or 'Sign Out' explicit inclusion in the application interface. So, we developed a script named "Oldie 1.0" that added labels to "Reply" and "Forward" buttons and a button to allow users closing their sessions.

3) Procedure and Tasks:

The same as for Experiment 1, detailed in Sections IV.A.3) and IV.A.4) respectively.

4) Results:

Of the 7 couples of participants, all could finish Tasks a), c) and e), 1 could not complete Task b), and 1 could not complete Task d). These results are detailed in Table IV. In this experiment, Problems 1, 2 and 3 detected previously have been eliminated. A couple of participants could not finish tasks b) and d) because they did not remember how to perform those tasks.

TABLE IV. RESULTS ACHIEVED BY OLDER USERS IN EMAIL USAGE *EXPERIMENT 2*

Task Id	Task Description	Couples Error Ratio
a)	Read an email	0/7
b)	Reply an email	1/7
c)	Write a new email	0/7
d)	Delete an email	1/7
e)	Close user session	0/7

So, we conclude that this improved interface contributed to obtaining a better performance of older users and this will pay off in more confident users, who use email application more frequently and who are willing to go on learning new Web applications.

V. DISCUSSION

Many of the difficulties suffered by older Web users are already solved. However, as older people do not recognize their disabilities, they miss the opportunity to use the Web in a more comfortable way.

There are many accessibility tools provided by the operating systems and also by the Web browsers. But as they are classified as 'Accessibility Tools', most users believe that they are targeted to help people with severe disabilities that do not include the elderly.

Besides, there are some useful accessibility tools developed and available in Web repositories.

We have worked with some email accessibility requirements detected while teaching computing courses to older adults. Experiment 1 allowed for gaining a significant experience to develop our ideas, while Experiment 2 applied for testing these ideas on the field.

We found that some of the detected requirements could be solved by modifying the Web browser or the operating system configuration. Other requirements were accomplished by installing some scripts that provide the desired accessibility adaptations, like the scripts (CleanUp 1.1 and Oldie 1.0) we proposed and developed to solve Problems 1 and 3, respectively.

However, all these solutions require assistance from a computing specialist, or at least, from someone with the required skills, who must configure or install the appropriate add-ins.

Thus, we are working on a pragmatic research approach and applying an iterative incremental process to develop a tool that includes all the accessibility adaptations and allows older people select the appropriate configuration by themselves. Besides, this tool must be able to provide help to older users, who are not familiar with application concepts and hence avoiding hesitation and frustration. All this will contribute to increasing quality of life of our Patagonian older Web users.

VI. CONCLUSION

Older adults represent the fastest growing portion of the world's population. Most older adults have got some declines that affect computer use, as difficulties with vision, hearing, mobility or cognition.

The World Wide Web Consortium (W3C) has got some initiatives like Web Accessibility Initiative (WAI) and Web Accessibility Initiative: Ageing Education and Harmonisation (WAI-AGE), which provide solutions to many of the problems of older people. However, many Web designers do not consider WAI recommendations when designing Websites.

So, there are some approaches focused on improving Websites' accessibility. Some of them consist on Web adaptations that provide solution to a varying amount of accessibility issues.

In this article, we showed different solutions provided to solve distinct older pupils' requirements. However, from our

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experience, we must highlight two issues about these solutions: (i) they do not cover all needs and, (ii) they are not usable enough for elderly citizens. Due to these reasons, new solutions should be developed and these solutions must prevent older people having to get help from someone else who can configure or install suitable accessibility settings to grant our seniors one of their main wishes: "independence".

As regards social requirements of our older students, our next goal is exploring difficulties experienced by them with social networks and finding appropriate solutions. This is a high priority requirement of our older citizens since our distant geographical situation and extreme weather conditions deprive them of enjoying many current activities that older people in other geographies can perform.

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