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Aligning Usability Requirements with the Accessibility Guidelines focusing on the Visually-Impaired

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Abstract

The user interface should meet the expectations and needs of a variety of users. They should be accessible by any person, independently of their physical, perceptual-motor, social and cultural capabilities. The current research aims to show that the development of accessible Web applications goes beyond the design of sites in compliance with accessibility guidelines: usability issues should also be addressed. The interaction between visually-impaired persons and several sites was observed and the problems detected in this process, were analyzed. The analysis was based on a taxonomy of non-functional requirements (NFR) related to usability. This taxonomy was aligned with the accessibility guidelines aiming to help professionals in the identification of accessibility and usability problems that may avoided or minimized during requirements planning, and thus, facilitate the interaction of visually-impaired users with the Internet and provide sites that offer content that is easy to understand and are easy to navigate.

Keywords: usability, accessibility, visually-impaired

1. Introduction

The present article is aimed at showing that to really obtain accessible web applications it is necessary more than just guarantee a code compliant with the accessibility directives; usability's issues must be considered. Towards this end an exploratory study was conducted, comprised of a field study at the Instituto Benjamin Constant (IBC), main reference center in Brazil for the education and re-education of visually impaired persons, where various visually disabled people were observed and the usability problems were analyzed. During the analysis, based on an "Usability Taxonomy" (Ferreira, 2003), the non-functional usability requirements (NFR) listed in the taxonomy were aligned with the accessibility directives with the objective to assist systems' professionals at identifying and defining usability and accessibility problems that can be solved or minimized during the system definition.

2. Usability aligned with the accessibility guidelines with a focus on the visually impaired

Even though usability issues determine the easy use of an interface, one cannot forget that interactions are also influenced by the users' ability in properly detect, interpret and respond to the systems' information. In the computational environment, great part of information is presented visually, so the computational skill of a person relies essentially on complex visual processes [1].

Visually impaired persons, when accessing an application, require an assistive technology; these technologies capture the interfaces and turn them. The Access to the internet (or other computer application) of a blind is done by means of software called "screen readers", connected to the interface and associated to other programs called "voice synthesizers." [17] [2]. So, interfaces must be designed in such way that, when accessed by a screen reader, they

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continue to provide friendly interactions, with simple and consistent sequences that clearly indicate what must be done without letting the user confuse. The interface must guarantee a transparent communication, that is, it must assure that when a user accesses system to perform any task, he or she needs only to focus their energy on the intended task [3].

Usability problems are considered any observed characteristic that might prejudice the performance of a task, might annoy or distract a user. So, usability issues related to accessibility occur, generally speaking, due to three reasons: the main aim of accessibility evaluation programs is compliance with directives where usability aspects are overlooked; many evaluation programs rely only on syntax verification techniques for sites and so detectable errors are limited to the tag description layer and usability aspects are not considered; and finally, the users' mental models are not taken into account once that evaluation programs do not take in account that users hardly ever sit passively waiting to hear a spoken exit; they move around Web pages using complex combinations of keys. By means of this process, they create their own models and attempt to surf Web pages in a logical way [4].

3. Research method

The study, exploratory in nature, was carried out in three stages:

A) Selecting the Category of Users: Users with visual impairment were chosen as the object of study of the present work; this decision was made based on the fact that the Internet has done much to contribute to improving the quality of life of those visually impaired, allowing them not only access to information that was previously only attainable with the help of another person, but also providing them with other facilities [5].

B) Field Work: Field work was conducted at the IBC, an agency of the Ministry of Education, founded in Rio de Janeiro in 1854 under the name of *Imperial Instituto dos Meninos Cegos*. IBC has become a center of excellence and national reference in matters related to studies of visual impairment. Its main aim is to promote the education and integration of visually impaired persons within a greater framework. During the field work, which took three months, different sectors of the institute were observed. In addition, several informal interviews and six in-depth interviews were conducted with employees, students and former students at the institution, most of who are visually impaired and work there nowadays.

