AdaptNow – A revamped look for the web

An online web enhancement tool for the elderly

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Abstract. Elderly population will become the largest age group of our society in the next twenty years. Consequently, we need to be able to accommodate technologies to the needs of this population. AdaptNow is a web-based application that allows users to adapt existing webpages and turn them more accessible and user friendly. Users can do so directly from any web browser thanks to AdaptNow's user personalization and automatic adaptation artificial intelligence algorithms. In this paper we present the design and implementation of AdaptNow, a solution that improves navigation on the web for elderly users.

Keywords: Web enhancements, Elderly users, Accessibility, Human Computer Interaction.

1 Introduction

A recent study predicts that elderly population will become the largest age group of our society in the next twenty years [1]. Consequently, we need to be able to accommodate technologies to the needs of this population. Policy makers are already working in accessibility and inclusive design methods in an attempt to provide a barrier free society with initiatives like [2], [3]. Universal design aggregates a wide group of ideas that have the objective of producing buildings, products and environments that are built to be usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life [4]. The difficulty in using computer systems by people with impairments is a well know problem. Despite the current efforts in accessibility, computer interfaces are still an accessibility barrier for elderly users. Interfaces are typically designed with the assumptions that 1) they are going to be used by able-bodied individuals; 2) using an typical set of input/output devices and; 3) that users will be in a static environment [5]. Further, elderly users are generally associated with impairment due to the loss of motor and visual capabilities due to the ageing process [6]. Hence, complex and multi-functional systems may present substantial cognitive challenges for elderly. In an attempt to make the usage of technology more comfortable some applications have been developed to aid in the interaction with technology [7]. These are divided in two groups, hardware and software. For the first there are devices such as special computer mice that increase the user's control, and larger

screen monitors that ease the reading. As for software, there exist client-side applications that enhance the font size, colour and font family of the operation system [8]. Unfortunately, many of these approaches have been discontinued either by lack of funds, their complexity, expensive maintenance, or because the target audience is a minority with low resources [9].

One particular case in point is that of web pages. Web 2.0 technologies are quickly gaining popularity due to their power in terms of design, flexibility but also because of their tremendous reach. Unfortunately, there is still a poor adherence to accessibility standards. Consequently, people with disabilities meet barriers of all types while navigating the web that make it hard for them to understand what they should do [10]. These barriers come in form of confused webpages, abundance of misleading ads, unnecessary videos, moving information, etc. Moreover, the abilities of elderly users can fluctuate throughout the day due to several factors (fatigue or medication), or evolve across days or months following longer-terms age related changes [5]. This makes it hard to create general purpose interfaces that can be a best fit to everyone. Hence, the ideal solution needs to be adapted according to the environment and the specific needs of the user.

With all this in mind, the goal of AdaptNow is to provide a web enhancement navigation tool that simplifies and eases web experience. AdaptNow is a web platform that dynamically enhances the original webpages through an artificial intelligence (AI) system trained with elderly user data. By using AdaptNow to enhance navigation and remove all undesired noise around the desired action we want to provide a simple and adaptable solution for web navigation. AdaptNow provides users with a simple way to configure enhancement settings. Further, AdapNow improves its AI by tracking user behaviour and extrapolating settings from similarly designed websites.

2 Methods

AdaptNow is a web based enhancement system for elderly and impaired users. AdaptNow was designed after several field studies and development iterations in an attempt to understand how to improve web experience and minimize the effect of age related conditions and/or the lack of web experience.

2.1 Web enhancements and artificial intelligence (AI) modelling

To understand what elderly would do to enhance usability of webpages we performed a first experiment with a system that was able to modify several features of web pages, such as 1) highlighting (box/underline) clickable objects with user defined colours; change the mouse pointer 2) size and 3) visual aspect; modify 4) zoom as well as 5) font sizes; and 6) page scrolling mode (Fig. 1). We interviewed and evaluated the prototype with 12 users with ages between 51 and 63 years old to understand how elderly users would adapt the above mentioned features in web pages to improve navigation. For that purpose we tested 10 different web page examples in several domains such as social, news, travel, mail and search engines.

Fig. 1. Some of the features present during the first user experiment. a) Mouse cursor sizes; b) Mouse cursor over links; c) Available cursor colours; d) Link enhancement colours; e) Link enhanced with box/underline; f) Webpage with high zoom and low font size; g) Page with low zoom and high font size.

