

Web Accessibility Assessment and Universal Access

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Abstract

The advancement and diffusion of Web technology forced the availability of information with quality and easily accessible. Such requirements have actively engaged Human-Computer Interaction (HCI) research community to ensure that IT interfaces can be used on an equal basis by users with disabilities and older users. It is therefore essential that the interface is easy to use and that it meets the expectations and needs of all users.

The advancement and diffusion of technology, particularly the Internet, requires providing quality and easily accessible information. These requirements confirm the relevance of the role of the interface as the main element of user interaction with information systems.

The development of interfaces that satisfy users with different needs, use their motor and perceptual, cultural and social skills is not a simple task. According to several experts and pioneers in HCI, interfaces must be built respecting the principles of user-centric design, using a high level of use and in compliance with the guidelines of basic accessibility so that all the aspects of a user's experience (UX) in such environments are considered and covered.

We realize that interfaces are still an important research, worth exploring for its potential to create accessible personalized interfaces. That's the aim of this work when proposing a methodology for assessing dynamic websites accessibility which can be applied throughout or in the end of the development phase. This evaluation is based on an open document made available by the World Wide Web Consortium (W3C) regarding accessibility guidelines, a standard to ensure the long-term growth of the Web through the Web Accessibility Initiative (WAI).

Keywords: Universal Web Access; Web Accessibility Assessment; Human-Computer Interaction; Interfaces.

I. Introduction

Accessibility and Universal Access are not new concepts. However, in view of the population that is aging and of the constantly increasing technological complexity, they become not only timely, but also pivotal for the prosperity of future societies (Stephanidis, C. et al., 2019). In this sense, accessibility standards were established in national legislation. In September of 1999, Portugal regulated the adoption of rules for accessibility to information made available on the Internet by the Public Administration.

Afterwards in June 2000 the European Commission's – eEurope 2002 An Information Society for All – action plan¹ was approved, which included among other measures, the commitment to adopt guidelines on accessibility, Web Content Guidelines Accessibility (WCGA), from the World Wide Web Consortium (W3C), made available by Web Accessibility Initiative (WAI), on public Websites until the end of 2001.

The accessibility standards defined by the accessibility guidelines for Web content, WCGA2.1 (latest version), allows to meet the needs of different groups and situations through three levels of compliances, namely: A, AA or AAA. Level A is the minimum required for a Website to be accessible by a group of users with a low degree of disability (WAI, 2018).

It is also to be employed by international standardization organizations, which signifies that on a political level it is not only of importance for people with disabilities, but anyone can also benefit from universal access approaches, as it is now clear that one's abilities are constantly changing (Persson et al., 2015).

In Portugal we had to put hands-on work after the publication of a resolution of the Council of Ministers (no. 155/2007) made with the purpose to establish guidelines regarding the accessibility of Government Websites and services and public institutions of the Central Administration on the Internet to citizens with special needs. This resolution recognizes that the 97/99 resolution had no practical effects. With this new legislation, it has been defined that only informative Websites must comply with WCAG 1.0 level A, within three months from the date of its publication, while Websites with transactional services must comply with level AA, within six months.

A task-force has been established with advisory functions, consisting of representatives of the Administrative Modernization Agency, responsible for its coordination, of UMIC - Knowledge Society Agency of the National Rehabilitation Institute - and the Government Network Management Centre – which shall work in articulation with the General-Secretariat of the Presidency of the Council of Ministers, and shall contribute towards the proper identification of technical requirements for accessibility, namely those related to conformance level "A" and "double-A", and provide further cooperation as far as technical advice is concerned. This time we could see the results and real effects mainly on public administration Websites accessibility.

The WCGA guidelines, not being mandatory for non-public Websites, have come to guide and encourage Webmasters to reach a certain level of accessibility in the Websites they manage, certified by posting one of the W3C logos in the homepage.