C) Selection of the usability analysis method and alignment of the usability requirements with accessibility directives: During this phase, different methods of analyzing usability were analyzed. It was selected the analysis based on a NFR usability taxonomy proposed by Ferreira and Leite [6]. This taxonomy was chosen because it is being systematically used to analyze several sites. Once the analysis method was determined, the NFR usability listed in the selected taxonomy were aligned with the accessibility directives with the objective to assist systems' professionals at identifying and defining usability and accessibility problems that can be solved or minimized during the system definition.

4. NFR usability

A good interface must be easy to use and must be accessible by any person. So the user interface's designed must be oriented to usability and accessibility. To achieve this end, its design must guarantee a transparent communication, that is, it must assure that when any user accesses the system to perform any task, he or she needs only to focus their energy on the intended task. A powerful and easy to use interface can only be developed if there is a way of guaranteeing that the NFR usability is taken into consideration at the system definition, and also, that is oriented to accessibility. The design of an accessible interface that considers user characteristics and the NFR usability is a difficult process for many reasons, but most of this difficulty can be traced to the lack of attention on NFR during the system definition process. Building systems that take in consideration NFR, require the availability of a corpus of knowledge to help the engineer in the task of defining the system to comply with those requirements [7].

Current article aimed at showing that to really obtain accessible web applications it is necessary more than just guarantee a code compliant with the accessibility directives; usability's issues must be considered. Do this work can be a starting point on the direction of producing a corpus of knowledge on accessibility and usability, in such a way that it could be used in the context of the NFR framework). The approach used here is a qualitative one, that is, it is

used a taxonomy, shown in Table 1, that has been put together using as source the general literature on design and usability and the authors experience with the topic. The taxonomy is organized around two main categories: presentation and data entry. The taxonomy allows analyzing interfaces of information systems pointing out the problems that an organization may find when the NFR usability is not taken in consideration. This taxonomy was used in this article to align the NFR usability requirements with the accessibility directives in order to support systems' professionals at identifying and defining usability and accessibility problems that can be solved or minimized.

Requirements Related to Information Presentation	Requirements Related to data entry
A) Consistency	A) Help facilities
B) Feedback	B) Minimize Error
C) Different Ability Level and Human Behavior	C) Error Recovery
D) Human Perception	
E) Metaphor	
F) Minimize Memorization	
G) Efficiency on Dialogue, movements and thoughts	
H) Commands Functional Sort	
I) Direct Manipulation	
J) Exhibit Only Information Essential to the Context	
K) Meaningful Labels, Abbreviations and Messages	
L) Proper Use of Windows	
M) Resolution Independency.	

Table. 1. Non-functional usability requirements Taxonomy

5. NFR usability taxonomy aligned with the accessibility directives

5.1 Requirements Related to Information Presentation

Since the technology infrastructure used to construct web sites can deal with images, sounds and text composition, it became more evident that the output of information should be treated with care. Information presented cannot be incomplete, ambiguous or unintelligible. So, to present information properly, it is necessary to attend some requirements in order to design efficient interfaces. The following sections present practices that help to promote accessibility and turn facilitate the interaction done by an assistive technology, like a screen reader.

A) Consistency: Consistency is one of the main features for the usability of an interface. It helps avoiding the frustration induced when a system does not behave in an understandable and logical way. Moreover, it allows a person to generalize the knowledge about one aspect of the system to other aspects [8]. In a consistent interface, all menus, commands, information exhibitions, and functions have the same visual presentation and behavior [9]. To preserve the consistency of the information presented by means of screen readers, it is necessary to remind that the order in which a screen element appears to the user accessing a page by voice reader is not the same order in which it appears visually on a navigator. What determines when it appears on the screen reader is the position it holds in the source code; so programmers must be careful with this position. It is essential to write consistent codes in order to guarantee that elements appear in the same order in all interfaces (visual, sonorous etc.) that constitute the system. When the project of the site is altered, this obliges the visually impaired user to relearn the name and position of all the key elements on the page. Though this was not considered an obstacle, the visually impaired interviewees [18] [19] [20] wished to be notified every time a new version of the site came into effect. One interviewer reported that, when the page of her provider was modified, she and her husband, also blind, had no idea what was going on, unsure of whether it was an error on the part of the program or something they had done wrong [20]. One suggestion to cater to the needs of the visually impaired user is to put some identification inside the page containing the number and date of the current version. It is recommended that the alt attribute should always be present so that contents can be read by a screen

