European Internet Accessibility Observatory: let's make accessibility measurements, accessible to everyone!

Accessible Presentation of Measurements from a Web Accessibility Observatory

Patrizia Bertini (patrizia@patriziabertini.it), FBL, Italy

and

Terje Gjøsæter (terje.gjosater@hia.no) Agder University College, Faculty of Technology, Grimstad, Norway

INTRODUCTION

Accessibility is increasingly becoming a huge priority to improve e-democracy and to remove the digital divide which affects not only the elderly or disabled, but can affect virtually every citizen. 37 million people in Europe are disabled and the society is aging rapidly. Digital application and services could greatly improve disabled and elder people's everyday life, providing valuable services through an Internet connection.

But in order to allow everyone to take advantage of the information society, we need to ensure that information is accessible and the interface is user friendly.

For this reason Accessibility has become a huge priority for national governments and also for the European Commission which, since the meeting in Lisbon in March 2000, adopted the so called *Lisbon Strategy*, which is expected to show its full potential by 2010, and released a number of important communications concerning accessibility.

The European Internet Accessibility Observatory (EIAO) (http://www.eiao.net)[1] is an IST project launched in September 2004 which aims at creating a new tool for government, associations, stakeholders and EU decision makers to get a clear picture of the accessibility status across Europe. The lack of common metrics and the number of national regulations which have came into force in the last years asking for accessible websites, shows that web accessibility needs to be monitored and controlled based on a common set of rules. EAIO is going to provide a concrete answer to this need by developing a technological infrastructure consisting of a web crawler, web accessibility assessment modules, and a data warehouse for storing the measurements, which will enable us to show developments in the results over time.

PROBLEM SETTING: WHAT EIAO WANTS TO DO

EIAO will perform large scale monitoring of web accessibility of European public web sites. A web crawler will each month collect pages that are automatically assessed using a WCAG-based (http://www.w3.org/TR/WAI-WEBCONTENT/) methodology called the Unified Web Evaluation Methodology (UWEM) (http://www.wabcluster.org/uwem1/) so that EIAO can ensure that the results collected are comparable, as other web accessibility assessment results today are not completely comparable due to the different regulations already mentioned. This produces large

1 The project is co-funded by the European Commission DG Information Society and Media, under the contract IST-004526

amounts of very detailed assessment data that are stored in a data warehouse. In order to make these results accessible to the public, a web based user interface is being developed.

The need to develop an accessible user interface to show the results achieved by EIAO brings up a number of issues to be considered before starting development.

The first step to undergo for an efficient design is to know our target: the main target groups for the EAIO user interface are policy makers and stake holders, but web developers and users are also expected to be interested in the results.
An obvious requirement is that the results are presented in an accessible way.

The results need to be aggregated to a level where they are meaningful to the main target groups. In the first release of the user interface, we will display tree main types of reports; for single web sites, for regions and countries in Europe, and for different sectors such as federal organisations or local municipalities.

EIAO monitoring started in June 2006 and will be performed once a month each month in the future. The results are presented in reports based on scorecards indicating the result, and the change in score since previous month will also be displayed in the scorecard. It is possible to expand the report to show results for the individual check points that the overall score is based on. One interesting challenge is to display the results in a way that is both accessible, functional and intuitive to all users.

Main issues which are taken into consideration to develop accessible interfaces include:

- Navigation problems
  - Information architecture and its consistency
  - Presence of labels
  - Presence of help information
  - Provide orientation mechanism
- Controls
  - Menu bars and their accessibility
  - Controls are device independent
- Forms
  - Correct field labeling
  - Input are device independent
  - Logical tab order
  - Default value in boxes
- Communication
  - Easy command and label
  - Clear help
  - Usage of easy language

Menus, for instance, needs to be named considering the contextual, cultural and user characteristics (Preece, 1994); names and links needs to be clear, unambiguous and easy to remember. EIAO is developing its menus to allow users to request reports, print them and make their selections, the wisest choice is to use textual forms to label commands and menus. For active interfaces, which expect users to perform some actions, textual menus are the most clear and unambiguous way to convey information to them, reducing the errors and learning time.

