Context Sensitive Accessibility Aid to Middle-Aged Adults and Elderly Users in Web Systems

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ABSTRACT
This paper describes an interaction mechanism aimed at enhancing the accessibility of Web pages to middle-aged adults and seniors. The proposed approach builds on previous research on problems commonly encountered by these users. The presented solution encompasses the customization of Web page layouts and the use of automatically-generated voice prompts to users. One of the main contributions of this work is the use of contextualized aids according to the genre of Web pages and the types of features they contain. An automatic page categorization scheme has been developed, alongside with a tool to collect knowledge from users about the nature of pages. The preliminary results from a usability inspection of the tool are discussed, and proposals for future investigations on the impact of this technology on the accessibility of websites for middle-aged adults and senior users are also outlined.

Categories and Subject Descriptors
H.2.2 [Design Tools and Techniques]: User Interfaces;  
H.5.4 [Hypertext/Hypermedia]: User issues

General Terms
Accessibility, Human Factors.

Keywords
Web accessibility, middle-aged adults, elderly, adaptation

1. INTRODUCTION
Demographic and epidemiological changes have brought a significant increase in the population of middle-aged adults and seniors in Brazil. It is estimated that the period 2000 to 2050 will encompass the largest increase in the proportion of elderly, from 5.1% to 14.2% and in 2025, the population over 60 will reach 34 million people [1].

One way to quantify the quality of life of an individual is by means of the degree of autonomy with which he/she performs the day-to-day tasks and his/her ability to carry on tasks such as looking after personal hygiene, cooking, organizing their finances, ability to make purchases, among others [1].

The Web can be regarded as an essential facilitator to obtain information and services, especially when one begins to show functional decline associated with aging, which prevents him/her from performing their daily tasks. Therefore it is of fundamental importance that an individual can perform their interactions with the Web in a satisfactory manner, despite possible difficulties.

Most Web sites, in order to offer increasingly sophisticated pages, use technical resources that can become barriers to access for certain groups of users. This includes middle-aged adults with limited experience using computers, the elderly and the people with special needs.

The demand for productivity and the development speed of sites often leads the developers not paying attention to the human aspects. The time pressure makes them worry primarily about creating technologically efficient environments, but leaving aside specific needs of certain groups of users.

To facilitate the experience of people in interactions with the Web, it is essential to take into account the needs of different user profiles. However, currently solutions have failed to address problems such as lack of skill in the use of web applications and learning difficulties of such applications by middle-aged adults and the elderly.

This paper presents a support mechanism for Web interaction developed as an add-on, which aims to enhance browser functionality, allowing people with differing needs to access the services originated from interaction with the Web in a more natural way and as much independently as possible, providing improvements in quality of life, and promoting their social integration and also their inclusion.

This paper is organized as follows: in Section 2 are shown the main problems associated with aging that influence the interaction of middle-aged adults and elderly with Web pages, in Section 3 is presented the proposed mechanism, called Tuki, which was developed to support interaction with the Web and in Section 4 are presented the conclusions and future work.
2. OLDER ADULTS AND THE WEB

The definition of middle-aged adults, for the purposes of this study, was considered as adults who are older than 40 years and below 60 years of age, and seniors as those aged over 60 years. According to the literature [2], there is no physical or biological marker to determine accurately the point in time when the end of the maturity or the onset of old age. This process is influenced by several factors such as gender, socioeconomic status, physical and mental health conditions, habits and lifestyle, and others [2].

According to the N/N Group [3], the main reasons why older adults are using the Web, aside from work demands, are: catching up with news, finding out about diseases and medications, reading about hobbies, travelling, finding recipes, religion-related activities, among others, and especially to communicate with family and friends. Part of these users also uses the Web to shop online and to carry out banking activities.

By means of field observations, we could really see that Web use by middle-aged adults and elderly people currently has more to do with entertainment than with the actual need of carrying out day-to-day tasks. It was also noted that many users have no awareness of the benefits of Web use and blame themselves for the difficulty in learning, using as an excuse their lack of experience with technology resources and their cognitive difficulties of memorization of procedures [4].

Several studies have been found in the literature addressing the effects of aging on cognition. Most of them have focused on major cognitive functions such as memory, reasoning, problem solving, and language, among others. The skills that present declines during the aging process are especially those that require an efficient working memory [5] [6] and fast processing [7], which means that the cognitive activities that rely more heavily on fluid intelligence, such as cognition and spatial reasoning, dealing with the maintenance and manipulation of visual images tend to be negatively affected by aging [8]. Studies have reported that early spatial deficits appear around 40 years of age and may become more pronounced after 50 years of age [9].

