Interfaces for disabled and people with special needs

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Contents

Abstract

This publication has been made for the Human Computer Interfaces (HCI) module, at the Cork Institute of Technology (lecturer: Paul Rothwell). The goal of this report is to see why interfaces for disabled people are so important, what means accessibility to disabled people on computing supports, and which systems exist currently.

We begin by talking of accessibility to disabled people in the real life, to make a parallel and illustrate what is accessibility in computing. Then, we present some existing systems for some of the main disabilities: move impaired people, blind people, deaf people. After the external systems, we see how accessibility is implemented in software, by seeing what exists in some operating system window managers. We finish the report by treating one of the most important software accessibility: the accessibility to the Internet contents.

Introduction

There are quite a lot of illness which can lead to huge disabilities, and make for these people impossible to use some tools of the everyday-life. Deaf, blind, motor-disabled are some of them. Computer use does not make an exception to this rule. As computers have become a tool more and more useful, and for certain people nearly indispensable, it become important to figure out means to enable disabled people, as everybody, to use this kind of tool.

In a lot of domains, governments and authorities make rules, laws, efforts, to make a lot of things accessible : buildings, transports... In computing and software designing, the case of disabled people can be [11] and has been taken into account. But it is a non-trivial domain, and a lot of developed systems are still part of the research fields.

In first place, we will highlight the accessibility to disabled people in the real world, through some examples. That will enable to go to accessibility in software. So we will see, in a second chapter, some of the means which exist to enable disabled people to use software. Then, we will see how, in software, accessibility can be implemented, through the example of operating systems. Then, we will finish by seeing accessibility on the Internet, which is a very important part of mainstream computing.

Chapter 1

Generalities

1.1 Example of projects set up by the authorities

The political powers have already studied the question of accessibility of information technologies for the disabled people. Some authorities have launched projects around that. We see here one example of them : an european project.

According to the Information Society Technology (IST) [21], there are between 10 and 15% of european people who have disabilities, and 20% who have over 60 years old. In that people, many need the use of a computer. Face to this challenge, the european power has launched, via *e-Europe*, a project with several goals around stimulate the use of the Internet. According to that, the IST program has been launched, which goes in the continuity of which has already be done at european level, like[1] :

- Graphic User Interface for blind persons (GUIB) ;
- Web accessibility initiative guideline (WAI) [7];
- "Design for all" (telephones for all).

So authorities play a great role in management of disabilities. As they have to make better the life

[1] Cf. presentation [21], slide 18

of our citizen, they try to provide civil help (like the irish authorities, which have published a *disability act* in 2005[2]). That lead us to the following part : examples of help to disable people in civil domains.

1.2 Quick examples of civil life helps for disabilities

1.2.1 Example of the design of homes considering disable people needs

The "Technology and disability journal" provides a very interesting example of how to build an accessible system for disabled people. In science computer, metaphors and comparisons are often taken. It is the case as for the computing elements ("mouse", "folder", "library"...) as for systems and algorithms, like in genetic algorithms, in artificial intelligence, where researchers have inspired of nature working (an example of this is explained in that publication : [14]). So it is interesting to consider methodologies of other fields, because some elements can be applied to software design.

The presented methodology is developed as a set of questions to ask about the system conception. Set of relevant questions deal with a precise domain, and domains are following, the one after the others, logically. Then eventually, the system is designed to be enough accessible, visible, usable. For more information on that process, you can read the source document : [17].

1.2.2 IT system for civil accessibility: the example of teleshopping

Another good civil example is shopping. The big and heavy bags, for people who are limited to move, is an important issue. On that subject, *Teleshopping for older and disabled people* [13] is very interesting. Indeed, the authors analyze several possibilities of making teleshopping, by the use of information technologies, in order to facilitate the transfer of goods for people who couldn't move a lot. We can take two examples of how teleshopping can be made.