The menu bar developed for the EIAO GUI (Graphical User Interface) shown in Illustration 1 is used for choosing the report type. It contains descriptive names, and consists of only text formatted using CSS (Cascading Style Sheets) and will show up as plain text if CSS is disabled or not supported by the browser. Each tab, the menus available on the top of the page here represented, have access keys associated with them, which grant that users can access them easily also via keyboard. A challenge concerning accesskeys was to find out some efficient key combination not already in use in any software. Jaws, for instance, a worldwide used screenreader

software, has a number of predefined accesskeys and the software tends to override the interface accesskeys with its owns. In a study conducted in 2002 it was shown that in Windows operative system, most of the ALT + X keystrokes have already been used in different applications

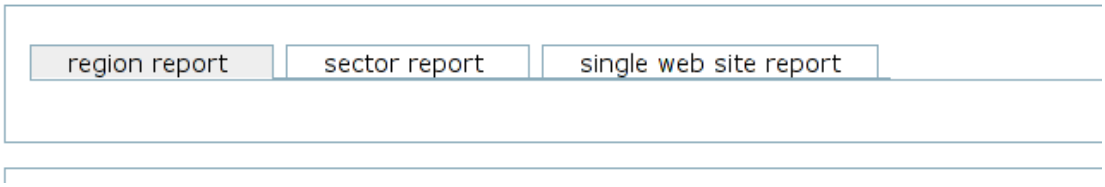


Illustration 1: The report selection menu bar

The following piece of HTML defines the menu bar:

```
<ul id="portal-reportTab">
      <li class="plain">
      <a href="http://localhost:8080/EIAO/eiao_gui/regionReport?type=simple">
Region report</a>
      </li>
      <li class="plain">
      <a accesskey="3"
      href="http://localhost:8080/EIAO/eiao_gui/sectorReport?type=simple">
      Sector report </a>
      </li>
      <li class="selected">
      <a accesskey="4"
      href="http://localhost:8080/EIAO/eiao_gui/singleSiteReport?type=simple">
      Single web site report</a>
      </li>
</ul>
```

ALT+3 and ALT+4 accesskeys, shown in this code example, were chosen as according to the current keystroke usage in Windows, these are available keystrokes which can be defined by users. We considered mainly windows' users as Jaws and many assistive technologies run on Windows operative system and only recently different operative systems have started supporting assistive technologies. Thus we tried to use those keystrokes which could be free from formal usage in other applications. This solution, plain HTML with accesskeys not already in use in other applications, can grant controls a high level of device and application independence. All main parts of the GUI can be reached by access keys.

A comprehensive help page is available, explaining various aspects of the usage and background of the GUI. It is also directly reachable, also with an access key, from anywhere in the user interface. It is designed as one page with a table of contents with links to each topic, and each topic is followed by a link to the top of the table of contents.

It's important that each of the aspects mentioned before in their solution follow the main usability concepts (Nielsen 2003):
Learnability: The user can quickly go from not knowing the system to getting some work done with it.

- Efficiency: Once the user has learned the system, a high level of productivity is possible.
- Memorability: The infrequent user is able to return to using the system after some period of not having used it, without having to learn everything all over.
- Errors: Users do not make many errors during the use of the system, or if they do make errors they can easily recover from them. Also, no catastrophic errors should occur.
- Satisfaction: Users are subjectively satisfied by using the system; they like it.

An intensive application of usability and accessibility guidelines guides our design process, together with the principles stated in this paper.

THE EIAO APPROACH

When talking about accessible interfaces, it's important to emphasise that accessibility for people using assistive technologies can mean both:

- Providing the equivalent information;
- Providing an alternate source of information.