reader. The alt attribute (alternate text) provides an alternative text associated to an icon or image. If the texts for these icon or image attributes are written appropriately, they can provide useful information for disabled users with respect to the meaning of the images being read by the screen readers [2] [10] [5]. But when a site contains an icon or image without an alt attribute, this image may be detected or not; it will depend on the screen reader program being used. Some readers don't pick up anything, while others may indicate the existence of an "image" to the visually impaired user, but cannot furnish any information about the nature of the figure [2]. When navigating by means of keys, it is essential that the text describing the link be identified in an informative and useful way [5]; this text will be picked up by the screen reader and it is by this means that the disabled user will know what the link is for. So, simply identifying links with words like "click here" or "next" are an obstacle for users who rely on voice readers, as is the case of the visually impaired [2]. Just like icons' names, the links' texts must be standardized among the whole site.

B) Feedback: In well-designed sites, proper feedbacks orient the user when navigating through their pages. An example of a good feedback is when the site highlights the link that the user is about to choose. Once the user follows this link, his new location must be informed in some way. This can be accomplished by using the same name for the link and the page to which it leads [6]. Another proper feedback related to links and navigation is when the site changes the appearance of visited links. But these feedbacks are typically visual features and they are useful just for sighted people, once they rely essentially in the users' visual ability. A proper way to provide this type of feedback is to use the "title" tag, when a user accesses a webpage through a screen reader, the information the reader first detects, is the content of this tag. So a good practice to indicate to a visually impaired the section currently being accessed consists in of putting the section's name in the "title" attribute [16]. Another feedback often used, especially in search engines, is to emphasize the links. When one passes over a link using a mouse, the link's appearance changes to the shape of a "hand" (a browser feature) and its color also changes. Even though an unsighted user does not notice this visual feedback, the link is perceived because the screen readers indicate it, but to really be useful, the link's name must be properly chosen. Good feedback, normally found in forms, is the indication of fields where one is required to make use of with different color or font formatting. But screen readers do not recognize this change. An alternative to this would be to use an asterisk, but screen reader users often disable the punctuation. Ideally this should be indicated by a letter that would represent the word "obligatory" [5]. Some interfaces are made in such a way that very often, when a visually impaired user locates the field to be filled out, no voice indication is made to explain what needs to be done; the user only hears a standard notification from the reader: "edit box." The "label" tag would allow placing a text to be read by the user, giving information on what needs to be filled out [2];

C) Different Ability's Level and Human Different Human Skill Levels: Mental models are representations existing in the minds of people, which are used to explain, simulate, predict or control objects in the world. These representations are externalized through conceptual models. The elaboration of a user's conceptual model depends on the previous knowledge and experience of each person and is based on the expectations, aims and understanding of the user with regard to the system. Users create models based on "objects" they already know from their daily activities; they try to relate the computer elements to these familiar "objects", in an attempt to understand the machine better [7]. When accessing a system, disabled users make use of a very different environment from non-disabled people. They relate the computer elements to "objects" from their day to day lives, developed to supply their needs. In addition, people with disabilities, such as blind persons, develop special skills, e.g., excellent hearing; they hardly ever sit passively waiting to hear a spoken exit; they move around Web pages using complex combinations of keys. By means of this process, they create their own models and attempt to surf Web pages in a logical way. As these facts increase the level of difficulty when interacting with sites [10], this ends up influencing their conceptual models [4]. Therefore, the ideal is to design an interface aiming to accommodate different personalities, or a personality typical of the final users. One way to accommodate different personalities is to design systems in compliance with accessibility guidelines. The accessibility criterion defines the ease with which something may be utilized, visited or accessed in a general way by all persons, including those having some type of deficiency. In order to promote accessibility, it is recommended to use certain facilities that help to set aside the barriers or obstacles in the environment, helping these persons achieve the same action that a person without any deficiency would achieve [11]. Accessible interfaces facilitate experienced and beginners interaction. Some features like menus, forms and prompts

are great aid to the beginners they clarify the system's language. An example of this can be found at electronic banking interfaces, typically oriented to prompts and forms, with the finality to be accessible to people with no computer experience. Since many times advanced users consider these features an obstacle, well designed interfaces must also allow the use of accelerators such as function keys and textual commands, in order to make the interaction faster [8]. An important element is the language tag, an attribute that shows the language use in a document or part of it. Screen readers automatically detect the language tag and choose the right voice synthesizer to read this block;