First, there is "assisted online shopping". Thanks to a laptop installed in the house of disabled people, they access to a "virtual shop" online. The costumer are connected to this virtual shop, and the virtual shop is connected to the supermarket. Costumers can order their command, and pay by

[2] `http://www.oireachtas.ie/documents/bills28/acts/2005/a1405.pdf`

credit card. This way makes transactions very fast, compared to other means [13].

A second example is ordering the command using the telephone. This approach is called "Standard supermarket telephone ordering". Here, the users are directly connected to the supermarket. They can pay by credit card or cheque. But the cost for the supermarket is higher [13].

1.3 From real-life to computing assistance to disabled people

Like for civil help to disabled people are not only humanistic, but answers to political popularity, help and accessibility in computing is not only a matter of philanthropy. Indeed, according to *Human-computer interaction: towards the year 2000* [12], help and accesibility of software is also a "large and growing market"[3]. Thanks to surveys, they show that 5% of the american population show a disability (blindness, central palsy, language-impairing, hearing-impairing...).

[3]Cf. *Human-computer interaction: towards the year 2000*, page 673.

Chapter 2

Systems for disabled people

There are some systems to help disable people understand the contents, hugely depending on the disability. We will begin by the higher disabilities.

2.1 Systems for people with movement disabilities

2.1.1 Systems of voice recognition

For people with troubles for making proper movements, the voice-recognition system can be interesting.

The goal of that kind of systems is to be able to capture words, from a sound source (generally people's voice - so they are more commonly called speech recognition systems). This kind of systems begin to appear in some mainstream computers, natively integrated in software (like in Microsoft Windows Vista, for example [8]), even if the mainstream systems are not always very efficient. There is still a lot to do in research to improve that kind of systems, to have better results. These improvements can be made at a lot of levels, as researchers of the University of Geneva say [23] :

1. improve the mathematical and theoretical representations of voice in a machine ;
2. improving the hardware level, to have more powerful equipments, generating less noise and better voice ;
3. improving training systems.

We can take an example of a study to improve speech recognition. Researchers of Finland and Slovenia have studied the influence of encoding / decoding on the quality and the deformation of the speech [26].

One of the main issues with speech recognition in general, is that this is very dependent of the considerate person. This kind of issue is present in other domains, like in writing recognition. Indeed, the voice has a great variability, and depends on a lot of factors: emotion, tone, fatigue... That is confirmed by the conclusions of the researchers of University of Geneva study [23].

These kinds of systems have been developed to make interfaces usable, nearly without the help of a mouse and a keyboard. One of the main motivations to do that is improving user's comfort and productivity. But obviously, this sort of system can also be used to help people with movement disabilities. Besides, this can be broadened to a lot of people, with little or fleeting disabilities, due to fatigue, pain... or disabilities like dyslexia. So this sort of systems is very interesting, because it can helpful for a lot of disabilities, and because it begins to become mainstream (around $200 for a full system) [1].

2.1.2 Navigation by eyes and head movements

Another field of research for people with paralytic disabilities is the capture of the only movements they generally can do, as eyes movements for example. Thanks to the research, some computers, thanks to sensors, are able to detect these tiny movements, and activate the mouse with that.

To do it, there are two possible ways for movement information acquiring [10]. The first, electro-physical, considers the action of the muscles which control the person's eyes. It is the oldest technique, and seems not to be extremely efficient. Indeed, the other movements of the near muscles and tissues can interfere with the eyes muscles, and make the measure false. Moreover, another problem is that putting the required electrodes on the subject is quite heavy, for the simple use of a computer.

The second records directly the movements of the eyes, by reflexion of light in the eyes. The aim is for the person to look at a special point on a screen, so that the sensor can detect relative movements and interpret it to transform it into a real mouse movement. This technique shows also

some limitations, because eyes movements are not fluids ; there are a great number of little uncontrolled movements which can interfere with the wanted move.

For people who are less disabled, and can move the head for example, it exists a third technique, which exploit this possibility. A classic keyboard is shown on the screen, a cursor on it. Also by light reflexion on the eyes, the sensors captures the movement of the head, and moves the cursor in consequence in the keyboard. Then the person will make a signal (whatever it is) to validate the key.