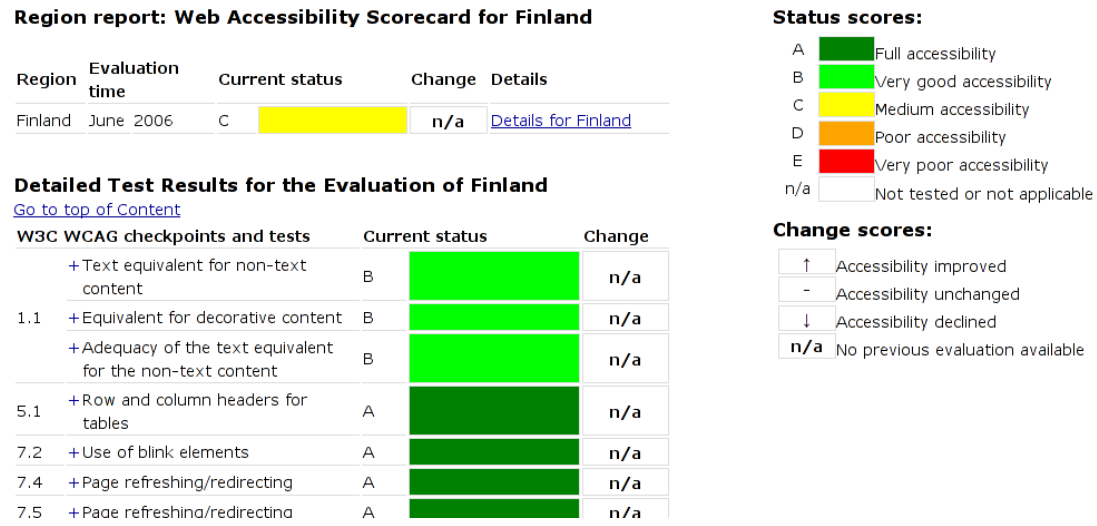
In the first case information is accessed by the same area and it's redundant in some parts – invisible to end users – to allow disabled users to gain the same information as all other users.

An alternative information is provided by means of a different application or web page, with no loss of information, but with the need to focus more on accessibility issues targeted to users surfing with special assistive technologies.

EIAO wants to develop a fully accessible user interface which will be able to overcome any technological barrier, linked to the technologies used by users, and cognitive barriers as well, putting into practice usability and information architecture findings in a user centered way.

The EIAO approach is to provide equivalent information on the same framework, promoting info-inclusion and allowing everyone to access the platform and the results provided by the observatory.

Illustration 2 shows a possible way to redundantly display results using both letters and colour in order to make it understandable to the largest possible range of users.



Region report: Web Accessibility Scorecard for Finland

Region	Evaluation time	Current status	Change	Details
Finland	June 2006	C	n/a	Details for Finland

Detailed Test Results for the Evaluation of Finland

Go to top of Content

	W3C WCAG checkpoints and tests	Current status	Change
	+ Text equivalent for non-text content	B	n/a
1.1	+ Equivalent for decorative content	B	n/a
	+ Adequacy of the text equivalent for the non-text content	B	n/a
5.1	+ Row and column headers for tables	A	n/a
7.2	+ Use of blink elements	A	n/a
7.4	+ Page refreshing/redirecting	A	n/a
7.5	+ Page refreshing/redirecting	A	n/a

Status scores:

A	Full accessibility
B	Very good accessibility
C	Medium accessibility
D	Poor accessibility
E	Very poor accessibility
n/a	Not tested or not applicable

Change scores:

↑	Accessibility improved
-	Accessibility unchanged
↓	Accessibility declined
n/a	No previous evaluation available

Illustration 2: Results shown with both letters and colour

COMPETENCIES AND TECHNOLOGIES

The selected approach is a user centered one based on HCI findings as EIAO shall be fully accessible also to disabled users using assistive technologies.

