WEB ACCESSIBILITY: PRINCIPLES, INTERNATIONAL CONTEXT AND ITALIAN REGULATIONS

Oreste Signore, Barbara Leporini
ISTI/CNR, Via Moruzzi 1, I-56124, Pisa, Italy
{oreste.signore | barbara.leporini}@isti.cnr.it
Maria Luisa Marucci
CSI-Piemonte, Corso Unione Sovietica 216, I-10100, Torino, Italy
MariaLuisa.Marucci@csi.it

Universal access is a key principle for the web, however, it is sometimes inaccessible, as can present barriers to people with different kinds of disabilities. Designing for accessibility is a real quality issue, granting access to information to people having different cultures, traditions, facilities. We present a general description of accessibility issues and international context. We also discuss the basic principles adopted in defining the Italian technical rules, and present some examples of best practices.

1 Introduction

Among the initial motivations that lead to the birth of the web, we must recall the *Universal Access*, that is to make the Web accessible to all by promoting technologies that take into account the vast differences in culture, languages, education, ability, material resources, and physical limitations of users on all continents. The importance of Web Accessibility has been widely recognized by almost all countries and governments, and in some cases specific regulations have been issued. Recently (9th January 2004) the Italian Parliament approved a law (4/2004) which is imposing that impaired people should not be discriminated, and must have access to the services supplied using ITC technologies. This act greatly affects Web sites and e-government applications.
We just remember that web accessibility has not only a *social* value, but is also an *economic* opportunity and a *technological* challenge. In fact, designing for accessibility means designing for all, as there are many cases where environmental conditions can put a "normal" user in the same conditions an impaired person could be.
In this paper we first present a general overview of the main issues related to the web sites accessibility, making reference to the international standards and regulations. Afterwards, we will illustrate criteria that guided the definition of the technical regulations in Italy, showing some practical examples and best practices.

2 The web accessibility

The Web is the fastest-adopted technology in history, and for people with disabilities, it's sometimes a "mixed blessing": In fact it is displacing traditional sources of information and interaction, like schools, libraries, print materials, discourse of the workplace. Some of the traditional resources were accessible; some not.
The Web is becoming a key, but sometimes inaccessible, resource for *information gathering* (news, information, commerce, entertainment), *education* (classroom education, distance learning), *employement* (job searching, and workplace interaction), *civic participation* (laws, voting, government information, services). An accessible Web will mean unprecedented access to information for people with disabilities. Further, *Web accessibility* is a cross-disability issue, as the Web can present barriers to people with different kinds of disabilities:

- *visual* disabilities (unlabeled graphics, undescribed video, poorly marked-up tables or frames, lack of keyboard support or screen reader compatibility);
- *hearing* disabilities (lack of captioning for audio, proliferation of text without visual signposts);
- *physical* disabilities (lack of keyboard or single-switch support for menu commands);
- *cognitive or neurological* disabilities (lack of consistent navigation structure, overly complex presentation or language, lack of illustrative non-text materials, flickering or strobing designs on pages).

However, Web accessibility is not only an unmissable target for helping impaired persons, it is also a *marketplace* issue, and few organizations can afford to deliberately miss this market sector. In fact, 10% to 20% of the population in most countries has disabilities, and average age of population in many countries is increasing. Even if not all disabilities affect access to the Web (for example difficulty walking,

© Oreste Signore, Barbara Leporini, Maria Luisa Marucci (2004) – Permission to make copies for personal or educational use.
Document URI: http://www.w3c.it/papers/eurocmg2004.pdf

heart condition, etc., don't, while vision, hearing, dexterity, short-term memory ploblems do), we must consider that aging sometimes results in combinations of accessibility issues (like vision and hearing changes, dexterity). Finally, web accessibility is also a *technological* challenge. In fact, designing for accessibility means designing for all, as there are many cases where environmental conditions can put a "normal" user in the same conditions an impaired person could be. More generally, a design aware of accessibility issues often results in a better quality design and is coherent with the Universal Design principles, so granting information access to people with different cultures, traditions, tools.
In fact, accessibility contributes to better design for other users, and therefore to Universal Design, in several ways:

- **multi-modality** (support for visual, auditory, tactile access):
  - benefits users of mobile phones with small display screens, Web-TV, kiosks;
  - increases usability of Web sites in different situations, like *low bandwidth* (images are slow to download), *noisy environments* (difficult to hear the audio), *screen-glare* (difficult to see the screen), *driving* (eyes and hands are "busy");
- **redundant text/audio/video** can support different learning styles, low literacy levels, second-language access;
- **style sheets** can support more efficient page transmission and site maintenance;
- **captioning** of audio files supports better machine indexing of content, faster searching of content.

In conclusion, it is worthwhile to stress how Web accessibility is a *quality* issue. In fact, any web designer concerned with the quality of the web site would carefully consider issues as correctness, comprehensibility, navigability, that are essential characteristics of accessible web sites.

3 The international framework

3.1 What does it mean "impaired"?

The World Health Organization (WHO) gave (1980) the International Classification of Impairments, Disabilities and Handicaps.

- *Impairment*: "any loss or abnormality of a psychological, or anatomical structure or function".
- *Disability*: "any restriction or inability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being".
- *Handicap*: "any disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfilment of a role that is normal ... for that individual". The classification of handicap is a classification of circumstances that place individuals "at a disadvantage relative to their peers when viewed from the norms of society". The classification of handicap deals with the relationship that evolves between society, culture and people who have impairments or disabilities, as reflected in people's life roles.