2.2 Accessibility for blind people

It seems that, currently, for blind people, there are two technologies: put information in relief and put information on hearing format [27].

2.2.1 Overview of the two main possibilities

The main example of the first technology is the *braille* technique. The goal of this technique is to make points in relief, in a certain position. The points have a certain meaning, corresponding to the position in which they are. But this technique is not straightforward, because it takes some times to make braille supports. So it is not adapted to moving, evolving and changing content. Moreover, it generally needs a lot of space of storing [27]. That is why this kind of thing is more specially present in libraries, for example.

The second technology seems to be easier to put in place, and cheaper. Indeed, registering the voice is quite easy for mainstream, and moreover, it is easy to reproduce magnetic supports and audio tapes, by copy.

2.2.2 Focus on hearing correspondence to written content

Otherwise, there is another possibility, in hearing format information. That consists in making a machine capable of translating written information into audible speak. These are screen readers, which are able to tell what is displayed on the screen, and which are able to, through keyboard shortcuts, move a cursor on the different parts of the screen, so as to read what is relevant.

As an example, we can cite *JAWS*, which enables to vocalize Microsoft Windows and Office applications [22].

2.3 Accessibility for deaf people

2.3.1 Communication computer → people

Helping deaf people having a complete and efficient use of a computer is less hard than for blind people, for example. Indeed, as they can see what happens on the screen, they can consequently navigate through the applications, they have access to the content by reading, and so forth.

The main problem, for deaf people, are to find and implement alternatives to all alerts and events which use sounds to warn the user, or to give him/her some feed-back. For that, there is no special device or system. It is mainly to software editors to consider that case, and to adapt their software so that it can be used properly by hearing-deficient people. In general, one of the main thing to do is replacing sound alerts and feed-back by visual stuffs.

There are quite a lot of examples in software. We will see some of them in the part of the report which deals with accessibility in software (cf. chapter 3 on page 10).

2.3.2 Communication people → computer

There are also systems which are developed, whose goal are for deaf people to be able to communicate with or through their computer. For the communication with the computer, this is comparable with voice-recognizing systems, that begin to appear (like in Microsoft Windows Vista for example [8]). For the communication with other people through the computer, this could be comparable with microphones and VOIP systems (like Skype, for example).

For example of the research in this domain, a group of french and greek researchers have studied how to recognize forms of *cued speech*. Cued speech is a set of positions of the hands, which position mainly corresponding to a sound or a letter [4]. So the researchers have filmed these hand positions, with several means of video-acquiring (like webcams, for example). Then, thanks to images and forms

recognition techniques, they make the computer extract the global shape of the filmed hand, and match it with an internal library of shapes. With this technique, sounds, letters and words can be acquired by the computer, and this data can be used by other software. The main problematic of the study, is to know when to use 2D and 3D recognition, to extract the shape of the hand: is it one more relevant ? In which condition(s) ?... Eventually, their result is that 2D acquiring is more adapted when the hand has a very good "segmentation", that is to say, when shapes are very clear. Besides, 3D recognition is more relevant is the other case, that is to say, when there is quite a great "noise" is the images captured by the video support [15].

Chapter 3

Accessibility in operating systems

introduction

A lot of pieces of software have put elements to improve accessibility. Some are very similar, that is why we are going to see the example of operating systems.

The Operating System (OS) is probably the most important piece of software in computers, because it is through it that the computer become usable. Thus, accessibility seems particularly important for operating systems. We are going to see some examples of what software developers have engineered to make their operating systems more accessible to disabilities.

3.1 Windows Vista

There are a lot of systems to improve accessibility to disabled people in Windows Vista. A brief description of these are available on Microsoft website[1]. There are also guidelines and tutorials available, to be able to set up the accessibility systems[2].

[1] See `http://www.microsoft.com/enable/products/windowsvista/default.aspx`

[2] See `http://www.microsoft.com/enable/training/windowsvista/`

3.1.1 Navigation and devices alternatives

Windows Vista includes a on-screen keyboard, which can replace the real keyboard. It includes also shortcuts, which enables to use arrow keys instead of the mouse, or to open some windows and services by a combination of keys. The OS has also a feature of "filtering keys" : in ignores keystrokes that happen too quickly, to prevent unintentional strikes. This last thing can be interesting for some disabilities where people shake.