Our goal is to produce a functional, safe and usable system, easy to learn and to use, regardless of the technologies in use, connections, users' peculiarities, or other environmental factors.
This approach requires that during the design procedures, the designers and developers team take into consideration many aspects, chiefly related to 2 different areas:

- Humans;
- Technology.

When developing user centered interfaces it is always essential to be aware of the technology potentials to hack them to the user needs and have a clear picture of user needs. Good design is the result of a fully interdisciplinary approach based on functionality – covered mainly by the technological approach, and usability, covered instead by human related knowledge and extensive user needs' analyses and evaluation processes.

The first area, regarding humans, takes into consideration how humans behave in front of a computer based interface, but also more general aspects like user's satisfaction, experience level, motivation, enjoyment, interface learning process, equipment in use, communication, interaction, human information processing.

The technology side indeed takes into consideration the input and output devices, their technical requirements, the development of tasks, technology in use.
This aspect gains a relevant importance when designing interfaces meant to be used on all available access devices, including both advanced devices (mobile phones, PDAs) and assistive technologies.

In between there are some issues which needs to be discussed both by human experts and technical ones, like colors, icons, graphics, command structure, user support materials, usability, accessibility guidelines respect.

Assistive technologies have many differences in use and in technical requirements, thus is designers' main concern to provide the most compatible interface able to fulfill each kind of access device.

Assistive technologies are divided in 2 main areas: Software and Hardware.
Software products involve text-to-speech technologies, like screenreaders mainly used by blind, sight impaired, cognitive disabled people and motor disabled people as well.
Other software products used to take advantages from the residual capacities of disabled people are software mouse and keyboards, chiefly used by motor disabled persons.

Hardware includes special keyboards and mouse, joysticks, sticks, Braille Bars.

Each of these products present some specific or shared limitations in managing online information. When designing to grant compatibility to all the most widespread assistive technologies, designers need to be aware of the main technological aspects (Rizer & al. 1999):

- Compatibility and computer platform
- Operating system and environment requirements
- Programmable features
- Programmability by the user
- Multiple users able to customize for individual needs
- Adjustable response and actions
- Methods of selection
- Ability to transmit information
- Ability to receive information
- Method of interfacing with the computer
- Additional required equipment
- Degree of transparency to the computer system
- Portability

- Upgradability
- Flexibility
- Expandability
- Type and extent of feedback provided
- Value as an evaluation tool
- Cognitive load required of the user
- Degree of training required

A MULTIMODAL INTERACTION

A part from the technical limitations due to assistive technologies in use, designers need to face individual problems and limitations providing a multimodal interaction.

A multimodal interaction is an interaction which provides information and services in many modalities and in many different and parallel ways, adapting itself to the user environment and individual needs. A multimodal interface allows different interaction techniques which can be used sequentially or concurrently, and independently or even in combination, according to the users' needs and technologies. (Nigay & Coutaz, 1993).

Users who access online interfaces in a graphical form (GUI) have a spatial interaction: they move with their eyes on the page, have time to read and re-read instructions and contents and decide how to operate on the interface itself.

But the interface shall be user friendly and easy to manage.

Instead, users accessing the online interface with text-to-speech technologies will have an aural access and a spoken interaction, which is indeed a temporal interaction, not based on the virtual space provided by the GUI, but based on the encoded information semantically structured for these specific targets. This means that the read text shall be clear and short in order to be usable and easy. Designers avoided confusing text and audio redundancy and allowed users to navigate the application and interface according to their needs with the chance to skip parts they are not interested in – for instance, some menus can be skipped if the user has already learnt the information architecture of the website and wants to go directly to the main content of the webpage.

The basis of multimodal interfaces lies in synchronization: users shall not be penalized if they are using a temporal or spatial interaction. They have to access the same content and services at the same time they ask for it, without letting anyone be aware of the design efforts provided to ensure a multiple interaction.

Redundancy is another key factor to ensure successful multimodal interfaces: visual information provided in the GUI must be available in a different format usable from those who can't access the graphical information; alerts or confirmations shall be provided both via audio and visual format, for instance.