The WHO's International Classification of Functioning, Disability and Health (2001), known more commonly as ICF, is a "multi-purpose classification intended for a wide range of uses in different sectors. It is a classification of health and health-related domains – domains that help us to describe changes in body function and structure, what a person with a health condition can do in a standard environment (their level of capacity), as well as what they actually do in their usual environment (their level of performance). These domains are classified from body, individual and societal perspectives by means of two lists: a list of body functions and structure, and a list of domains of activity and participation. In ICF, the term *functioning* refers to all body functions, activities and participation, while *disability* is similarly an umbrella term for impairments, activity limitations and participation restriction. […] ICF is WHO's framework for healt and disability. It is the conceptual basis for the definition, measurement and policy formulations for health and disability. […] ICF is named as it is because of its stress is on health and functioning, rather than on disability. […] ICF put the notion of 'health' and 'disability' in a new light. It acknowledges that every human being can experience a decrement in health and thereby experience some disability."

3.2 International initiatives and rules

Due to its importance, a number of governments require Web accessibility for certain kinds of sites, often for government Web sites first, sometimes other sites, to implement anti-discrimination policies, or policies that directly address Web accessibility. Information on requirements in different countries (European Union, Denmark, France, Germany, Ireland, Italy, Portugal, United Kingdom among the others) is available ([WA-Policies]).
In the following, we will give a brief description of two of the most relevant actions in the web accessibility area: the Web Accessibiility Initiative at W3C and the USA Section 508.
In most cases regulations substantially refer the WAI guidelines (see next paragraph), but the regulations are, in most cases, just guidelines or general principles, and don't have the full power of a law. In two cases, Germany and European Parliament resolution 2002(0325), there has been an explicit reference to the WAI guidelines.

3.2.1 The Web Accessibility Initiative at W3C

The World Wide Web Consortium (W3C) is an international, vendor-neutral consortium, which is leading the development of Web Technologies,

promoting evolution and interoperability of the Web. The Web Accessibility Initiative (WAI) is supported by a variety of government, industry supporters of accessibility and organisations, including European Commission (DG XIII, Telematics Applications Programme for Disabled and Elderly). WAI enables different "stakeholders" in accessibility to work together at the design table. WAI has several levels of work, among the others we recall: ensuring that Web technologies support accessibility, developing guidelines for accessibility and tools to evaluate and facilitate accessibility, conducting education and outreach.

WAI coordinates with other W3C working groups to ensure that Web technologies support accessibility. Several specifications, namely HTML 4.0, CSS, SMIL and MathML already include support for accessibility, like style sheet linkage, alternative representation, navigation, improved table mark-up, layout, fonts, user control, aural CSS, synchronization of captioning and audio description, semantic representation of math content ([HTML-AF], [CSS-AF], [SMIL-AF], [MathML]).

In addition, WAI is working on accessibility issues in many current areas of W3C technology development.

Guidelines play a critical role in making the Web accessible, by explaining how to use Web technologies to create accessible Web sites, browsers, or authoring tools. WAI has three different guidelines to address these different needs:

- **Web Content Accessibility Guidelines** 1.0 ([WCAG]) which explain to authors how to create accessible Web content. WCAG 1.0, developed by *Web Content Guidelines Working Group*, became a W3C Recommendation on May 5, 1999, and is made by 14 guidelines with 65 checkpoints. It identifies three *priority levels* and three *conformance levels*.
- **Authoring Tool Accessibility Guidelines** 1.0 ([ATAG]) which explains to developers how to design authoring tools that are accessible to authors with disabilities, and that produce accessible Web content, conformant to WCAG 1.0. ATAG became a W3C Recommendation on February 3, 2000, and is aimed at better support for creation of accessible Web content: WYSIWIG editors, conversion tools (word processors, presentation software), tools that dynamically generate Web pages from databases, image editors, site management tools. The ATAG guidelines address creation of valid content, strategies for prompting, alerting, help, validation, and accessibility of the user interface.
- ***User Agent Accessibility Guidelines*** *1.0*, ([UAAG]) became a Recommendation on 17 December 2002. They explain what the software developers can do to improve the accessibility of mainstream browsers and multimedia players so that people with hearing, cognitive, physical, and visual disabilities will have improved access to the Web. UAAG 1.0 explains the responsibilities of user agents in meeting the needs of users with disabilities. *Techniques for User Agent Accessibility Guidelines* ([TUAAG]) provides implementation detail.

An *Evaluation and Repair Interest Group* and an *Evaluation and Repair Working Group* ([WAI-ER]) coordinate discussion and development on tools to facilitate accessibility ([WAI-Tools]).

3.2.2 USA: the Section 508

American Law for regulations of US Websites. Section 508 requires that Federal agencies' electronic and information technology is accessible to people with disabilities. "Section 508" refers specifically to Section 508 of the Rehabilitation Act of 1973, as amended by the Workforce Investment Act of 1998. The law requires Federal agencies to purchase electronic and information technology that is accessible to employees with disabilities, and to the extent that those agencies provide information technology to the public, it too shall be accessible by persons with disabilities.

Actually Section 508 was included in an amendment to the Rehabilitation Act in 1986, with the requirement that the Federal Government provide accessible technology to employees and to the public. But the 1986 version provided no guidance for determining accessibility of information technology and there were no enforcement procedures.

The final Section 508 rule includes so-called *functional* standards that require, for example, that there be a way for a person who is mobility impaired or blind to use your product or Web site. In addition, and more importantly, the Section 508 standards say your Web site has to satisfy sixteen *specific* items for Web accessibility. These are specific things you must do during Web site development to ensure that a person who is mobility impaired or blind, for example, can use your site. These standards are the basis of the subject matter for this course.

Eleven of the sixteen 508 Standards are drawn directly from the WAI Web Content Accessibility Guidelines (WCAG), in some cases using language more consistent with enforceable regulatory language. Five of the 508 standards do not appear in the WAI checkpoints and require a higher level of access or give more specific requirements. On the other hand, there are four priority 1 WAI checkpoints that were not adopted by the Access Board.