3.1.2 Magnifier

Some things in the screen can be written in very tiny characters, or be little details that can be important. To improve the vision of the screen, there is a magnifier in Windows Vista, that permits to magnify from 2 to 16 times the size of a part of the screen. This can obviously help visually impaired (and maybe elderly) people.

3.1.3 Narrator

An interesting system to help blind or visually impaired is called *Narrator*. This is a system which contains recorded sentences, and which plays some of these sentences while an event occurs. For example, it can tell the user that he has just opened a window, or that there was just an error (describing the error), and so forth.

3.1.4 Other systems

There are speech recognition systems, of which we have talked before (cf. subsection 2.1.1 on page 5). There is also a visual system of notifications, with blinking screens, that can replace sound notifications. Finally, there is a centralized control panel, to be able to control a lot of parameters from a single point.

3.2 Linux Ubuntu

The window manager mainly used in Ubuntu is Gnome. The features browsed here are more in that window manager[3].

3.2.1 Visual themes

Gnome includes a set of graphic themes specifically designed for visually impaired people. These are high-contrast themes, with characters of great size.

3.2.2 Keyboard modifiers

Ubuntu includes also a screen keyboard, which is extensible through macros. You can also modify parameters of reaction rate and repeat rate of keyboard and mouse keys (respectively *Slow keys* and *Bounce keys*). So it looks like the *filtering keys* of Windows Vista, but there you make your own parameters on this, so that the system ignore unwanted keystroke, but don't ignore too much (potentially wanted keystroke).

3.2.3 Screen reader and magnifier

Ubuntu includes a screen reader and magnifier, named *Orca*. This piece of software supports and provides key-mapped functions for magnifier, navigation, speech and braille devices. And ubuntu includes also a magnifier.

3.3 Mac OS X

Mac OS X includes a great number of accessibility systems. It would be quite long and fastidious to enumerate all of them, so we will see some of them. For more information, you can go on Apple website : `http://www.apple.com/accessibility/macosx/`.

[3] See http://www.ubuntu.com/products/whatisubuntu/accessibility

3.3.1 Some systems already seen

Like in the OS we seen before, Mac OS X includes system alerts, screen magnification, display adjustment, on-screen keyboard, shortcuts, slow and sticky keys, talking alerts, text-to-speech...

3.3.2 Automator

A piece of software useful for physical and motor disabilities is *Automator*. This enables to automatize tasks, making a workflow with a succession of tasks. That would be helpful for complex and routine tasks. And all this can be launched through shortcuts.

3.3.3 Hand-writing recognition technology

Mac OS includes a piece of software, *InkWell*, that supports hand-writing devices. You can plug a tablet, and, when writing on the tablet, the piece of software will interpret the writing and recognize letters and words.

3.3.4 The trackpad

Most of the Mac laptops have a very useful trackpad. With it, you can not only move your mouse cursor, but also scroll (vertically and horizontally), make right-clics, activate the screen magnification... And some laptops, like the Mac Book Pro, include an even more elaborated trackpad, named *Multi-touched trackpad*. With it, you can rotate pictures, advance in a photo album...

Chapter 4

Web accessibility

We make a whole chapter about the case of the Internet, because it is probably the best example of a domain where accessibility is required for people with special needs. Indeed, it is a domain more and more important, which will become nearly a non-avoidable source of information, social and part-of-life area. Moreover, we will be able to take technical computing examples, to illustrate the talk.

4.1 Web sense of accessibility

Considering the World Wide Web, accessibility is not only considering disabled people. It considers special needs of disabilities, but it is even more general [16]. For the Web, accessibility covers these notions [16] :

- accessibility to desktop browsers, like Mozilla Firefox, Apple Safari... (the easiest to do) ;
- accessibility to "full text browsers", like Lynx [5], which are browsers with only text, accessible in a terminal for example ;
- accessibility to browsers on supports more little than a computer, for example browsers of mobile phones ;
- and of course, accessibility for devices made for disabled people, like voice browsers.