Another factor for interface design concerns the activity users are expected to perform on the interface itself. EIAO has clear ideas about it: share the data collected and provide users the most clear and extensive map of the European web accessibility status.

Thus designers have defined different kind of reports, based on regional and local basis and on sector basis as well. This double comparison will be very useful both to stakeholders and decision makers as soon as they will decide to analyze, for instance, how national laws impacted the accessibility situation over time or if the law has affected certain areas much more than others.

ROLE OF USERS

In our interface development methodology, EIAO is taking some basic inputs from the user testing activities already carried out in the project.

EIAO had already performed 2 large scale surveys addressed both to end users and stakeholders (Craven & Snaprud, 2005).

Around 500 questionnaires have already been distributed to potential end-users and collected data had already been collected and analyzed. Most of the end users who take part to the first EIAO survey were chiefly blind or sight impaired and motor disabled persons.
About 50 representative organizations were involved in the stakeholders survey, providing the designers and EIAO experts with a clearer picture of their expectations towards the project achievements and services.

The results collected by end-users' questionnaires and interviews showed us some useful differences between real users' needs and the standards used worldwide in term of priority. Users focused more on aspects like information architecture, menus' organization, link explanation, keyboard access, appropriate mark up for headers and titles and effective alternative texts, most of whom are priority 2 or 3 in the Web Content Accessibility Guidelines 1.0, the internationally recognized reference for accessibility. This has been a very valuable result for the design process as our aim is to apply the most user centric approach and this survey showed an interesting difference between formal requirements and user needs.
Our approach has taken into deep consideration both WCAG 1.0 and user needs in the design phase.

Stakeholders, questioned in the second survey EIAO performed, showed to be aware of the importance of accessibility and to be interested in having online reports like the ones provided by EIAO to make benchmarks and evaluate policies and their effectiveness. Also, huge interest was demonstrated towards the opportunity to monitor accessibility over time, which speed up our effort in this direction to provide effective answers to their needs.
Stakeholders answered that they would like to adjust the measurements manually, thus developers worked in order to allow users to configure the reports and analyses to be performed.

Thus the development stage can start having already useful and precious indications from the users ~~and~~ improving our fully user centered approach both in developing the technical infrastructure and in designing the services and applications available on the EIAO website.

This work previously done is essential to start a good design methodology and to define the most relevant aspects stakeholders expect from the Observatory, thus EIAO is today able to concentrate on more critical aspects which needs to be taken into consideration.

THE METHODOLOGY

EIAO's most exciting challenge concerning the results is to produce accessible results in an accessible framework. EIAO need to provide accessible data and measurements to grant everyone access to the results provided by the data warehouse. The main problems concerns a graphical visualization of the data; results can be aggregated in different ways, can be related only to single web pages, websites and regional or national basis.

The methodology followed by the designers is an iterative design.

Iterative design grants that users are involved in each step of the development and that all competencies, technical and human ones, collaborate together during the whole development cycle. In iterative design the evaluation process is repeated during the whole developing process: it's a cyclic process made of different phases which will be repeated until the product is not finished: prototyping, testing, analyzing, and refining.

The main steps in iterative design involve:

1. Requirements analyses, which means to analyse before designing users' needs and the main requirements.
2. Technical requirements; starting from the users needs, designers define the best technological solutions to suite the requirements collected in the first phase.

3. Requirements specification
4. prototyping, encoding and development
5. evaluation with users

The process, when it gets at an end, starts over again thanks to the feedbacks collected by end users' analyses.

If we plan to perform 3 evaluations during the interface development, according to J. Nielsen (1993) data we can expect to improve our accessibility and usability by 95% since the first release, from release one to release 4. Each iteration can improve the website quality of 25%, thus our expectations are to provide a useful, usable and accessible interface.