4 Accessibility vs usability

Usability is widely discussed in many papers and books, whose the most widely diffused is probably [Nielsen2000], often quoted as a textbook. We will not discuss this topic in detail, just reminding that usability issues are of big concern, and must be carefully considered in designing Web sites and user interface.

Several factors affect achieving usability for a computer system. System must provide functions that accomplish the intended tasks, are understandable and clearly visible through the user interface, fit in the user's context. Layout and input/output devices must be suitable for the target user group and their physical work environment. It is therefore evident as design for accessibility can be of great help for usability, even if the two concepts address different goals.
Usability requires a design allowing the presentation and input/output devices to vary. This can be accomplished separating the presentation from the remainder of the application, getting the benefit of adaptability to new requirements with limited costs and the possibility of having interfaces tailorable to different user needs and abilities. Once again, some hints and techniques from WAI Guidelines can be useful to achieve different goals.
The issue of usability has been considered with attention by WAI in preparing the new version of WCAG ([WCAG 2.0]).

5 The Italian regulation

5.1 The law

In Italy, there have been three official regulations.
The first one has been a "*circolare del Ministero della Funzione Pubblica*" (13 March 2001, n. 3/2001) which contains guidelines for organization, usability and accessibility of web sites of public administrations.
Susequently a "*circolare AIPA*" (6 September 2001, n. AIPA/CR/32) was containing "criteria and tools to favour access to public administration web sites and usage of informatic applications by disabled people".
Both made reference to the WAI guidelines.
However, they had a little effect, as having just the value of recommendation, not the force of a law.
The law 4/2004 of 9th January 2004 is imposing that impaired people should not be discriminated and must have access to the services supplied using ITC technologies.
There are some important points to illustrate.
A great number of entities must conform to the accessibility rules. At first glance, disabled people must have granted access just to the "informatic services supplied by public administration and to services of public utility". A more careful reading explains how there is a long list of subjects supplying services that must conform: among them, all local public administrations and all education organizations.
There has been a great debate about the absence of fines or other penalties when accessibility criteria are not fulfilled, but at the end, the law provides for a strong limitation (contracts that do not impose accessibility requirements are invalid) that would apply to all contracts concerned with maintenance or implementation of internet sites. Considering the pace at which sites are rebuilt, conformance to accessibility requirements should be reached in a short time. In addition, many are thinking that it is more important to be aware of the web accessibility, and work to achieve this goal, than pay a fine, and leave the site not accessible.
There will be a big impact in the education area, as all the material used in education must be accessible.
There are specific prescriptions about the education of the personnel belonging to the subjects that must conform to the regulations and responsibilities of managers.
Several levels of accessibility must be defined.
Finally, technical requirements and methodologies to verify the accessibility are matter of a specific decree, whose content must take into account international rules and guidelines, issued by both the European Union and international bodies. The technical rules must be updated when these guidelines change or new technologies appear on the market.

5.2 The approach

In considering Web accessibility, we must consider the importance of adoption of a common standard for the accessibility of Web content, browsers, media players, and authoring tools that are used to develop Web sites. Fragmented standards may arise for many reasons, sometimes related to the belief that disability requirements are different locally, or the interests of local organizations in writing their own standards, or is simply dictated by the idea that "*following our own way*" would give better results.
However, fragmentation of standards not only is in contrast with the web principles, as it ignores that the web is a World Wide Web (access by everyone, everywhere, with any device), but also creates a fragmentation of the market. In fact, coping with different standards is a disincentive to create sites with accessible contents, develop accessible authoring tools and tools to evaluate the accessibility of Web sites. In addition even the assistive technologies should be aware of various standards. Therefore, fragmenting standards is a waste of resources with no advantage.
Harmonization of standards, instead, is essential to Web accessibility for many reasons, as it not only is useful to web sites designers and to implementers of authoring and site evaluation tools, but also to some realities, as multinational enterprises, that are faced with the universality of the web even in their intranet environment.
The "Italian way" has been aware of the need to harmonise standards, as well of the need of defining a set of rules that could be checked in case of controversy[1]. It was also considered that some WAI

[1] At the time of writing, the text of the Italian regulations has not been officially presented to the wide audience. Therefore, we simply report some general considerations and principles, as they are at the present status, in the aim of not disclosing any reserved

checkpoints can be automatically verified imposing a strict conformance to formal grammars (e.g. XHTML).
The technical rules provide for *technical/heuristic* and *subjective/empiric* accessibility checking.
Definition of specifications for heuristic checking took into account international standards and guidelines (namely: W3C/WAI Recommendations, Section 508 and ISO specifications for accessibility).
Empiric evaluation criteria in addition considered ISO/IEC 9126-1, ISO/IEC 9241-11, Universal Design principles, scientific literature.
Heuristic evaluation requires that a certain number of appropriate requisites has to be checked by an expert, using automated or semi-automated tools. Basically, at this stage the expert must verify that the language conforms to the standards (using, for example, W3C validators), and that the elements have been used accordingly with the language specifications (eg. appropriate usage and sequence of <hn> tags, meaningful text for `alt` attribute, etc.). Subsequently, several other checks take place, similarly to what is suggested in [WAI-ER]. Attention has been given to the appropriate contrast among foreground and background and to low vision people needs.
Empiric evaluation considers several characteristics, and can result in assigning different levels of accessibility, above the minimum level gained at the heuristic evaluation stage. Many of them refer to general usability principles, as suggested by the Universal Design ([UD]) approach, like perception, use, consistency, safety, security, transparency, fault tolerance, etc. The most relevant point regarding the empiric evaluation is that, beside the evaluation by an expert, done using the cognitive walkthrough method, there will be an in depth involvement of the users, setting up an appropriate user panel, where people with disabilities must be included. It is suggested that user shall be involved since the early stages of development.