Next, we used the data to quantify and model the relationship between webpage characteristics (website dimensions; number of images, buttons, heading tags, divisions, scripts, and links; flash content; image sizes; and screen resolution) and the corresponding adaptations made by users. We used a multi linear modelling approach, using step-wise regression, to create a model of users preferences based on web page characteristics. Using each user's enhancement choices the model will provide an adaptive yet personalized set of enhancements. Based on this procedure, we obtained equation 1, which is used to provide the values for the automatic enhancements.

$$Enhancement = Coefficient_0 + Coefficient_1 * Characteristic_1 + \ldots + Coefficient_n * Characteristic_n \quad (1)$$

2.2 Enhanced history and bookmark visualization and navigation

To build a revamped history view and a dynamic bookmark navigation we interviewed 17 additional people of two age groups (>40 (A) and <40 (B) years old). The average age was 47.8 and 22.6 years old for A and B respectively. We also considered the younger group (B) because of their large web experience. Information provided by B could bring in interesting insights and can acts as a control group for A. We asked users about what information they value more in a history view (time spent on a web page, number of visits, type of content), how to highlight pages they visit the most (icon size, colour, contrast, total visits counter), and how to present the information (all pages at once, showing the order of navigation, grouping pages of the same domain).

2.3 Implementation

The system is a fully web based application in order to make it accessible from everywhere, designed to work on any modern browser and from any device without the need of any installation. AdaptNow uses a combination of 1) html and css technology to define webpage enhancements; 2) a server-side php and SQL database to implement AdaptNow's AI, create user profiles, store user settings, and history; 3) a client-side Javascript/JQuery to modify the original webpages in real-time by injecting the html/css enhancements in order to make navigation smother and more intuitive to the user; and 4) a server-side transformation proxy that allows a web page to appear to come from a local server to overcome cross-site scripting restrictions using the open source WebAnywhere framework [10]. AdaptNow records all the enhancements applied by the user to visited webpages and creates both a personal and global website adaptation models to best fit the learnt preferences.

3 Results

The first experiment allowed us to define the core AI that models each web enhancement (zoom factor, font size, mouse cursor, etc) as a multivariate linear regression of the variables that define the web page characteristics (resolution, page height, number of words, etc). Interestingly, our modelling approach allows us to identify and quantify to what extent web site features do determine the enhancement choices made by elderly (Table 1). From these results we were able to fully model zoom and text enhancements with an average error of 6-7% (Table 2). The border and button enhancements could also be satisfactorily modelled using the multivariate approach. Some of the enhancements could not be satisfactorily modelled with a linear approach due to their underlying bimodal nature.

All statistically significant enhancement models were implemented in AdaptNow to enable the system to learn from the data collected from the user and automatically build adaptation model for each user, making the automatic adaptations system a best fit for each one (Fig. 2).

Table 1. Web page characteristics and their corresponding web enhancement AI model. The used web page characteristics are a) Screen Width, b) Page Height, c) Number of words, d) Biggest image Width, e) Average image width, f) Number of scripts, g) Number of H1 tags, h) Number of H2 tags, i) number of divisions.

Propriety		a)	b)	c)	d)	e)	f)	g)	h)	i)
Zoom (0-100)		0,0001	-	-	-	0,0088	-	0,0005	0,0237	-
Text Size (0-100)		-	0,0001	0,0008	-	-	-	0,0001	-	0,0001
Link Enhancement	Box (0-1)	-	-	-	-	-	-	-	-	-
	Underline (0-1)	-	-	-	-	-	-	-	-	-
	Colour	-	-	-	-	-	-	0,0108	-	-
	Border Size (0-100)	-	0,0001	-	-	-	-	-	-	0,0001
Button	Enhanced (0-1)	-	-	-	-	-	-	-	-	-
	Colour	-	-	-	-	-	0,0003	-	-	-
	Border Size	-	-	-	0,0003	-	-	-	-	-

From the second inquiry, the feature that was chosen as the most important for automatically adding a bookmark to a webpage was the number of visits. Group B, the more experienced group, classified the amount of time spent on a page also as very important. Therefore, both time spent on the webpage and number of visits is used for dynamically adding a page to the “most visited” section. To avoid a history of visited pages that current web browsers use containing long lists of redundant information that are very difficult to search we asked users about how they would prefer infor-

mation to be presented. Interestingly, users preferred grouping all pages of the same domain, what is the opposite of what current browsers do. Users also reported the importance of showing the navigation order of the visited pages. Finally, we presented users with three models of possible history views and asked them about what they would do in order to identify the most visited ones. The most consensual answer was showing the number of visits to each website, following the icon size and the contrast of the displayed icon (Fig. 3).