Accessibility, it is considering that website are made for the largest number of people, so most people should be able to access the content of the websites. As Jonathan Snook says, “accessibility is just usability but marketed to a particular segment of the population” [25].

The main and most followed standards are provided by the World Wide Web Consortium (W3C). This consortium has been founded and is headed by Sir Tim Berners-Lee, which is considered as the inventor of the World Wide Web. This organism provides recommendations and guideline about the web, and its technologies (HTML, XML, CSS...) [20].

4.2 Accessibility : make content arrive to the user

4.2.1 Overview

When doing a website, an individual or an organization aims to communicate some information to the public. So the goal is for the original information known by the publisher to arrive in the reader’s mind. For that, the way is composed by a succession of stages, using the Web, described in figure 4.1 page 15 (published by the W3C[1]).

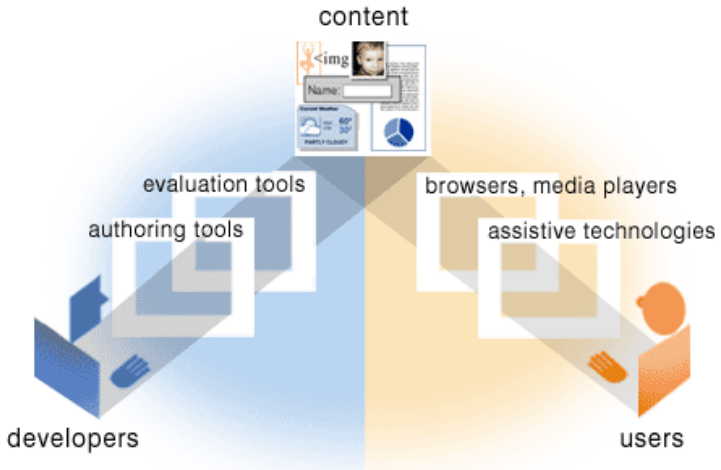

Figure 4.1: information flow (from W3C)

[1]Cf. http://www.w3.org/WAI/intro/components.php

In that picture, there are two branches for the information traveling : from the producer to the main support, the Internet, and from this intermediate support to the user. For each of that branch, there are tools and technologies to insure the information will be able to travel correctly.

4.2.2 Setting the content

The first part of the information way is going from the source to the web.

Authoring tools

First of all, the producer needs to create the website. To do that, there are a lot of development tools which help for making a proper website.

Some of the biggest WYSIWYG[2] tools (like *Microsoft Word*, *Microsoft FrontPage*, *Macromedia Dreamweaver*) don't necessarily produce webpages which are compliant with the web standards [24].

Some other tools, in contrary, enable the developer to make easily webpages which are compliant with the Web standards. For example, NVU[3] is another WYSIWYG editor, which places HTML 4.01 Transitional valid tags. It also includes a HTML validator (cf. part on evaluation tools) [6].

But the drawback of the pieces of software like NVU, is that they are only capable of making good (X)HTML and CSS products, and they don't support useful web script languages like PHP or Perl. That is a great limitation, given that most of the dynamic websites need PHP to work.

Evaluation tools

Evaluate the website Once the website has been created, before put it online, it is important to check that the developed product is really compliant with the web standards. In order to do that, there are a lot of evaluation tools. In general, these evaluation tools are parsers, which take the webpage (or a set of webpages) in input, analyze the tags, the structure, the content, check the points provided by the standard guideline, and give a result with errors, warnings, info, tips...

[2] acronym of "What You See Is What You Get" : refers to tools where you can build the product with the final result, and not with code lines (for example, MS Word is a WYSIWYG tool , contrary to LaTeX).

