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Web Accessibility Among the Countries of the European Union: a Comparative Study

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Abstract – In a short period of time, the World Wide Web (the Web) has had a huge impact on our society and lives. The Web provides access to news, email, online purchasing, fun activities, etc. However, the Web is often a barrier to access to information and services for some groups of disabled users. To support the accessibility of web sites, different accessibility guidelines and standards have been introduced for the last ten years. Unfortunately, web developers often lack sufficient knowledge to meet these guidelines. To assure and certify the fulfilment of web accessibility guidelines, various automatic accessibility evaluation tools have been developed.
In this paper, a comparative study of the web accessibility of official websites from countries of the European Union is presented. Two automatic evaluation tools have been used to perform the comparison: the W3C Markup Validation Service to check the source code of the web pages, and eXaminator to test the accessibility.

Keywords – *accessibility, web, evaluation, assessment, quality, European Union*

INTRODUCTION

Currently, the World Wide Web (the Web) is present in all areas of our lives, from accessing the Web to collect information about different topics to using online services as the electronic government (e-government). In a very short period of time compared to the history of human beings, the Web has become an essential part of our society and lives.

The social and economic impact of the Web cannot be refused. Many people cannot imagine their lives without the Web nowadays. However, many web users may encounter problems if the websites do not achieve a minimum level of web accessibility. Therefore, web accessibility is increasingly critical to the Web experience. Tim Berners-Lee, inventor of the World Wide Web, once noted that *"the power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect"* [1]. However, providing equal access to people with different disabilities (visual, hearing, cognitive, mental, and physical impairments) represents a huge challenge for web designers and web developers.

Traditionally, accessibility is a term most associated with architecture instead of computers and websites. With websites, the term usually refers to creating websites accessible to all users who want to access them, regardless of users' disability. When sites are correctly designed

and developed, all users can have access to information and functionality. A simple definition of web accessibility is *"the property of a site to support the same level of effectiveness for people with disabilities as it does for non-disabled people"* [2]. An alternative definition of accessibility is *"making web content available to all individuals, regardless of any disabilities or environmental constraints they experience"* [3]. In summary, the objective of the web accessibility is to ensure that people with disabilities can access websites just like everyone else.

According to the first ever "World report on disability" [4], produced jointly by the World Health Organization and the World Bank, approximately 15% of the world's population has a disability, of whom 2-4% experience significant difficulties in functioning. Although not all types of disabilities have an impact in the web surfing experience, the total number of users who can suffer web accessibility problems is huge. Moreover, the prevalence of disability is growing due to population ageing and the global increase in chronic diseases.

Since 1999, the European Union [5] has worked to promote among member states to set up web sites and provide citizens with online access to government information. Besides, the European Union has paid great attention to improve education and training opportunities and ensure the full participation of people with disabilities in the digital society.

Unfortunately, not many studies to measure the level of compliance with accessibility guidelines have been done among the member states of the European Union. The most significant study was published by the same European Union in 2009 [6].

In previous studies [7, 8], we have proposed a combined methodology to evaluate the accessibility of websites. In this paper, the result of a comparative study of the web accessibility of official websites from countries of the European Union is presented. The aim of this study is to provide evidence and analysis to help understand and compare the level of compliance of accessibility guidelines by the European countries. Two automatic evaluation tools have been used to perform the comparison: the W3C Markup Validation Service to check the source code of the web pages, and eXaminator to test the accessibility.

WEB ACCESSIBILITY AND EVALUATION TOOLS

Web accessibility primarily benefits people with disabilities. However, as an accessible website is designed to meet different user needs, preferences, skills and situations, this flexibility can also benefit people without disabilities in certain situations, *"such as people using a slow Internet connection, people with temporary disabilities such as a broken arm, and people with changing abilities due to aging"* [9]. In addition, an accessible website can help people who have limited access to certain technology, such as computers slow or slow Internet connections.

In 1999, the Web Accessibility Initiative (WAI), a project by the World Wide Web Consortium (W3C) published the Guidelines for Web Content Accessibility Guidelines (WCAG) version 1.0 [10]. These guidelines were widely accepted in many countries around the world as the definitive guidelines on creating accessible websites. However, on 11 December 2008, the WAI released the WCAG version 2.0 [11] to be up to date while being more technology neutral. Conformance to the WCAG is based on four ordinal levels of conformance (none, A, AA, and AAA).