6 Best practices

6.1 User interface issues

User Interface quality can largely affect the success of any information system (intended in general sense). In the Information era, giving access to everybody, irrespectively from his/her abilities or culture, is a must. Systems designed for specific areas (like health or cultural heritage) exhibit some additional degree of complexity, due to the need of taking into account *different cultural traditions* of the potential users.
Accessibility is a primary requirement, nobody can accept to leave people with disabilities out of reach of the online information available on the Web. WAI guidelines are a major reference. The experience clearly shows that in many cases a little effort can give extremely relevant improvements, even if some goals are not so easy to achieve.
Usability takes into account the intended tasks and the user community the system is addressed to. Usability can take advantage by adopting some techniques intended for design for accessibility.
For users with certain disabilities such as vision or hearing impairment, or movement difficulties, the layout and structure of the interface play a meaningful role. When navigating by a screen reader the user perceives the page content in a different way from its rendering on the screen.
The screen reader referred to in the following is Jaws for Windows [Jaws], [Damery 2003] which is the most frequently used by blind people the world over. JAWS gives quick access to the information in a logical format. The information comes right from the HTML used to create the page.
Hence, tables, lists, headings, and so forth are all announced.
Several issues related to visual layout and different perception are discussed in [Pitt 2003] and [Leporini 2004]. More examples about accessibility and usability when interacting through screen reader can be found in [Leporini 2003].

6.2 Examples of best practices

It is possible to implement web sites that are "technically accessible", in the sense that they pass the technical verification tests, but result in not usable sites and vice versa.
Therefore, it is important that accessibility is perceived by designers as a fundamental issue, and not just, as it is in many cases, as a limitation that leads to scarcely appealing web sites. Smart designers are well aware that designing for accessibility is designing for all, and can lead to better quality web sites.
In this section some examples of accessible structure which are not easy to navigate are discussed: lists, layout tables, heading levels, and link contents. For each instance, a non-appropriate usage and a advisable method are discussed.

6.2.1 Lists

Unordered or ordered lists are simple lists of items starting with bullet points or numbers (e.g., one or more asterisk (*****), period "**.**" or hyphen "**-**").
Lists are clearly recognized by a screen reader. The user is informed about when the list begins, which is the number of items, when the item starts, about possible nested lists, and so on. Lists are used by developers for several purposes, such as in building simple element lists, menus and hierarchical structure. Thus, it is very important that lists are well-structured for both a desired visual layout and aural perception.
Often developers provide visual lists by rendering item list in a layout table, and by using graphical bullets rather than applying the common tags `<ul>` and `<li>`.

information. Readers are invited to check the full official document as soon as it will be available.

Table 1 shows a list whose items are links, which is not built in a correct way.
As we can see in the table, although the list visually seems a normal bullet list, it is not well-interpreted by the screen reader Jaws. Indeed each item is recognized as composed of two links – one graphical and the other textual - pointing to same resource. A blind user who perceives that information by voice synthesizer probably does not understand that both links refer to same resource. In addition, having two links for each item makes quite tedious the navigation in sequential way and through Tab key. Then, the first link of an item has a text not significant: the link text "pallino" is not clear; it is necessary reading the other link.

Furthermore, a list created by this method uselessly increases the number of items.
Differently, the screen reader interprets correctly a list if it is obtained by using the appropriate tags <ul> (or <ol>) and <li>. In fact, in this way Jaws is able to jump to next list by simply pressing the key "l". So, user can skip the previous content very quickly. Besides, the bullet symbols are identified appropriately. For example, when the user navigates a Web site frequently, he/she can learn that there is a vertical menu built by a list; so he/she is able to reach it by simple pressing "l" key. Table 2 shows a correct list.

Code	Browser view	Jaws reading
`<a href="Novita.html">` `<img src="pallino.gif" width="13" height="13" border="0"` `alt="Pallino"></a>` `<a href="Novita.html">Novità</a> ` `<a href="Servizi.html">` `<img src="pallino.gif" width="13" height="13" border="0"` `alt="Pallino"></a>` `<a href="Servizi.html">` `Servizi</a>` ` ` `<a href="Forum.html">` `<img src="Pallino.gif" width="13" height="13" border="0"` `alt="Pallino"></a>` `<a href="Forum.html">` `Forum</a>`	• Novità • Servizi • Forum	Link pallino Link Novità Link pallino Link Servizi Link pallino Link Forum

Table 1 - Example of a non-correct bullet list

Code	Browser view	Jaws reading
`<ul>` `  <li>Milano</li>` `  <li>Roma</li>` `  <li>Palermo</li>` `</ul>`	• Milano • Roma • Palermo	Lista di 3 elementi Punto elenco Milano Punto elenco Roma Punto elenco Palermo fine lista

Table 2 - Example of a correct list

6.2.2 Tables

Tables are made up of columns and rows with information placed inside table cells. Tables may be used in one of two ways. Data tables display relationships between types of information. Layout tables position information on the page or define the general layout of a page. When moving through a table with standard reading commands, the screen reader moves through the cells in order from left to right. Jaws behaves as if each cell begins on a new line. This is referred to as "linearizing" the table - presenting the information in logical order from start to finish. This presentation can make it difficult to understand the relationships shown in data tables.
Layout tables do not display relationships between information but are used to position information on the page. A layout table may display text in columns, or it may be used to display menu bar on a portion of the page and the text of an article on another. Jaws interprets tables with only one row or column as layout tables and ignores them by default. However, because often layout tables have more then one rows or columns, it is important paying attention how tables are created and how information are organized.
HTML allows authors of Web pages to provide additional information about tables, such as a summary of the data in the table, or a caption. When users move to a table, Jaws announces the number of columns and rows, and reads the summary, if a summary is available.