D) Human Perception: The perception of each person depends on her abilities to perceive and to treat information. To create an interface that in fact can be used by different people, it must be possible to display its content in different forms in order to accommodate the different perceptions [7]. When designing a site, it should be kept in mind that the way information is perceived varies from person to person. For example, older persons usually have difficulty in reading small fonts and prefer pastel colors. Sequentiality is one of the barriers found by those visually disabled when browsing a site with a screen reader (or by means of a program that amplifies the interface): the user is only able to access a limited portion of the screen and, thus, loses out on the idea of the general context of the page at hand [12]. Although these users lose the notion of context, they end up developing certain skills, such as excellent hearing and memory. So, as they access the Web through the screen reader, they don't have to hear all the words in the page. They only hear enough to quickly determine where they want to go. Like persons with sight scanning the page with their eyes, these blind users do it with their ears [5]. Since screen readers process site content in a way quite different from visual reading, its use requires training and experience, so it is important that the interfaces be as simple as possible. This is why HTML language tags that can be identified by the screen reader become an important element in the information perception process of visually impaired users. They allow the reader to provide information about the structure of the site [12]. As the perception of the system is influenced by the experiences of a person, each user creates his/her own conceptual model; since it is highly unlikely that people without special needs undergo similar experiences when surfing the web as those with deficiencies, the models for disabled people tend to be distinct from the models for non-disabled people [4]. Another important factor is the fact that most people when facing a problem apply a series of heuristics (guidelines, rules and strategies) based on the comprehension of real world situations. Thus, the good interface allows the use to interact with it through coherent, solid heuristics. In the case of visually-impaired persons, these heuristics should be based on their peculiarities;

E) Metaphors: With regard to accessibility, metaphors deserve special study. Everyday objects of people with sight are different from the elements of the visually-impaired. For example, according to Prof. Hercen, who was born blind, the window metaphor (Windows), which indicates the visualization of a work area, has no such meaning for a blind person [19]. Thus, depending on the situation, an apparently obvious metaphor may not represent anything;

F) Minimize Memorization: Since the signs (icons, command's names etc.) are the essential elements of a screen, they must be well produced. During development process, the designer must pay attention to the choice and design of the signs so that they do not induce doubts. The chosen icons must clearly express their objectives. One should avoid giving long names to commands, so as to make it easy to learn them by heart and not to crowd the screen. Ideally, there should be no situations where the user hesitates about the meaning of something [7]. It is important to consider the fact that the visually impaired rely heavily on their capacity to "learn by heart" how to navigate the sites [2], since they need to memorize a series of information (commands, sequences of operations, alternatives, etc.). Human memory is extremely complex and made up of two parts: short-term memory – STM and long-term memory [13]. Short-term memory stores the sensory inputs (visual, auditory and tactile), while long-term memory stores knowledge. A good system's interface does not require the excessive use of any of these memories by the user [7]. With memorization, the reading of tables throws a barrier to the visually-impaired. When using a screen reader, the tables are necessarily read horizontally, line by line. Since it is not possible to visualize where the different columns are located, it would be preferable that the screen reader re-read each column heading (the first cell of each column) before each cell's actual data [20]. HTML provides resources that allow distinguishing the headings from the other cells, opening the way for this type of reading, as long as this distinction is correctly applied in the source code. Therefore, the identification of each column name and row through the "th" (table header) tag is a good usability practice;