However, verifying the accessibility of a website can be a time consuming task and requires expert evaluators to validate. Automatic evaluation tools such as AChecker, A-Prompt, Cynthia Says, EvalAccess 2.0, eXaminator, TAW, and WAVE 4.0 have been the pioneers and are the most well-known, due to their usability, ease of use and its quick results.

Automatic tools generally verify the presence of a valid element or attribute, such as the alt attribute (alternative text) or the label element (description of a form control). However, human judgment is also needed, because some questions are very relevant, such as whether or not the value of the alt attribute clearly and effectively conveys the function of the image. For example, there is a big difference between the alternative text that an active or inactive image needs.

WEB CONTENT ACCESSIBILITY GUIDELINES

The World Wide Web Consortium (W3C) has developed the most important guidelines concerning web accessibility, the WCAG versions 1.0 and 2.0 [10, 11]. These guidelines have been widely accepted as the definitive guidelines on how to create accessible web sites.

WCAG 2.0 [11] is organized around the following four principles, which lay the foundation necessary for anyone to access and use web content. Anyone who wants to use the web must have content that is:

1. **Perceivable**: Information and user interface components must be presentable to users in ways they can perceive. This means that users must be able to perceive the information being presented.
2. **Operable**: User interface components and navigation must be operable. This means that users must be able to operate the interface.
3. **Understandable**: Information and the operation of user interface must be understandable. This means that users must be able to understand the information as well as the operation of the user interface.
4. **Robust**: Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. This means that users must be able to access the content as technologies advance.

The four principles are organized in 12 guidelines. For each guideline, there are testable success criteria at three levels, based on the checkpoint's impact on accessibility:

Priority 1: A Web content developer must satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents.

Priority 2: A Web content developer should satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents.

Priority 3: A Web content developer may address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents.

A web page must satisfy all priority 1 checkpoints or criteria to be considered minimally accessible. Web developers may implement priority 2 and priority 3 checkpoints or criteria to provide increased accessibility for users.

METHODOLOGY

In this study, the current 27 member states of the European Union [12] have been analysed and compared: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Three official websites from each country has been analyzed:

- The official website of the government.
- The official website of the Parliament (lower house).
- The official website of the Senate (upper house).

There are a number of differences between the national parliaments of member states, owing to the various historical development of each country. Therefore, fourteen states have unicameral parliaments, with the remainders choosing bicameral systems [13].

Two automatic evaluation tools have been used in this study. First tool is the Markup Validation Service, a free service by the W3C [14]. This validator checks the markup validity of web documents in HTML, XHTML, SMIL, MathML, etc. According to the W3C [15], *"Validating web documents is an important step which can dramatically help improving and ensuring their quality, and it can save a lot of time and money"*. The result of the Markup Validation Service is summarized in the number of errors and warnings in a web page.

The second tool is eXaminator, a free service to check the accessibility of a web page provided by Carlos Benavídez [16]. eXaminator checks the application of the WCAG 2.0 [11] on the HTML and CSS contents in a webpage and summarizes the results in an overall score from 1 to 10 that is quite easy to understand by everybody. Of course, the score calculated by eXaminator is a fast check of accessibility, but automatic evaluation does not cover all of the success criteria in WCAG 2.0.

RESULTS

A program was developed to automatically collect the results from the Markup Validation Service and eXaminator. All the tests were conducted during the same day in order to avoid changes in the content of web pages.

In the following sections, the results of the different three groups of websites are presented.

Government websites

Twenty-seven websites were analyzed. In Table 1, the results provided by the two automatic evaluation tools are summarized. The first two columns of this table are the name of the country and the Uniform Resource Locator (URL) of the home page of the website that has been analyzed. HTML tags is the number of tags or elements reported by eXaminator.

Score is a value from 1 to 10 reported by eXaminator: the higher the value, the better the accessibility. A colour code is used to clarify the results: a dark green colour represents a better accessibility, whereas a dark red colour represents a worse accessibility. The gray colour indicates an anomalous situation detected during the analysis.

Validity indicates if the markup of the website is valid. Errors represent the number of validation errors: the lower the value, the better the validation. A dark green colour represents a better level of validation (lower number of errors), whereas a dark red colour represents a worse level of validation (higher number of errors).