[3] NVU official website : `http://net2.com/nvu/`

The W3C validators One of the main tools of validation is the set of validators from the World Wide Web Consortium. They provide tools which validate code according to standards of XHTML 1.0, HTML 4.01, CSS 2.1, and accessibility. They are available online : juste give it the webpage, and it tells if the page is compliant or not[4]. These tools are so important, that they are included in development plugins for browsers. For example, there are validators on Mozilla Firefox. Thanks to that, the web developer can control, when implementing, that what is done is correct.

Page purifiers There are other systems, named *page purifiers*, that can take a webpage in input, and try to make it compliant with a chosen standard (HTML 4.01 strict, HTML 4.01 transitional, HTML 2.0...). An example is *Delorie web page purifier*[5].

Browser testers There are also tools which check if the webpage will be supported or not by browsers. They do it by making tests on the webpage, knowing how browsers implement the technologies. The probably most known was *Bobby*[6], but it has been acquired by IBM, so now it is an IBM product[7].

Built tools There are other tools, developed by associations, developers, and so forth, which can help to control and validate the code. Generally, they are based on the standards defined by the W3C. We can take the example of the "Eval" tool, promoted by the Braille Association and WatchFire. This tool makes a phase of requirements analysis, a phase of automatic tests, a phase of manual evaluation support. It is possible to select a set of predefined guidelines [19].

4.2.3 Understanding the content

Once put online, the contents are read by browsers. The main browsers are currently Internet Explorer (Microsoft), Firefox (Mozilla), Safari (Apple), and Opera (Opera Software). But there are other browsers, like Mozilla, Netscape Navigator, Konqueror...

[4] the validator is available at the URL `http://validator.w3.org/`

[5] `http://www.delorie.com/web/purify.html`

[6] `http://www.cast.org/products/Bobby/index.html`

[7] `http://www-01.ibm.com/software/awdtools/tester/policy/accessibility/`

There browsers can be classified into two categories : the *Gecko* browsers, and the others. *Gecko* is an engine for web browsers, in which are based all the Gecko browsers : Firefox3, Netscape9... Gecko has been made in order to implement open web standards [3]. By extension, others browsers, like Opera or Safari, can be considered as Gecko, as they implement correctly the W3C standards. The web developers generally differentiate all those web browsers, and Internet Explorer, for which a special style sheet is generally needed, as it doesn't implement correctly the web standards.

Web standards are made to provide a logical structure, and a structured content, readable by systems for disabled people. So, by implementing correctly the standards, web browsers should be able to display any page, and assistive technologies to correctly read them.

4.3 Doing accessibility

4.3.1 General principles

There are some general principles to the W3C guidelines, in order to make things accessible. We are not going to make an exhaustive summary of all the detailed principles, but we just list here some examples, the most important examples, so as to give an idea of how it is possible to make accessibility principles in web development.

- Separate content from presentation : like that, screen readers are able to read the contents, making it accessible.
- Provide text equivalent to multimedia supports : legend to images, summaries to videos...
- Clarify the style, the usage of natural language, provide clear navigation systems...

4.3.2 Technologies

We are going to see an overview of some of the most used technologies on the web, and see what are their relationships with accessibility.

(X)HTML / CSS

As we have seen, it is necessary to separate the content and the presentation. The couple HTML / CSS is perfect for that. All the structure and the contents are made with HTML, which is a simplified description language (like XML), and the presentation is made thanks to CSS. Thus, it will enable the screen readers to read only and clearly the HTML. XHTML is a standard of HTML, provided by the W3C, which insures the building of a correct structure, and some good practices for accessibility.

Javascript, Ajax

Javascript is a language that enables to make effects and change the contents of the webpages without having to reload them.

Ajax is a technology that uses a special Javascript object (`XmlHttpRequest`), in order to make a call to a server, retrieve asynchronously information thanks to XML format, and print these information in the webpages via Javascript, without reloading the page. The advantage is an important time gain for the user (the content can be updated, without necessitating a PHP or other script language call, so the page doesn't have to refresh).

So these are dynamic language and technology, which can cause accessibility problems, as the page content can be change without a reload – and so, probably without a re-read of helping systems. Moreover, most of the time this is readable by graphical browsers, but not by text browsers, which can make content disappear for browsers which don't read Javascript.