EIAO decided to work on a scorecard to let EIAO users have a quick and easy look to the results. This decision has raised many issues: average scorecards rely on color based information, which can't be considered an accessible solution due to the high number of pathologies which cause color blindness. This problem could have been avoided using a blue scale, but also in this case some minor problems related to contrast have to be dealt with. The issues can thus be faced using different scales based on symbols. To ensure that the scorecards can be read by everyone, the scorecards, shapes and different scales will have alternative text, in order to make the scorecard accessible to every kind of user.

THE DEVELOPMENT

Having a clear idea of the activity performed on the interface, the most exciting part of the development was the organization of the content and the development itself.

For developing the GUI, the Plone (http://plone.org) content management system was used as a basis. This allows the developers to concentrate on creating a user friendly and accessible GUI instead of spending time on the foundation for the GUI. Plone is also designed to be accessible and usable, and is therefore quite well suited for the task of developing a GUI for EIAO.

Creating an accessible interface is not only a matter of the HTML you write, but just as much what you don't write.

The first choice developers had to face was which DTD to choose: the choice was an XHTML 1.0 because this DTD offers a good compatibility with the Plone framework, and is at the same time a modern XML based HTML standard.

The interface uses a liquid layout because it allows webpages to adapt to whatever technology (browser, screen, access device) the user is using. "Liquid" means that the layout is entirely flexible, filling the browser window as it expands or contracts. A part some specific cases, like a kiosk, a handheld, or a full-screen video game, developers can't predict the conditions under which the user will access a website. Screen size, font preferences, access devices, or the importance of any particular page to the user - none of this is under your control. This lead developers to choose a liquid design based on CSS 2: all the layout elements have been developed in CSS. If the user is using a technology where CSS is not supported, the content of the page will be displayed linearly, each page element after the other, for example the menu bars will display as a plain list of links. Making sure that the page will also function with CSS disablewt is a high priority.

When considering pure accessibility, all developers' efforts have been made to respect the World Wide Web Consortium recommendations, the Web Content Accessibility Guidelines 1.0, with an eye on version 2, which are still not finalized.

According to the developers of the EIAO GUI, great care was taken to keep the interface as simple as possible, avoiding the temptation to, for example, add a lot of Javascript that would not really contribute so much to the usability of the site, rather risk making it less accessible and more complicated.

Javascript, once considered by many to be harmful to accessibility (Peter-Paul Koch, 2005), can be used in an accessible way if used properly and if granting equal access as we aim to do in our work (WebAIM, 2006). Our choice to avoid an extensive use of Javascript is more linked to the will to have the most accessible webpages we can rather than to a real limitation in Javascript usage. Some Javascript will be added but with great attention to accessibility. Two of the most important isues to be aware of when using Javascript is:

- Make sure navigation is also possible with alternative input methods and with Javascript disabled,
- Make sure that all content is visible to users of assistive devices and users without Javascript support

Where Javascript is used, it is made sure that the site would also function equivalently in a browser where it is disabled. Simple XHTML was used for content definition, CSS was used for defining formatting as required by WCAG 1.0, and Javascript was used only where the required functionality was dependent on it, for example the next iteration of the GUI will have collapsible side menus as shown in Illustration 3 for selection of regions for the region reports. When Javascript is disabled, the side menus will simply show up in the expanded state.

Illustration 3: Region side menu in collapsed and expanded state

A big challenge was to make the CSS compatible with both Internet Explorer and other browsers such as Firefox and Opera. Most browsers have some limitations in their CSS support, and they will also interpret the CSS differently, thereby making it hard to make a page look the same in different browsers. Particularly Internet Explorer has been a problem because of its limited CSS support and somewhat nonstandard interpretation of the CSS. Much work was put into this and we were finally able to make all the pages look and feel equivalently in all the most popular browsers.