The accessibility of the website of the Prime Minister's Office of Denmark (Statsministeriet) could not be analyzed, although the testing was repeated several times.

Regarding the accessibility, the worst results were obtained with the websites of Bulgaria and Latvia with a score of 3.5. On the other side, the best results were obtained with the websites of Netherlands and United Kingdom, with an astonishing score of 9.2, almost perfect.

Regarding the markup validation, the worst results were obtained with the websites of Cyprus, with 404 errors, and Bulgaria, with 658 errors. Although the website of Bulgaria is more complex than the other websites, because it has one of the highest numbers of HTML tags (a value that is an indicator of the complexity of the webpage), there are two other websites with higher numbers, Sweden with 1,077 tags and Malta with 1,202 tags, but they have a very low number of errors. Actually, Sweden only has 3 errors.

On the other side, five websites obtained the best result of 0 errors: Austria, Belgium, Estonia, Netherlands, and Spain.

Table 1. Results of the analysis of the Government websites

Country	URL	HTML tags	Score	Validity	Errors	Warnings
Austria	http://www.austria.gv.at/	419	8,5	Yes	0	0
Belgium	http://www.belgium.be/	35	6,5	Yes	0	1
Bulgaria	http://www.government.bg/	1074	3,5	No	658	11
Cyprus	http://www.cyprus.gov.cy/	335	5,7	No	404	7
Czech Republic	http://portal.gov.cz/	184	8,6	No	8	12
Denmark	http://www.stm.dk/	0	0	Yes	0	0
Estonia	http://valitsus.ee/	495	7,6	Yes	0	0
Finland	http://www.government.fi/	311	5,8	No	28	8
France	http://www.gouvernement.fr/	696	5,2	No	26	14
Germany	http://www.bundesregierung.de/	844	7,4	No	14	20
Greece	http://www.primeminister.gov.gr/	179	4,9	No	24	1
Hungary	http://www.kormany.hu/	429	5	No	11	0
Ireland	http://www.gov.ie/	127	6,9	No	4	0
Italy	http://www.governo.it/	331	7	No	1	0
Latvia	http://www.mk.gov.lv/	824	3,5	No	79	140
Lithuania	http://www.lrv.lt/	524	4,5	No	11	7
Luxembourg	http://www.gouvernement.lu/	825	5,1	No	37	0
Malta	http://www.gov.mt/	1202	4,3	No	77	4
Netherlands	http://www.rijksoverheid.nl/	383	9,2	Yes	0	0
Poland	http://www.president.pl/	215	7,5	No	2	0
Portugal	http://www.portugal.gov.pt/	734	8,2	No	12	1
Romania	http://www.gov.ro/	540	3,7	No	46	4
Slovakia	http://www.government.gov.sk/	173	8,4	No	1	0
Slovenia	http://www.up-rs.si/	323	5	No	1	1
Spain	http://www.lamoncloa.gob.es/	852	7	Yes	0	0
Sweden	http://www.regeringen.se/	1077	5,6	No	3	3
United Kingdom	https://www.gov.uk/	226	9,2	No	1	0

Source: own research

Table 2. Results of the analysis of the Parliament websites

Country	URL	HTML tags	Score	Validity	Errors	Warnings
Austria	http://www.parlament.gv.at/	605	7,4	No	1	0
Belgium	http://www.lachambre.be/	28	5,6	No	4	0
Bulgaria	http://parliament.bg/	397	4,9	No	1	0
Cyprus	http://www.parliament.cy	4	4,4	No	2	4
Czech Republic	http://www.psp.cz/	6	4,7	No	2	3
Denmark	http://www.ft.dk/	333	5,9	No	13	0
Estonia	http://www.riigikogu.ee/	303	6	No	18	29
Finland	http://www.eduskunta.fi/	5	5,7	No	3	4
France	http://www.assemblee-nationale.fr/	742	7,1	No	8	0
Germany	http://www.bundestag.de/	926	8,4	No	2	0
Greece	http://www.hellenicparliament.gr/	391	5,7	No	11	5
Hungary	http://www.parlament.hu/	412	3,1	Yes	0	0
Ireland	http://www.oireachtas.ie/	699	5,7	No	27	32
Italy	http://www.camera.it/	8	6	Yes	0	0
Latvia	http://www.saeima.lv/	354	5,4	No	31	24
Lithuania	http://www.lrs.lt/	515	3,9	No	9	0
Luxembourg	http://www.chd.lu/	391	4,6	No	109	53
Malta	http://www.parlament.mt/	508	3,7	No	52	37
Netherlands	http://www.tweedekamer.nl/	407	7,2	No	2	0
Poland	http://www.sejm.gov.pl/	167	6,9	No	7	3
Portugal	http://www.parlamento.pt/	0	0	No	55	32
Romania	http://www.cdep.ro/	276	3,8	No	53	19
Slovakia	http://www.nrsr.sk/	218	6,6	No	12	19
Slovenia	http://www.dz-rs.si/	763	4	No	426	53
Spain	http://www.congreso.es/	35	7,3	No	0	0
Sweden	http://www.riksdagen.se/	1032	8,1	No	1	2
United Kingdom	http://www.parliament.uk/	546	5,8	No	2	0