Working memory or the ability to keep information active declines with age and often appears as a limiting factor in performance in speech understanding, handling quantitative representations, and others [10]. In some situations, these limitations of working memory can be reduced by the exercise of constant practice of certain tasks (memory tasks) or by means of formation of planning strategies, or support to the work environment, with the objective of reducing memory demands.

Compared with younger adults, older adults are slower and less successful in acquiring new procedures, once they process information more slowly. The differences between ages increase with task complexity, particularly with respect to activities that require coordination of multiple tasks simultaneously [10]. With regard to attention, both visual selective attention (scanning in a visual display) and the dynamic visual attention (redirecting the focus of attention) show declines during aging [10].

Therefore, according to Fisk et al. [10], older adults are benefitting by receiving guidance and suggestions to get your attention in design elements. Following this approach a support mechanism was created to enhance the interaction of middle-aged adults and seniors with Web pages that will be described in the following section.

3. THE TUKI MECHANISM

Aiming to reduce demands on working memory, the Tuki mechanism was prepared in order to facilitate and encourage Web interaction by middle-aged adults, seniors and people with special needs.

The Tuki mechanism was designed with the aim of being a lightweight program, to add functions to enhance usability and accessibility for user interaction with the Web page, providing greater integration between them. Its main function is to provide aids and support during the interaction of middle-aged and older adults with the Web.

To create a mechanism capable of providing appropriate aids to the interaction of middle-aged adults and elderly with the Web it was necessary to make a categorization of Web pages accessed by the most common target audience and also those who would bring them more benefits if used in old age.

The categorization was the automatic identification of the main elements of interaction present in information-intensive Web (online newspapers, government pages, wikis, etc.), shopping sites, banks and services, form pages, and others. From the assignment of a page into a given context-category, it is possible to elaborate set of messages and tips that would be appropriate use for the user.

To perform the automatic categorization of a Web page, the engine extracts information items of the source code of the page, which encompass an analysis of their own page URL, metadata, titles, and the quantification of links, paragraphs, images and objects in flash, among others, a weight is assigned to each item, in order to help categorize it. The total values used for the classification are: minimum relevance (2), low relevance (5), relevant item (10) and maximum relevance (50).

The relevance of an item is described by its weight confirmation, or how this item can confirm that the page belongs to a particular category. The higher the weight of the item of relevance is the best match for the category. For example, the greater weight (50) is attributed to the presence of significant URLs of pages for a particular category or due to the presence of metadata, such as %tube% in URL for video category. The main categories observed and used as the basis for the construction of the behavioral actions of the support mechanism are: informational pages, online newspapers, government pages, collaborative pages, business pages (that place products on sale online), pages of banks (little relevant information can be extracted from this type of page because of the fact that they are secure pages) and pages containing forms.

It is noteworthy that the choice of items was performed by observing the source code and programming patterns present in most HTML pages accessed, where we selected the tags that are repeated more or uniquely identifying the category of Web page.

In addition to the automatic processing performed by the Tuki mechanism, another plug-in for Mozilla Firefox was developed, which allows the deployment of the classification according to the perception that users had the page. It was decided to make this collection due to the fact that the access to a free Web-based tool is a viable technology for the creation of a large corpus of classified Web pages according to the user's perspective.

After installing the classifier mechanism, in each new Web page that is accessed by the user, a form of classification appears, in
which the user must report his/her age, choose the most appropriate category to that page and send to server application, which registers the number of ratings per URL/category. The user can stop running the plug-in at anytime. In this first period made available an initial simple set of categories, such as information, banking, sales/purchases, videos and collaborate pages. The target audience used for this index was primarily undergraduate and postgraduate students in areas related to computing, because it is a public that has greater experience in using Web resources.

The Tuki mechanism, when activated, performs an automatic classification for the current Web page and the browser checks for a benchmark classification outside (free sort collected via Web user participation) for that page. After completion of the classification of context-category of Web page, behavioral actions are performed by the engine (Figure 1).

The implementation of the mechanism, was performed using a development tool for add-ons from Mozilla Labs called Jetpack Prototype [11] and its APIs [12]. This tool enables the development of scripts that can change the interface pages that are displayed by the browser Mozilla Firefox.