EIAO decided to work on a scorecard to let EIAO users have a quick and easy look to the results. This decision has raised many issues: average scorecards rely on color based information, which can't be considered an accessible solution due to the high number of pathologies which cause color blindness. This problem could have been avoided using a blue scale, but also in this case some minor problems related to contrast have to be dealt with. The issues was thus faced using different parallel scales based on symbols beside the color based scale. To ensure that the scorecards can be read by everyone, the scorecards, shapes and different scales will have alternative text, in order to make the scorecard accessible to every kind of user.

For the first version, a scorecard result scale consisting of both colours and letters of the alphabet was used, and also a change tracking scale based on arrows, as shown in Illustration 4. In addition to this, mock-ups of a wide variety of different options for visualising the results and changes have been created, in order to let participants of the user testing comment on the accessibility and usability of the different options.

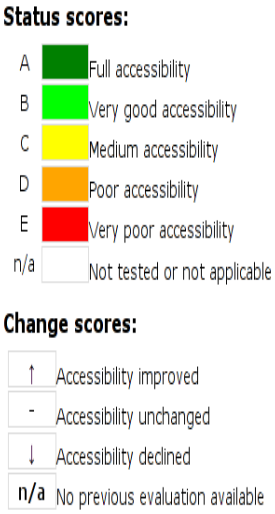


Illustration 4: Score card status and change score visualisation for the first iteration of the GUI

The GUI is developed following a slightly modified Model-View-Controller architecture pattern (Burbeck, 1992), which is very useful for separating the business logic of a computer programme from its user interface. In our system, the responsibilities of the modules are divided like this:

- *The Model* is responsible for communication with the data warehouse, and making the assessment results available to the View and the Controller.
- *The View* formats and displays the data to the user, and retrieves new data through the Controller based on user input.
- *The Controller* will query and retrieve the data from the Model, transforming and adapting it to the needs of the View.

This allows the developers of the View module to concentrate 100% on making an accessible and usable interface.

USER TESTING

Evaluation is a fundamental aspect in user centered and iterative design and EIAO, having had already a valuable output from users collected in the questionnaires, will pay a huge attention to the evaluation phase of the project.

In order to ensure that the interface is accessible, extensive user testing of the interface will be performed. Questionnaires and accessibility and usability assessments will be carried on after the

first release of the Observatory in order to improve the results achieved and make any needed correction to improve the users' experience.

Compatibility is a key issue to ensure accessible interfaces. By compatibility we mean that the interface works effectively on every technology and platform without any major adjustment on the user side. This requires a huge work from the developers and a constant contact with end users, whom will be involved in the project for the whole development phase.

Users involved in testing activities will include:

- blind people using screen readers, and Braille bars
- sight impaired people using magnification software and browser setting adjustments
- color blind people
- deaf and cognitive disable users, whose knowledge of the written text can be weaker because deep deaf people's first language is sign language rather than the official national language and EIAO is aware that accessibility is more than a simply technical issue
- motor impaired users using speech recognition software to interact.

The output of the assessment phase made with end users will allow us to develop a fully accessible interface and grant that the services and information offered by EIAO will be easy and user friendly.

CONCLUSION

EIAO main efforts are concentrated on fulfilling user needs in all directions: the interface is expected to be fully accessible both for users and conform to international recommendations. The final application and services with be developed taking into consideration stakeholders expectations in order to grant an efficient and useful tool which will be able to monitor accessibility and improve the state of the art by speeding up the process of having a fully accessible Internet.

All our efforts and knowledge would not be enough to make a good design and a good application as we need to tailor the services and technologies around the real users of our system. Good design and the development of useful applications can be made only by keeping the greatest attention on users and their needs, both in term of technologies and knowledge needs.
Starting from these points and adding our specific knowledge in human and technological aspects, is a promising basis which should be pursued by everyone willing to apply a proper and efficient interface design.

By taking into account universal design to meet accessibility challenges from the start of the of the user interface development, and additionally performing extensive user testing, we are developing a user interface that will not only display valuable information for stake holders and policy makers, but that will also be fully accessible to all users.

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