Source: own research

In general, there is a correlation between the accessibility and the markup validation. For example, the websites that obtained the best accessibility results, Netherlands and United Kingdom with a score of 9.2, were also websites with the lowest number of markup validation errors, with 0 and 1 error, respectively.

Parliament websites

Twenty-seven websites were analyzed. In Table 2, the results provided by the two automatic evaluation tools are summarized.

The interpretation of the results is the same as explained in the previous section. A dark green colour represents a better value, whereas a dark red colour represents a worse value.
The accessibility of the website of the Parliament of Portugal (Assembleia da República) could not be analyzed, although the testing was repeated several times. Due to some problem with the resolution of the domain names, this website was not accessible from eXaminator server. Besides, the markup validation of the Parliament of Spain (Congreso) could not be tested, due to an error in the encoding of the document, as it can be seen in Figure 1.

Four websites presented a very low number of HTML tags: Cyprus (4), Czech Republic (6), Finland (5), and Italy (8). This low number of tags shows an anomalous behaviour and therefore the results obtained with these websites should be taken with caution.

Regarding the accessibility, the worst result was obtained with the website of Hungary with a score of 3.1. On the other side, the best result was obtained with the website of Germany with a score of 8.4.

Regarding the markup validation, the worst result was obtained with the website of Slovenia with 426 errors. On the other side, two websites obtained the best results of 0 errors: Hungary and Italy.

The result of the website of the Parliament of Hungary shows a strange behaviour: this website is both the worst website in terms of accessibility and the best in terms of markup validation.

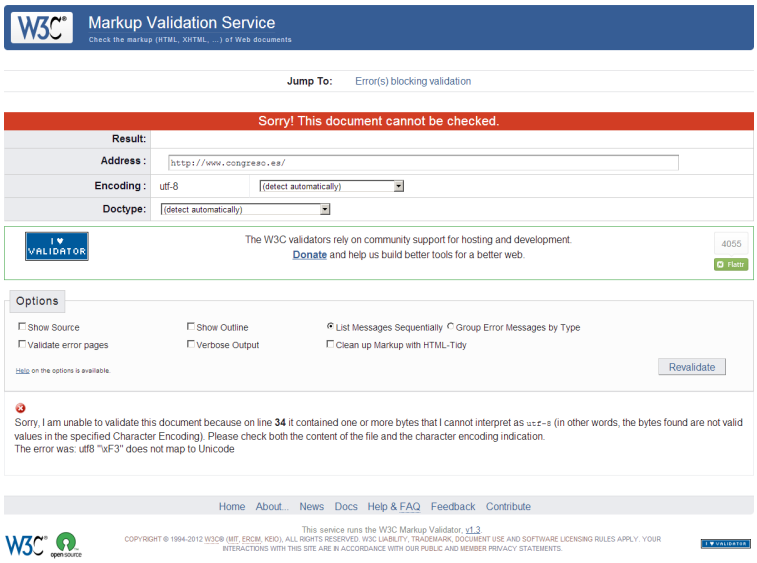

Figure 1. Error message when trying to validate the website of the Parliament of Spain

Source: own research

Senate websites

Only thirteen of the current member states of the European Union have a bicameral system. In Table 3, the results provided by the two automatic evaluation tools are summarized.

Again, the interpretation of the results is the same as explained in the previous sections. A dark green colour represents a better value, whereas a dark red colour represents a worse value.