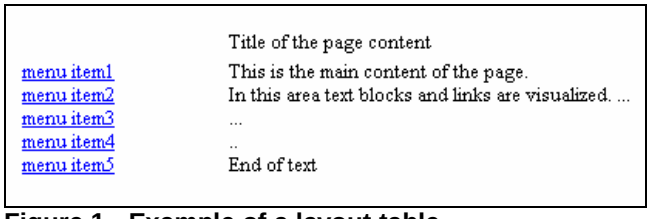

Figure 1 - Example of a layout table

Using tables to format the content in the pages is usually not recommended. However, developers often prefer to use this technique because it allows obtaining more a precise content layout. Therefore, in this case it is important to insure that tables have descriptions which are appropriate and meaningful. Descriptions such as 'this is a layout table' or 'this table is used for layout purpose' are not significant for the user. However, the discussion about this issue is not considered herein.
Let's see how a layout table can be made more usable for a better reading through screen reader.

Let's consider a table with 4 cells (2 rows and 2 colums) used to render a left side menu, a title of the page content, and lastly the main page information (See figure 1). Such a layout table is used a lot of times for rendering data within the page.
Each object – title, menu and page content – is placed in a single cell. The order by which these cells are filled out affects the screen reader interpretation. This implies less or more usability in table reading.

`<table summary="not usable table: screen reader announces title of the page content, the side menu, and finally the page content">` `<tr>` `<td> </td> <!-- empty cell 1,1 -->` `<td> Title of the page content </td> <!-- cell 1,2 -->` `</tr>` `<tr>` `<td width="130px">` `<!-- links composing the menu -->` `</td>` `<td valign="top"> This is the main content of the page....` `</td>` `</tr>` `</table>`	Summary: not usable table: screen reader announces first the title, then the side menu, and lastly the page content Table with 2 columns and 2 rows Title of the page content Link menu item1 Link menu item2 Link menu item3 Link menu item4 Link menu item5 This is the main content of the page. In this area text blocks and links are visualized . ... End of text table end

Table 3 - Not usable layout table

`<table summary="Usable layout table: the screen reader announces first the side menu, and then the page content">` `<tr>` `<td rowspan="2" width="130px">` `<!-- Links comosing the side menu -->` `</td>` `<td> Title of the page content </td>` `</tr>` `<tr>` `<td valign="top"> This is the main content of the page...` `</td>` `</tr>` `</table>`	Summary: Usable layout table: screen reader announces first the side menu, then the title, and lastly the page content Table with 2 columns and 2 rows Link menu item1 Link menu item2 Link menu item3 Link menu item4 Link menu item5 Title of the page content This is the main content of the page. In this area text blocks and links are visualized ... . End of content table end

Table 4 -Usable layout table

As we can see in the Table 3, the screen reader reads first the title of the page, then the left side menu, and lastly the main page content. This makes the reading less understandable, especially when the side menu has many links.

In Table 4 an example of the same visual layout can be obtained. In this case the reading is easier to be understood: first the left side menu is announced, then the title and page content is read. The navigation of the page results more usable.

The used technique consists simply in chaning the order of the cells, and applying the attribute “rowspan”

6.2.3 Using heading levels

A useful method by which information can be logically organized is to use appropriate heading elements. In fact, several screen readers have special commands to list the headings in the page, so that users are able to understand, with a general overview, which is the content of the page, and can reach some information more quickly. In practice, if tags <h1>…<h6> are applied to each section/paragraph of the page content, by a screen reader special command a certain index of the content can be produced. Figure 2 depicts the heading levels assigned to all the sections of the page containing The Second Edition of XHTML 1.0 W3C recommendation.

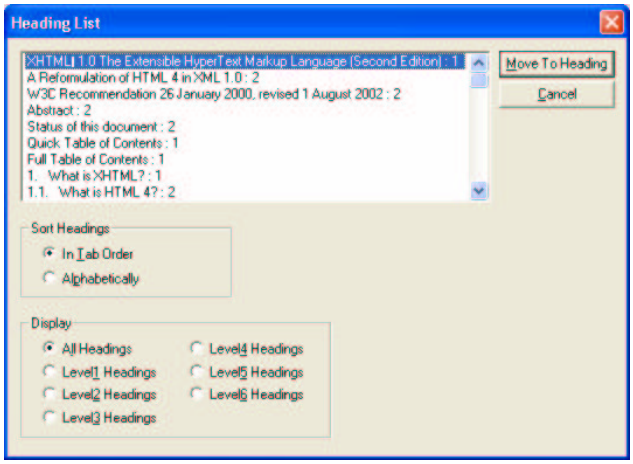

Figure 2 - List of the heading levels (produced by the special Jaws command insert+f6) referred to page at http://www.w3.org/TR/xhtml1/

Thanks to heading levels, user who navigates through keyboard can get some advantages: (1) having an overview of the page content through the heading list; (2) skipping quickly to a specific section by pressing the initial letter of the heading or moving by arrow keys along the heading list; (3) moving to next or previous heading through the “h” letter during the text reading. Furthermore, as we can see in the Figure 2 the screen reader allows to users (by setting a specific radio button) to customize which heading levels have to be listed.

Noting that, heading levels can be used not only for partitioning text sections (such as chapters, paragraphs and sub-paragraphs); <hi> tags can be used also for identifying specific text or link blocks (see figure 3). In this way, a lot of information being within the page can be partitioned in several easily identifiable and reachable areas.