Table 2. - Web page characteristics and their corresponding model significance and error. * p<0.05, ** p<0.01, and *** p<0.001.

Propriety		P-VAL	Model significance.	Mean Error
Zoom (0-100)		2,61E-10	***	5,5739%
Text Size (0-100)		3,06E-18	***	6,6132%
Link Enhancement	Box (0-1)	0,4264	-	42,07%
	Underline (0-1)	0,4264	-	42,07%
	Colour	0,1851	-	70,08%
	Border Size (0-100)	0,0034	**	7,8799%
Button	Enhanced (0-1)	3,60E-173	***	0,23%
	Colour	0,0356	*	58,33%
	Border Size (0-100)	1,38E-09	***	5,5729%

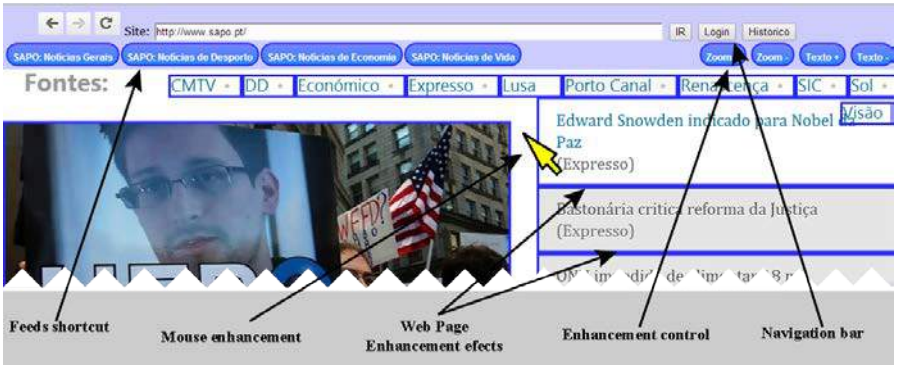

Fig. 2. AdaptNow interface visualization of an enhanced webpage

After 2 field studies, we implemented the beta version of AdaptNow. AdaptNow is currently composed of 3 main visual components: navigation, adaptation, and webpage. The first component presents the user with: 1) an address bar to choose where to navigate, and a back, forward and refresh buttons; 2) A login but-

ton/functionality is also available where the user can access and modify his/her settings and default information; and 3) a button to the history view. The second component shows the complete list of feeds (RSS) that a specific website is broadcasting to visualize the feeds in AdaptNow's own web enhanced RSS reader. In addition, direct buttons to web page enhancement options such as zoom and text alterations can be used at any time. The third and most important component is a large frame containing the enhanced web pages and where all the adaptations take place (both web page and mouse cursor and scrolling enhancements) (Fig. 2). With this design we want to achieve a layout similar to a regular web browser window in an attempt to reduce the amount of changes from what is expected by users.

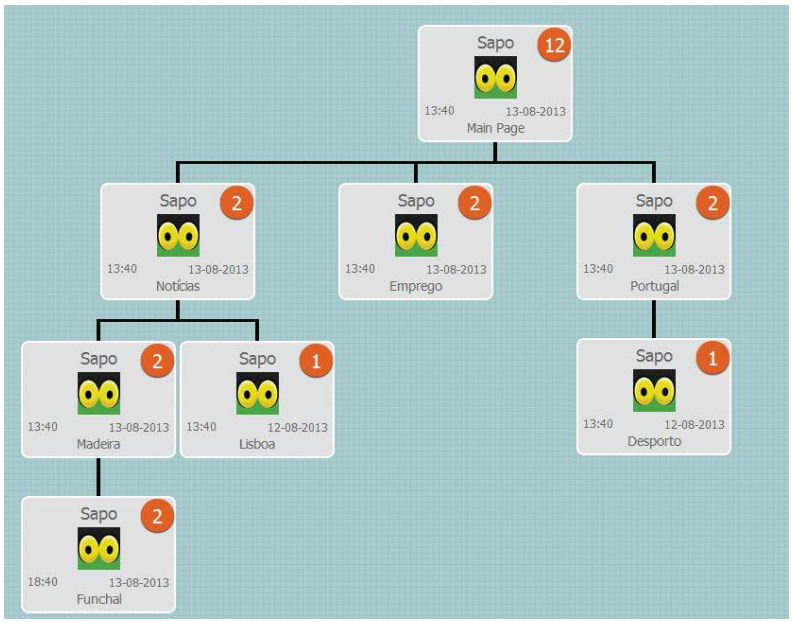

Fig. 3. AdaptNow visualization of the history visits of a webpage.