G) Efficiency in Dialog, Movement and Thought: In the screen layout design, it is recommended to minimize

the distance that the mouse has to cover between two clicks. Elements, generally used sequentially should be close together. With regard to the visually-impaired, the screen reader feature special function that allow the user to jump directly to the heading tags (h1, h2, etc.) a key element in the structure of easy-to-navigate sites. By using this tag, visually-impaired users can navigate on the headings, so as to get a general idea about the page [4]. According to Livramento [20], sites structured as paragraphs provide more objective navigation. Visually impaired users like to have the option of navigating by jumping from one paragraph to another, only reading through the ones they consider important; experienced users are quickly able to identify if they wish to continue reading a paragraph or skip to another, in this way approximating their method of reading to that of a person with ordinary eyesight [20]. This is why it is essential to adopt the practice of signaling each paragraph in HTML code by means of a "p" tag (a block tag, signaling the initial and end of a formatting choice) instead of a "br" tag, which only enables a line break (a single tag, that only signals the occurrence of an element – in this case a line break – in that position without describing the preceding or succeeding type of text). One of the problems in using a screen reader is that navigation on links is sequential [12]. This can slow down navigation. For instance, to return to a link to one's left, one would have to jump over all the links in order to restart reading the page and finally arrive at the desired content. Sites should provide resources that would enable users to jump links repeatedly, accelerating interaction. Hence skip links should be used, speeding up navigation and allowing users to jump links repeatedly and go directly to the desired content [5]. Skip links are not noticeable when a site is exhibited on an ordinary navigator, and are only useful when the site is being accessed by a screen reader [4];

H) Functional Command's Sort: Designers must take in account the amount of items on a menu. A research made by the psychologist George A. Miller [14] showed that when people need to deal with amount of items, it is known that they feel more comfortable if the number of items is not greater than seven more or less two (Millers' law) [6], thus, a menu must respect these limits. Besides being presented according to Millers' law, the items listed in the menu must be properly classified; different types of options must be placed in distinct parts of the menu. This can be properly done if the designer considers that the word menu is a metaphor with the restaurants' menu. Normally, in a restaurant's menu, the options are grouped together according to the kind of food (sea food, meat etc.). In the same way, in an interface's menu, the options must be grouped following some functional similarity criteria established by the designer [6]. When an interface has more than seven more or less two, sub-menus (pull-down menu or hierarchical menus) must be used. One of the advantages of a pull-down menu is that it is called only when it is necessary, thus saving screen space, without polluting the screen and without offering a series of options that can confuse the user [8]. But the problem is that resorting to the use of pulldown menus only works well if the user utilizes the mouse. The mouse frequently creates problems to those who need to navigate with the keyboard. Therefore, at the same time that this resource promotes usability, it hinders accessibility because the submenus are often not accessible when the navigation is done with the keyboard. An accessible site should ensure that all its content can be accessed with the mouse and with the keyboard. For this purpose, pulldown menus should be designed so they can be accessed with the mouse and the keyboard. Keyboard navigation benefits not only the visually-impaired but all users who have difficulty or are unable to us the mouse, such as people with motor coordination, cerebral palsy and Parkinson's disease [15]. A way to make the pulldown menus accessible may be to use JavaScript, which makes the submenu visible even when access through the keyboard. This happens because in most situations where this menu is inaccessible with the keyboard, the user has JavaScript enabled in the browser [15]. However, depending on the event to be activated, some Javascripts create difficulties. The script can be substituted for another that recognizes the keyboard, utilizing redundant handlers for the mouse events. Such as the use of "onmousedown" with "onkeydown" [2];

I) Direct Manipulation: Direct manipulation, even thought not useful for blind users, needs designers' attention. Direct manipulation makes people believe that they control the objects represented by the computer; an object on the screen must remain visible while the user is performing any action on the object; in this way, the impact of the operation on the object may be immediately perceived by the user. In the same way, when the mouse passes over any object that may be manipulated, this must be highlighted. Since the visually-impaired use the keyboard and not the mouse to navigate through the pages, they don't get the benefits of direct manipulation. Since training is necessary to properly use the keys, the visually-impaired who still have some sight, prefer to manipulate the objects directly. Since

their sight is limited, the colors used in the elements should be carefully selected to improve their vision [10];

J) Exhibit only the information that is essential to the context: In order to be better assimilated, only the information relevant to the current context or mode must be shown; the user must not have to be looking for many different data to find out what he needs to execute his/her task [7]. With relation to accessibility, a good practice is to place jump links (internal links) for the main content, search system and internal menu. These internal links, when placed at the top of pages and in other strategic locations may help to increase site usability for keyboard-only users and avoid that these users be forced to read a list of irrelevant information items [2];