Summarizing, developers have to wrap each section and sub-section title with tags <h1>…<h6> according to its structure level. They have to pay attention to not use those tags for text rendering style. And lastly, the title length enclosed between tags <hi> should be quite short.

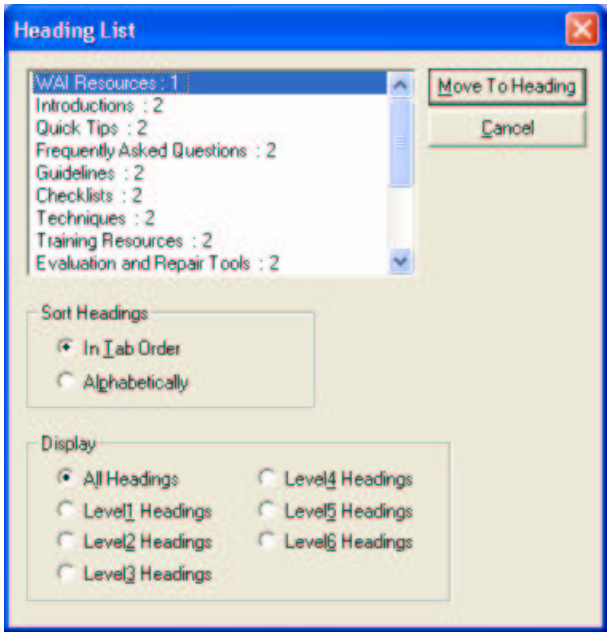

Figure 3 - Heading level list referred to w3c resource page at http://www.w3c.org/WAI/Resources/

6.2.4 More significant link text

An important issue of usability for users who read the Web pages through a screen reader is the text associated to links. The reason is that, while exploring a page with a synthesizer or Braille display, the user may not have a general view of the content. Navigating through keyboard, links are often accessed using the Tab key to move from link to link. For this reason, link text should be meaningful enough to make sense when read out of context. For example, a link like "About Web Search" is much more effective than simply making the URL the link text, such as http://websearch.about.com.

Therefore, if the texts of links are more significant, users can better orient themselves.

Such a typical problem occurs with links like “More details”, “continue...”, or “pdf”, which are not very useful. Often the link text refers to a specific context, so that if we consider links separately, we might not be able to understand the related content.

A user who cannot see the screen, often uses the Tab key to search in the page the wanted link without reading the whole content. Another way to select a specific link is to use a particular command of the screen reader to open the link list. In both cases, the user reads only the text of the links, so a meaningful text is important. More precisely, link text has to be context-independent (i.e. it should be auto-explicative). The previous figures show three link lists produced by the Jaws special command “insert+f6”. The links

considered refer to a typical documentation download page where several versions are available. In this case we suppose there are 3 format types of documentation – html, doc and pdf – for several languages. That means there are many similar links html, doc and pdf (i.e. 3 formats for each language type). The first two figures show two non-correct list. The first one has a list composed of simple links like "html", "doc" and "pdf". The user moving through tab key is not able to achieve the specific file referred to the desired language. In presence of many links of this kind, if users skip from link to link using the tab key or a special command of the screen reader that gives a link list, they read similar texts without knowing the context to which they refer. Therefore, in order to know which the appropriate link is, a user has to explore the page reading almost line by line. Practically he/she must read the page content in sequential way; or he/she can make a search within the page, which is not easy for less experienced users. A possible solution to this matter is adding the attribute "title" to the tags <a> using a more descriptive content.

Regarding our example, a first attempt is shown in the second picture. The original links are like "html", while those well-modified are like "italian: html format". To all text links the words "link to" at the beginning, and " – language" at the end were written into title attribute. Now each link is certainly more descriptive; however, they are still not so usable when interacting by keyboard and a screen reader. In fact, when the link list is opened, it is not easy skip quickly to a specific link as each link starts with the same letter "l" (i.e. the initial letter of the word "link to"). In addition, if the user is looking for a certain language, he/she is constrained listening to the whole link text because the type of language is written at the end. Consequently, all these negative effects make the page navigation quite tedious. Thus, the title attribute, i.e. the link text, should start with the key of the link content. In this case first of all it is important focusing on the type of language; next on the format type. If user would like to look for Italian documentation, (s)he presses the letter "I" (in case some times); and the "Italian" documentation first link is found very quickly.

Thus, in order to improve link usability, we can suggest some solutions. First, for graphical links, we have to apply the `alt` attribute with a meaningful description which has to refer to the meaning of the link rather than describing the image in itself. Second, for textual links we can change the entire text, or we can use ALT or TITLE attributes. This second alternative may be used if developers do not want to modify the writings visualized on the screen. In fact, the text associated to alt or title is read by the screen reader, and it is visualized in the status bar when the mouse is passed over links.