So there are best practices, recommendations, guidelines for the use of Javascript / Ajax in webpages (for example, there are some in IBM website) [18].

Flash

Flash is a language that enables to make fancy introductions, moving menus, and other graphical effects, on webpages. Like for Javascript, it is a dynamic language, which makes the webpage change without reloading the page, which can cause accessibility problems. According to Jeffrey Zeldman [28], the main problem of Flash is the fact that it is inappropriate to a lot of content and commerce

websites. So Flash is used in appropriate situations, juste in order to make fancy effects, the result being a lack of attention in accessibility. The other problem is, as some developers make flash without taking care of accessibility, they make effects readable by two of three browsers[8].

4.3.3 Some examples of accessibility implementation

Here, we show some examples of what, precisely, accessibility means in term of implementation. These are some points from Minimum Web Accessibility Standards, from the university of Ohio [2], which seems similar to W3C recommendations [16] as well [9].

The goal is not to list exhaustively all the points of the guideline, but rather to give an idea, with precise and technical examples, of how this can be implemented. So we only put here some points, for the others you can refer to the W3C official guideline [16].

- **Provide an equivalent to multimedia**: about that, it is required, for example, to always fill relevantly the `alt` field, with an alternative text explaining the picture [9].
- **Use markup properly**: use title tags to put titles (from `<h1>...</h1>` to `<h6>...</h6>`), identify changes in languages (`<p>A <span lang="fr">magnifique</span> day,...`).
- **Clarify natural language**: use acronym and abbreviations tags:

  ```
  <p>Welcome in the <acronym title="World Wide web">WWW</acronym></p>
  ```

[8] Cf. [28] chapter 3, page 96.

[9] That can also be found in [28] chapter 14, pages 346 – 357.

Conclusion

In Human-Computer Interactions, there are a lot of aspects to be aware of. One of the most fundamental is the fact that the interfaces should be designed for the greatest possible number of people. Indeed, the computers provide now so much information, that it is very important everyone can access to it ; otherwise, it would be maybe a partial isolation of some people, or at least the lack of access to an important tool. So the problem here is generally, make the content accessible to impaired and elder people.

A parallel can be made with accessibility in public locations. The state authorities, at least in Europe, set up project to insure a minimal level of accessibility. In software, this is the same. A lot of systems have been created to make blind, deaf, or other disabled people, to be able to reach the contents. Most of the operating systems have implemented some systems, in order to provide accessibility help: high-contrast themes, sound alerts, task automatization...

One of the domain in which accessibility is the most important is the WWW. Indeed, considering the tremendous database the Internet is, web accessibility is hugely important. For that, guidelines and standards have been defined (in particular by the W3C), to insure the accessibility of the contents.

In conclusion, is a very open domain, in hardware like in software. In hardware, because systems are very perfectible. In software, because it is important to adapt to software systems, and because the awareness of this aspect is needed when creating a piece of software or a website.

Bibliography

[1] Voice input computer systems. http://www.assistivetech.net/at_reports/guides/VoiceInput.pdf, March 2002.

[2] Osu minimum web accessibility standards. http://www.wac.ohio-state.edu/standards/mwas.htm, April 2004.

[3] Gecko (layout engine). http://en.wikipedia.org/wiki/Gecko_(layout_engine), October 2008.

[4] How does cued speech work? http://www.cuedspeech.org.uk/index.php?page=how-does-cued-speech-work, October 2008.

[5] Lynx source distribution and potpourri. http://lynx.isc.org/, October 2008.

[6] Nvu – standards compliance. http://en.wikipedia.org/wiki/Nvu#Standards_compliance, October 2008.

[7] Web accessibility initiative (WAI). http://www.w3.org/WAI/, October 2008.

[8] Windows speech recognition. http://www.microsoft.com/enable/products/windowsvista/speech.aspx, February 2008.

[9] Jojo I. Esposa Jr. How to write a good alt text. http://www.mccid.edu.ph/howtowritealttext.htm. Consulted in October 2008.