K) Use of Labels, Abbreviations and Clear Messages: One should be careful to use consistent labels, standard abbreviations, predictable colors and to avoid arbitrary signs to represent new items. Careful criteria should be used in the choice of these elements to avoid any doubts with reference to their meaning. So, it is important to remember that many visual features, such as bold, underlines, italic, and font styles are not detected by the reader, and are not perceptible. Other elements, such as labels, link titles and the "alt" attribute on images may be utilized to enhance the information [12]. The texts used in these screen attributes should be to make the conveyed information useful. Texts like "click here" or "follow me" reveal nothing about the objective of the elements in question. Likewise, messages issued should be clear and meaningful. The designer should not create messages that leave the user confused or guilty for having made a mistake;

L) The proper use of windows: When clicking on a link or button, the opening of new windows should be avoided. This practice, besides polluting the screen and covering the window where the use is actually working, deactivates the "Back" button, since the new windows do not inherit the original window's history [9]. An exception to this rule are documents which are supposed to be displayed and not processed by the browsers, such as PDF, Word and Excel files among others. The reason for this exception is that once people have finished using these files, they click the "Close" box instead of the "Back" key [9]. And if it is necessary to open several windows, at least a part of each window should be displayed on the screen. Another type of window to be avoided is popup window. Besides irritating the users, they distort what people expect from the Web, which is to have the information displayed on the browser's main window [9]. Impaired users also have trouble managing extra windows. People with motor coordination difficulties certainly do not want to click on undesirable "Close" boxes. And people with sight problems probably will not even notice that a new window was opened. The screen space should be utilized as much as possible. The excess of interfaces with advertisement sites, banners and similar should be avoided. Besides taking up much screen space, the sites use to display repetitive elements, common to all the pages, such as menus and banners among others, being an obstacle to access by the visually-impaired: when these elements are detected before the main content, reading becomes slow and tiresome [12] [19] [20];

M) Resolution-Independent Design: Another issue that must be considered when designing usability-oriented sites is the resolution-independent design. In traditional interfaces, the designer knows for which environment he is designing; he has total control on each pixel of the screen that appears for the user, and he can be sure how each element will be seen in the screens, independent of the resolution of its monitor. In Web, the designer has no control on the layout of the interfaces. Once the user can access the Internet in many ways, design for web must adequately be planned. One of the basic principles of constructing resolution-independent sites is to, instead of using fixed sizes to design elements of the interface, specify layouts as percentages of the available space [9]. This really must be considered once many people and organizations still have low-resolution's monitors. A resolution-independent design it's the key to accessibility, once it allows the site to be accessed by any dispositive, including the mobile ones, like cell phones.

5.2 Requirements Related to Data Entry

Users spend a lot of time choosing commands, typing data and others inputs. A good interface must minimize the time that the user spends with these tasks, so some requirements are needed in order to allow powerful and easy interfaces [7]. On entering data, visually impaired users do not use the mouse, but the keyboard, which has become a facilitator capable of being used by any visually disabled user due to an international typing norm: all keyboards produced in conformity with regional technical norms have, on the lower part of the J and F keys (on the

alphanumerical side) and 5 (on the numerical side), high-relief to guide blind people when positioning their hands, just as people do when learning to type [2]. Relying solely on the keyboard, one could spend a long time choosing commands, typing data and inputting other things. Added measures should be taken to promote accessibility in interfaces dealing with data entry [3].