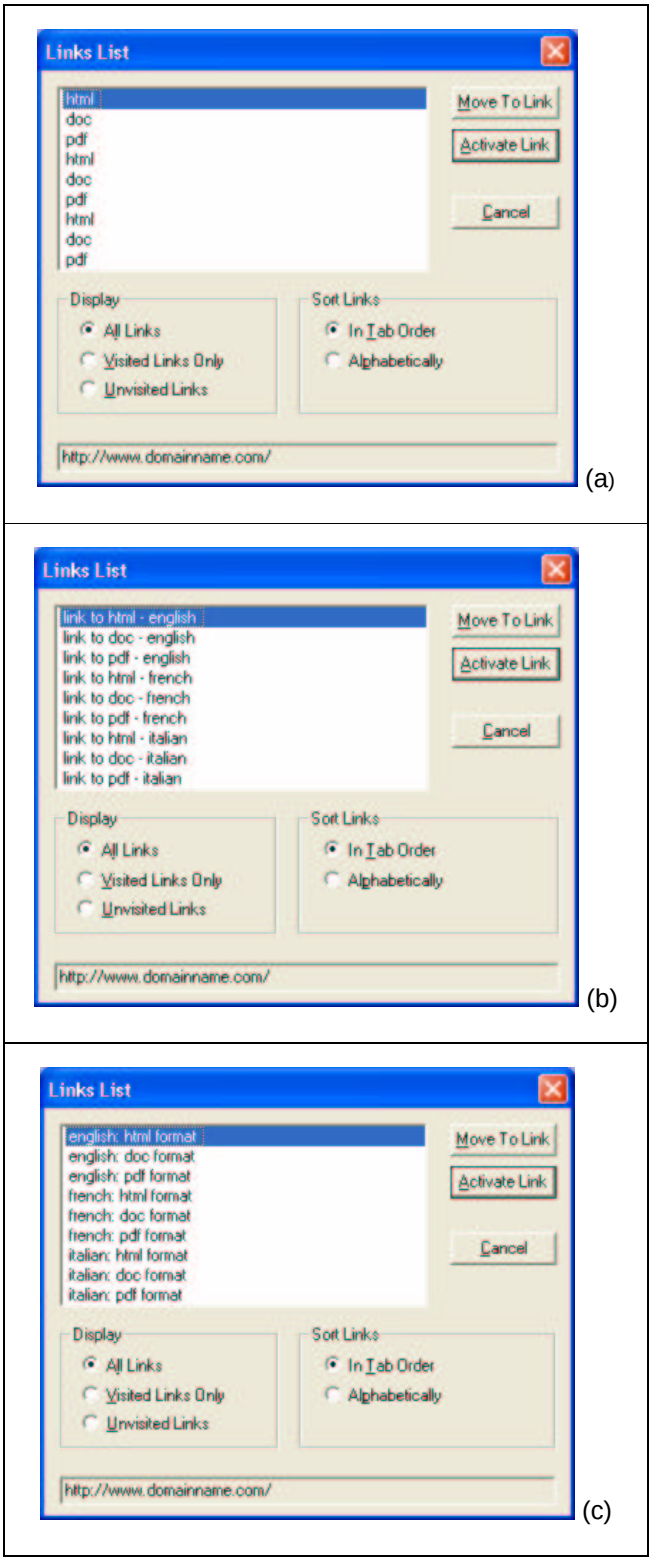

Figure 4 - Link lists (produced by the Jaws command insert+f7) related to a page where documentation in several languages can be downloaded. (a) Wrong list; (b) non-appropriate modified list; (c) suggested well-modified list.

It is important to use text that makes sense when read out of context to improve accessibility for an aural perception.

6.2.5 Navigation bar and menu

The so-called navigation links (i.e., the links appearing on each page and enabling users to reach the main parts of the site) represent a source of delay and inefficiency for screen reader users. Since such links appear on each page (and often even twice), the users who are forced to read the contents in an almost sequential way (by means of a speech synthesizer or a Braille display) are always compelled to skim them before they can identify the contents of the current page. Therefore, highlighting the navigation bar at the top and/or the bottom of the page, if any, can be useful to make it more understandable to users who are unable to see its visual features (e.g., horizontal or vertical position, colour or font types, etc.) and can increase navigation efficiency for these users. Other features can be used in order to localize the navigation bar through a screen reader. Therefore, we need to select techniques that make navigation easier for people using a speech synthesizer (e.g., by graphic and/or text references or frames), and, on the other hand, for visually impaired people (e.g., by different colours and dimensions).

A first suggestion is using layout tables to group the navigation links. In this case we suggest the application of an appropriate summary attribute to those tables, such as 'Navigation bar' instead of the misleading 'Right part of the head'. This way, users are able to immediately understand the goal of the table. However, we suggest inserting a link like 'skip to content' in order to avoid reading the navigation bar content (which is always the same) and to go directly to the new content.

Another suggestion is putting specific hidden text in order to mark the start of the navigation bar (or submenu); that Hidden markers when encountered by the screen reader navigating with arrow keys inform users about the starting of the bar or menu.

Another technique to be applied consist on differentiate importance of navigation bar links respect to those the current page. Links belonging to the navigation bar could have a lower level, whereas those of the current page could have a higher level. When user moves with Tab key, first visits the links of the current page, then those belonging to navigation bar.

When in a Web page there are several links organized into various levels, lists can be used. When we build a menu composed of sub-items, it is important to distinguish which are main items and which sub-items. So, menus and submenus should be created by using an unordered list (i.e., <UL>); in fact a well-structured list (with nested lists) can solve this issue as it allows obtaining a hierarchical structure easily identifiable with the screen reader. In order to focus easily the same hierarchical structure by low vision users, font and colour features in order to visually differentiate multilevel menu elements should be applied.

An example (in Italian) of these issues is shown in figures 5 and 6. The example is taken from http://www.uiciechi.it/toscana/download/programmi.htm

Figure 5 - Screenshot of a page containing both a horizontal navigation bar and a vertical side menu

Documenti&Download::Download di programmi

Graphic Barra di navigazione:
Link salta al contenuto alt+0
Link Home alt+h
Link Notizie alt+n
Documenti&Download alt+t
Link Organizzazione alt+o
Link Lista tasti alt+l

Graphic Sotto menu:
List of 4 items
• Link Programmi di utilità
• Link Lettori multimediali
• Link Screen reader
• Link Masterizzatore
list end

Heading level 1 Download di programmi
...

Figure 6 - Page read by screen reader

The graphic links "menu bar" and "sub-menu" point to the corresponding objects. The "skip to content" link is hidden.