Table 3. Results of the analysis of the Senate websites

Country	URL	HTML tags	Score	Validity	Errors	Warnings
Austria	http://www.parlament.gv.at/	605	7,4	No	1	0
Belgium	http://www.senate.be/	50	3,8	No	0	0
Czech Republic	http://www.senat.cz/	517	7,2	No	30	0
France	http://www.senat.fr/	762	6,4	No	18	0
Germany	http://www.bundesrat.de/	1085	7,5	No	13	1
Ireland	http://www.oireachtas.ie/	699	5,7	No	27	32
Italy	http://www.senato.it/	338	7,5	Yes	0	1
Netherlands	http://www.eerstekamer.nl/	537	8,2	No	2	0
Poland	http://www.senat.gov.pl/	570	5,3	No	11	0
Romania	http://www.senat.ro/	63	5,3	No	2	3
Slovenia	http://www.ds-rs.si/	303	5,3	No	20	13
Spain	http://www.senado.es/	454	5,8	No	32	3
United Kingdom	http://www.parliament.uk/	546	5,8	No	2	0

Source: own research

The markup validation of the Senate of Belgium (Senaat) could not be tested, due to a fatal error in the encoding of the document, as it can be seen in Figure 2.

Two countries have the same website both for the Parliament and the Senate: Austria has the same website for the National Council (Nationalrat) and the Federal Council (Bundesrat), and United Kingdom has the same website for the House of Commons and the House of Lords.

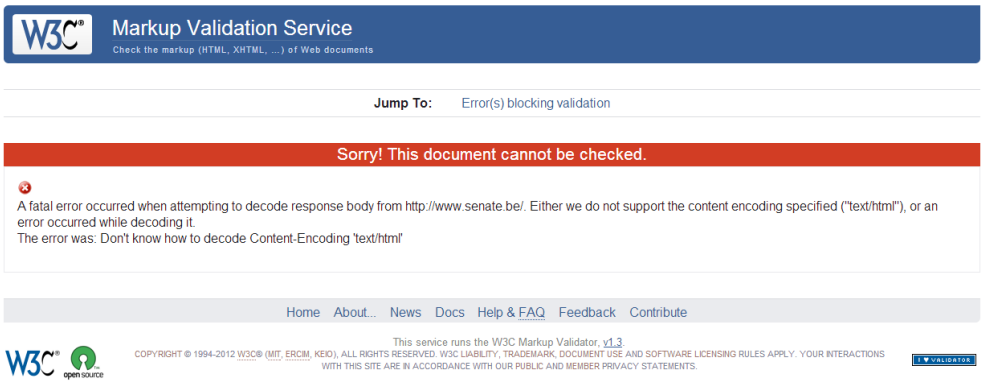

Figure 2. Error message when trying to validate the website of the Senate of Belgium

Regarding the accessibility, the worst result was obtained with the website of Belgium with a score of 3.8. On the other side, the best result was obtained with the website of Netherlands with a score of 8.2.

Regarding the markup validation, the worst result was obtained with the website of Spain with 32 errors. On the other side, the website of Italy obtained the best results of 0 errors.

CONCLUSIONS

Advances in digital technology provide huge opportunities to overcome barriers (socio-economic, geographic, cultural, time, etc.) for people with disabilities.

During the last decade, the European Union has proposed different recommendations to member states to take account of the requirements of people with disabilities in the development of information and communications products and services. The European Union and the member states have committed themselves to guarantee that all public web sites are accessible to people with disabilities. However, compliance with this commitment varies from one country to another country.

In this paper, a comparative study of the web accessibility of official websites from countries of the European Union is presented. Two automatic evaluation tools have been used to perform the comparison: the W3C Markup Validation Service to check the source code of the web pages, and eXaminator to test the accessibility.

Automatic evaluation tools provide quick results are essential when you want to analyze a large number of pages. In this study, only the home page of each website has been analyzed. In order to achieve a more accurate view of the accessibility of each website, this study is going to be extended to study hundreds or thousands of web pages in each website to have a more precise view of the accessibility.

One way to get a more realistic view of the accessibility of a website is to analyze the most relevant pages according to the results of a search engine like Google. Therefore, we plan to base our future analysis on the most relevant, and therefore, most important web pages of a website.

Finally, another future work is to detect the most common problems that recur in the same site and between different sites.

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