4 Conclusion

We believe that AdaptNow provides useful insights as how simple alterations on regular web pages can make the web more accessible to elderly. Further, the AdaptNow tool is web based, making it worldwide accessible though all computer platforms that support a modern web browser. AdaptNow is developed after 2 field studies that informed us on how enhancements are used depending on the characteristics of each web page, and how we can improve history visualization and bookmark navigation with contextual information. An interesting feature of the system is that the more we use the system the more data we collect, consequently making our AI more accurate and personalized to each user to deliver more accurate enhancement.

A similar web enhancement was done by [11] where they proposed an adaptation of the a particular web page by decomposing it in its different divisions and reordering them to create a new navigation experience. Our approach differs from previews because AdaptNow is completely web-based and does not require any installation and the user profile and data is available everywhere. Another aspect that differs is our automatic enhancement system that changes the web page based on the learnt preferences and web page characteristic. Something similar can be achieved in more generic terms for a larger group of webpages if the new tag system from HTML5 is used. With this in mind we think that a deeper study of HTML5 and CSS3 functionalities is necessary to determine what can be achieved once most web pages start using these standards. These types of enhancements work well in responsive webpages because these pages adapt the content to the view and reorganize themselves automatically.

As we continue the development of AdaptNow we hope to achieve a full integration with WebAnywhere allowing us to use speech technologies to provide additional information through speech that could be relevant to users. AdaptNow currently does not support pages like Facebook that explicitly prevent their pages to be rebuilt locally. Local rebuilding needs to be done in order to overcome cross domain restrictions, so a new approach needs to be explored to solve this issue.

5 References

1. P. L. Emiliani, L. Burzagli, M. Billi, F. Gabbanini, and E. Palchetti, *Report on the impact of technological developments on eAccessibility*. 2008.
2. European Commission, "Web Accessibility," 2014. [Online]. Available: http://ec.europa.eu/digital-agenda/en/web-accessibility. [Accessed: 10-Jan-2014].
3. European Commission, "Design for all for eInclusion," 2013. [Online]. Available: http://ec.europa.eu/digital-agenda/en/content/design-all-einclusion. [Accessed: 13-Dec-2013].
4. Ron Mace, "North CarolinaState University - Ronald L. Mace," 1998. [Online]. Available: http://www.ncsu.edu/ncsu/design/cud/about_us/usronmacespeech.htm. [Accessed: 31-Jan-2012].
5. K. Z. Gajos, D. S. Weld, and J. O. Wobbrock, "Automatically generating personalized user interfaces with Supple," *Artif. Intell.*, vol. 174, no. 12–13, pp. 910–950, Aug. 2010.
6. P. Gregor, A. F. Newell, and M. Zajicek, "Designing for dynamic diversity: interfaces for older people," in *Proceedings of the fifth international ACM conference on Assistive technologies*, 2002, pp. 151–156.
7. [M. Impairments, "Working Together : People with Disabilities and Computer Technology Providing access to technology," *DO-IT*, 2012.
8. V. L. Hanson, "Web access for elderly citizens," *Proc. 2001 EC/NSF Work. Univers. Access. ubiquitous Comput. Provid. Elder. - WUAUC'01*, p. 14, 2001.
9. K. Z. Gajos, D. S. Weld, and J. O. Wobbrock, "Decision-Theoretic User Interface Generation," *interactions*, 2008.
10. Andrew Arch (W3C), "Web Accessibility for Older Users: A Literature Review," 2008. [Online]. Available: http://www.w3.org/TR/wai-age-literature/.
11. J. Chen, B. Zhou, J. Shi, H. Zhang, and Q. Fengwu, "Function-based object model towards website adaptation," … *World Wide Web*, no. 49, pp. 587–596, 2001.