[10] Jenny Preece, editor. *Human-computer interaction*, chapter 11.5 and 11.6, pages 224–229. Addison – Wesley, 1994. isbn: 0-201-62769-8.

[11] Ben Schneiderman, editor. *Designing the user interface – third edition*, chapter 1.5 (accommodation of human diversity), pages 24–27. Addison – Wesley, March 1998. isbn: 0-201-69497-2.

[12] Ronald M. Baecker, Jonathan Grudin, William A.S Buston, and Saul Greenberg. *Readings in human-computer interactions: towards the year 2000 – second edition.* Morgan Kaufmann, 1995. isbn: 1-55860-246-1.

[13] James Barlow and Mary Breeze. *Teleshopping for older and disabled people.* Joseph Rowntree Foundation, 2005. isbn: 1-85935-279-0.

[14] Benoît Baudry, Franck Fleurey, Jean-Marc Jézékel, and Yves Le Traon. Automatic test case optimization: A bacteriologic algorithm. `http://www.irisa.fr/triskell/publis/2005/Baudry05d.pdf`, 2005. From IEEE SOFTWARE, published by the IEEE Computer Society.

[15] Alice Caplier, Laurent Bonnaud, Sotiris Malassiotis, and Michael G. Strintzis. Comparison of 2d and 3d analysis for automated cued speech gesture recognition. `http://www.iti.gr/files/specom_04.pdf`, *(no date).*

[16] Wendy Chisholm, Gregg Vanderheiden, and Ian Jacobs. Web content accessibility guidelines 1.0. `http://www.w3.org/TR/WAI-WEBCONTENT/`, May 1999.

[17] Guy Dewsbury, Karen Clarke, Mark Rouncefield, Ian Sommerville, Bruce Taylor, and Martin Edge. Designing technology in homes to meet the needs of disabled people. `http://www.dirc.org.uk/publications/articles/papers/65.pdf`, March 2005. From the Technology and Disability Journal.

[18] Becky Gibson. AJAX accessibility overview. `http://www-03.ibm.com/able/resources/ajaxaccessibility.html`, April 2006.

[19] Pierre Guillou, Denis Boulay, Sylvie Duchateau, Dominique Burger, and Michael Cooper. The eval research and development project.

[20] Ian Jacobs. About the world wide web consortium (W3C). http://www.w3.org/Consortium/, April 2008.

[21] Manuel Monteiro. Presentation of the high level group on employement and social dimension of the information society (esdis). http://ec.europa.eu/employment_social/soc-dial/info_soc/esdis/monteiro.pdf, July 2000.

[22] Guillaume Papin. Nouvelles technologies et handicaps sensori-moteurs. Master's thesis, Paris 8 university, August 2005.

[23] Klaus Scherer, Tom Johnstone, and Tania Banziger. Verification of emotionally stressed speakers: The problem of individual differences. http://www.unige.ch/fapse/emotion/publications/pdf/specom_98.pdf, *(no date)*.

[24] Christopher Schmitt. Accessibility, web standards, and authoring tools. http://www.alistapart.com/stories/tools/, March 2002.

[25] Jonathan Snook. Accessibility and usability – what does accessibility mean? http://snook.ca/archives/accessibility_and_usability/what_does_accessibility_mean/, November 2007.

[26] Jari Turunen and Vlaj Damjan. A study of speech coding parameters in speech recognition. http://www.elektronika.uni-mb.si/Elektronika/Pdf_files/3e83fafbe8dbcTurunen-EUROSPEECH01.pdf, 2001. From EUROSPEECH'01 Proceedings, Aalborg, Danmark, pp. 2363-2366.

[27] Gérard Uzan. *Les nouvelles technologies daide aux non-voyants et mal-voyants*, chapter 2. Actes du séminaire Écrit, Image, Oral et Nouvelles technologies, 1995-1996.

[28] Jeffrey Zeldman. *Designing with web standards – second edition.* New riders, *(No date)*. isbn: 0-321-38555-1.