![Figure 1: scheme of operating the facility TUKI](image1)

![Figure 2: highlighting the option of creating accounts](image2)

![Figure 3: focus on the options menu](image3)

![Figure 4: emphasis on the field to be filled](image4)

The first step is to make changes in page layout, eliminating pop-ups, banners and other elements that have been shown to affect this audience interaction with Web pages. The definition of the Tuki mechanism behavior depends directly on the elements present in the Web page itself concerned. Suppose, for example, that the current Web page is a Wikipedia page. In the first step it will be categorized as a Wiki page. From there, it will extract the present options on their menu, so the engine can instruct the user as to how he can use the page and what options he can access, as shown in Figures 2 and 3.

The mechanism of support for wiki pages highlights the main elements by including a border around the option while it reproduces an explanatory text via voice. For the option of creating accounts (Figure 2) the user hears: "If you want to create a user account or enter an existing account click the mouse in this region". By highlighting the left side menu (Figure 3) is reproduced the following statement: "To the left of the screen are the navigation menu, click the mouse on an item to access it".

If the Web page in question contains a form, the Tuki mechanism identifies the elements present and puts an outline around the input fields to give greater prominence to them at the same time it instructs the user via voice message to click the mouse on the highlighted field and start typing using the keypad, and the explanation of alternative means of access, such as shortcut keys, among others (Figure 4). Immediately after completing the field by the user, the Tuki mechanism sends a text message on the interface "field filled!" and performs the highlight of the next field.
such modifications. Considering that the development platform is based on JavaScript (with support for jQuery), CSS and HTML, this language associated with the DOM, it enabled the plug-in to do the identification, addition or removal of elements, such as pop-up windows and banners, by keywords (located on the page source) that tend to be standardized by the developers of the sites.

For playback of voice messages via software was used TextAloud [13], which converts text documents like txt, html, pdf, doc, rtf in natural language, including Portuguese language.

It is worth noting that with the Tuki mechanism it is possible to extract any information that is present in the tags of the source code of the webpage, and that the higher the level of information contained in these tags, the better its performance in helping to interact with the pages.

The main objective of this mechanism of usability and accessibility is to encourage middle-aged adults and seniors to use the Web in their day to day in order to reap the benefits that this interaction can give them, especially when they reach old age.

4. CONCLUSIONS AND FUTURE WORK

The growth in Internet usage has occurred in parallel with its own evolution, since it is no longer just a repository of static pages that provided information to its users and now offers support in various segments of their lives. Currently, in addition to providing applications for communication, entertainment and services online, it must be also offered support for the realization of the interaction between users and resources available on the Web.

Initially a usability inspection was performed on Tuki mechanism, according to the Nielsen heuristics for evaluation of prototypes and initial designs [14], where the main suggestions made by experts were: inclusion of the indication that the mechanism is active or not (on/off); addition of the symbol [x] to close it, aiming to avoid potential clicks on the image of Tuki; although the image used by the engine was very striking to the user, it is not explicit in its appearance that it is a mechanism to support accessibility; possible adjustments in calculations of time spacing between one another for help and action on registration pages, based on the average time of filling in fields for real users and also the capture of task completion by the user; inclusion of documentation and assistance to the user in the interface of the mechanism. This absent of documentation occurred because the Tuki mechanism was designed to be a plug-in for Mozilla Firefox browser, and because of its nature, must be very light on his activity, so that the documentation concerning its operation will be included in their respective page of installation.

The evaluation of Tuki mechanism by middle-aged and elderly is currently underway, and the results of the analysis should provide more insight into the impact of the use of such a mechanism on the interaction of these users with Web sites.

The next step in the development of this mechanism is to capture user interactions, and from that interaction be able to provide appropriate aids to the desired interaction, such as what users can do from where they are. Other features include splitting a complex task into smaller steps, recovering previous navigations as a way to remember a forgotten procedure, and others.

The next stages of this work should consider the extent of modeling behavioral actions of the Tuki mechanism, to work in pages of e-commerce, collaborative editing, among others, and also the storage of data about the interaction, allowing the user to remember their steps and achievements, showing when prompted, everything has been done in terms of navigation, how and which transactions were conducted, among others, to reduce the demands on working memory and prior knowledge.

5. ACKNOWLEDGMENTS

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6. REFERENCES