Menu bar and submenu have been built using CSS for their positioning. They have been coded sequentially in the page source, so that the screen reader can read first of all the menu bar, afterwards the menu, and finally the page content. Requirements for low vision

people have been considered, using different colours and enlargement on mouse up.

7 The cost of the accessibility

"High costs of accessibility" are often claimed by implementers as a reason for higher costs or reduced accessibility. We want here to stress that accessibility is a high cost when it is necessary to make interventions on existing sites, and costs are higher when the original (internal) quality of the site is low, namely when the original code was not conformant to the language, or was not correctly using some features (just as a trivial example, not using CSS and relative fontsize). As it is true in the building architecture, costs for accessibility are very low when attention is paid since the early design phases, while they are higher after completion of the work.
Presently, the true additional cost is, in many cases, education of designers and implementers, which must acquire the appropriate skills. However, this should be considered a normal cost in a so rapidly evolving environment as the Web is, and is a necessary step towards quality. And, after all, quality is an investment, as it implies reduced costs for maintenance (corrective, perfective and evolutionary), and better image.

8 Conclusion

The Web offers so many new opportunities to people with disabilities that are unavailable through any other medium. It provides a method for accessing information, making purchases, communicating with the world, and accessing entertainment that does not depend on the responsiveness of other people. The Internet offers independence and freedom. But this independence and freedom is only partially a reality. Too many Web sites are not created with Web accessibility in mind. Whether purposefully or not, they exclude the segment of the population that in many ways stands to gain the most from the Internet. Only by committing to accessibility and providing for accountability, training, and technical assistance, can the Web's full potential for people with disabilities become a reality.

9 Acknowledgement

Many thanks are deserved to all who kindly helped us in preparing this paper, with useful suggestions or illuminating discussions.
A special acknowledgement goes to the group serving the Ministry of Innovation and Technology and CNIPA for the definition of technical rules for law 4/2004. Among the others, we thanks Pier Luigi Ridolfi, Antonio de Vanna, Mario Didomenicantonio, Domenico Natale, Paolo Graziani.

Finally the up to date documentation maintained by the WAI Team on the W3C site was of invaluable help. Some content of this paper comes directly from this source.

10 References

[ATAG] *Authoring Tool Accessibility Guidelines 1.0*, http://www.w3.org/TR/WAI-AUTOOLS/

[CSS-AF] *CSS2 accessibility features*, http://www.w3.org/TR/CSS-access

[Damery 2003] Damery E. (2003) JAWS for Windows version 4.51. New features and accessing the internet. Proceedings of 18th Technology and Persons with Disabilities Conference (CSUN), Los Angeles, California, USA.

[HTML-AF] *HTML 4.0 accessibility features*, http://www.w3.org/WAI/References/HTML4-access

[ISO9126] ISO/IEC FDIS 9126-1: Software Engineering - Product quality - Part 1: Quality model (2000) - http://www.usabilitynet.org/tools/r_international.htm#9126-1

[ISO9241] ISO 9241-11. Guidance on usability. 1998 - http://www.usabilitynet.org/tools/r_international.htm#9241-11

[Jaws] Jaws for Windows, Freedom Scientific. http://www.freedomscientific.com

[Leporini 2003] Leporini, B., Paternò, F. (2003), Increasing Usability when Interacting through Screen Readers. Springer International Journal Universal Access in the Information Society (UAIS), Special Issue on "Guidelines, Standards, Methods and Processes for Software Accessibility".

[Leporini 2004] Leporini B., Andronico P., Buzzi M. Designing Search Engine User Interfaces for the visually impaired. To be published in The Proceedings of the ACM W4A International Cross-Disciplinary Workshop on Web Accessibility 2004, at the Thirteenth International World Wide Web Conference, 18th May 2004, New York (NY).

[MathML] W3C's Math Home Page, http://www.w3.org/Math/

[Nielsen2000] Nielsen J.: *Designing Web Usability: The Practice of Simplicity*, New Riders Publishing, Indianapolis, 2000, ISBN 1-56205-810-X.

[Pitt 2003] Pitt I. and Edwards, A. Design of Speech-Based Devices - a Practical Guide. Springer, London, Great Britain, 2003.

[SMIL-AF] *SMIL accessibility features*, http://www.w3.org/WAI/EO/SMIL-access

[TBL1999] Tim Berners-Lee: *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web by Its Inventor*, HarperSanFrancisco (1999), ISBN 0-06-251587-X

[TUUAG] *Techniques for User Agent Accessibility Guidelines*, http://www.w3.org/WAI/UA/WAI-USERAGENT-TECHS/

[UAAG] *User Agent Accessibility Guidelines 1.0*, http://www.w3.org/TR/WAI-USERAGENT/

[UD] The Center for Universal Design - Universal Design Manifesto. Principles of Universal Design http://www.design.ncsu.edu:8120/cud/univ_design/princ_overview.htm

[W3C] *World Wide Web Consortium Home Page*, http://www.w3.org

[WAI-AERT] *Techniques For Accessibility Evaluation And Repair Tools*, http://www.w3.org/TR/AERT

[WAI-ER] Evaluation and Repair Tools Working Group, http://www.w3.org/WAI/ER/

[WAI-Tablin] *WAI Table Linearizer*, http://www.w3.org/WAI/ER/WG/tablin/

[WAI-Tools] Evaluation, Repair, and Transformation Tools for Web Content Accessibility, http://www.w3.org/WAI/ER/existingtools.html

[WA-Policies] *Policies Relating to Web Accessibility*, http://www.w3.org/WAI/Policy/

[WCAG] *Web Content Accessibility Guidelines 1.0*, http://www.w3.org/TR/WAI-WEBCONTENT/