A) Help Facilities: Help must be supplied for every input action [8]. When a user passes the mouse over some screen's elements, tips sometimes maybe useful if they are shown over these elements. This speeds up the work, as the user is able to know the purpose of a given item, without having to resort to the textual help system. Good systems also must take in account the task of filling out forms and therefore must assist users in doing so. When a user needs to fill out a form, he must input data in several fields. It must be shown to the user which fields are mandatory and what kind of data must be input (all numbers, no space etc.). Normally, the indication of fields where one is required to fill, make use of different color or font formatting. An alternative to this would be to use an asterisk, but screen reader users often disable the punctuation. Ideally this should be indicated by a letter that would represent the word "obligatory" [5]. One way people send data over the Internet is by filling out forms. Since the user navigates through forms by using the tab key, in order to facilitate data entry, the fields to be filled out and search buttons, if important, should preferentially be located at the top of the page [12]. Interfaces must be designed in such a way that a visually impaired user locates the field to be filled out, a voice indication should be provided to explain what needs to be done; the user only hears a standard notification from the reader: "edit box." The "label" tag would allow placing a text to be read by the user, giving information on what needs to be filled out [2]. This tag also permits attributing a rapid access key to each field on the form, in addition to enlarging the click field for selection box and radio box, which would make filling out forms easier for those with only partial visual impairment. One should also avoid using a default value in the field, because even when read by the reader, it would require the user to erase the value [5]. Another way of sending data is by means of command buttons, such as the "send" or "submit" button; these do not require a "label," since they can be read by means of the "value" attribute; however, one should avoid using words such as "click here" or "continue" with this attribute, because they indicate nothing about the purpose of the button. If the button has an image instead of a text, it would suffice to use the "alt" attribute [2];

B) Minimize Error Possibilities: One of the objectives of a good interface is to prevent that its users commit errors. Well-designed interfaces must provide error prevention mechanisms that guide the users within any context and make it difficult for the user to do things that are not allowed in that context. Therefore, the user will not choose an invalid option and afterwards receive an error message. Items not valid in the current context should be inhibited or disabled. For example, if the user did not select an object in the screen, the interface should prevent the selection of the "Cut" and "Copy" options. This practice is important when one thinks of users accessing the screen through a screen reader. When an item is disabled, the reader issues a sound message informing that "name of item in question disabled". The user must be informed of how he must fill in any field. The systems must guide the user in this task: whenever there is minimum or maximum limit of characters, this should be indicated either by the length of the field or a real-time character counter; mandatory fields and minimum and maximum length for passwords must always be indicated. This information must be given to the user before he fills the field and sites must indicate mandatory fields. There are different ways to minimize data entry. For instance, when the user is registering into a site, his or her street address may be discovered by having them type the zip code first, then having the website do a look-up and automatically fill out the address field for the user. Another way is by using "List Boxes", for the choice of limited options, like sex and state, where the user just choose the letter correspondent to his/her choice. This feature restricts user answers, so the possibilities of mistakes, and, at the same time, to save the users time;

C) Provide Error Recovery: Experimental evidences show that people are more productive if their mistakes can be readily corrected. So a well-designed site must provide a good error recovery (undo, cancel, etc.). By providing this error recovery, the user feels more comfortable to explore unlearned facilities without fear of failure. This encourages exploratory learning. Basically there are two types of errors: functional and syntactic [8].

6. Conclusions

The objective of the present work was to align the usability NFRs with accessibility directives. This alignment was

aimed to help system professionals in identifying possible accessibility and usability problems that may be avoided or minimized during requirements planning, and thus, facilitate the interaction of visually-impaired users with the Internet and provide sites that offer content that is easy to understand and are easy to navigate. A field research was undertaken in the IBC, a reference institution in the education and re-education of the visually-impaired in Brazil. The choice of opting for the visually-impaired was the fact that the Internet is a strong contributing factor in improving quality of life, allowing the visually-impaired to create new relationship forms, to find work opportunities and alternative entertainment ways.

The research helped to understand how these users perceive and interact with the sites and detected barriers that they have to overcome to access information. The knowledge produced by the research and found in literature helped to identify the types of impositions and limits to which these users are subjected, which led to a better understanding of their special needs and skills. After this point, a way to evaluate site usability was selected. This was the proposal through the taxonomy of usability NFR [6]. This taxonomy was created with the intent of systematizing the definition process of these requirements and to reduce the usability problems and has been well utilized in usability analysis of several sites and may help system designers in the initial phase of requirements planning. At a later stage, one tried to align the usability analysis based on taxonomy with the accessibility guidelines. This alignment aimed to help information system professionals in the identification and solution of possible accessibility problems which can minimized during requirements planning. With this procedure led to the conclusion that the development of accessible Web applications goes beyond the design of Web pages in compliance with the accessibility guidelines: usability issues should also be considered.

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