II. Brief Literature Review

When the accessibility issues arise, several authors, such as Sloan, D. et al. (2000), Nielsen, J. (2000), Brajnik, G. et al. (2006,2008), Rutter, R. et al. (2007), Foley, A. (2011), Stephanidis, C. (2011,2014), within many others, started to systematize and study the assessment of accessibility (and usability), establishing different methods and variables for practical application. Several studies and methodologies have recently appeared, combining objective and subjective measures, using manual or automated tools. We have selected a few representative publications between 2015 and 2020; it is well known, within the IT community that five years is a long time due to its rapid transformation and evolution.

Aizpurua (Aizpurua, A., et al., 2015) published an article in *the Computers in Human Behavior* journal about what extent the expectations and confidence influence experienced accessibility on the Web. Coming to the conclusion that the evidence suggests that compliance with accessibility standards does not always guarantee a satisfying user experience on the Web. So, to fill this gap and in order to meet the literature indications, its decisive address the

expectations users have about online content and functionalities. To do so, 11 blind participants were involved and enquired through interviews and questionnaires about 12 tasks they completed in four Websites. They found that “Identifying the nature of expectations is key (i) to formalize more exhaustive user testing protocols and (ii) to complement and complete existing accessibility guidelines.”

Crespo et al. (2016) developed an automated tool to analyse Websites to detect accessibility problems automatically; after this, a guided assistant is used to offer adequate solutions to each detected problem. This approach can be useful to improve the level of accessibility of many Websites for people, besides experts.

Later, Schmutz, S., et al. (2016) questioned if the Implementation of the recommendations from Web Accessibility Guidelines would also provide benefits to nondisabled users, assured that contrary to some concerns in the literature and among practitioners, high conformance with Web accessibility guidelines may provide benefits to users without disabilities. Recognizing that the user’s involvement became fundamental at some stage of the Website development.

A year later, we found an interesting investigation from Aline Silva (Silva, A. B. P. D, 2017) about the continuous assessment of accessibility to support the evolution of Websites. A study was carried out, supported by an automatic accessibility assessment tool and a questionnaire adapted to support developers on finding and fixing the accessibility faults. A direct contact was used too, to alert the Website managers about the faults founded. Due to the lower adhesion and realizing that if these faults, if not validated again by experts or with the support of the tools, will cause a regression in the quality of the Website. This work had as main objective “to test the hypothesis that the adoption of a continuous process of validation of accessibility of Websites allows to keep them accessible, despite maintenance and modifications made throughout its existence” (Silva, A. B. P. D, 2017).

Still in 2017, Abduganiev, S. G. (2017) made a comparative study towards automated Web accessibility evaluation published in *The International Journal of Information Technology and Computer Science*. The purpose of this empirical research was to assess and compare eight popular and free online automated Web accessibility evaluation tools (AWAETs).

The main motivation was the necessity to “emphasize that one should not forget that the disabled are also human beings and they are in large numbers” once they consider the average accessibility level of sites to be very low.

The conclusions were compiled on a final report where they reported nineteen pros and fourteen cons of AWAEMs, fifteen recommendations for the AWAEM’s quality improvements. Since then, it was possible to fix the cons founded and choose the AWAET more appropriate to each case and “consequently contribute to rational use of AWAEMs in evaluating and enhancing Web accessibility”.

Few months later, Abascal, et al. (2018) published a study *in the Web Accessibility. Human–Computer Interaction Series*, about the same subject: Tools for Web accessibility evaluation. More tools came up to perform diverse types of automatic accessibility evaluations and on-site and remote evaluations with users can also be supported by specific tools. Even manual evaluations may be supported by crowdsourcing-based tools. It was necessary to investigate the importance of these innovations in the advancement of Web accessibility. This study concluded about the need for tools-based Web accessibility field and made a review about the main characteristics of those tools used in this area, providing insights about their effectiveness.

Acosta-Vargas, P., et al. (2018) presented a paper, in the *International Conference on Information Theoretic Security*, where they propose a combined method for evaluation of Web accessibility grounded in several studies

that recommend combining some methods with each other to achieve better results. In this study they applied the Web Site Accessibility Assessment Methodology (WCAG-EM) considered in the Web Content Accessibility Guidelines 2.0 (WCAG 2.0). From the results, we conclude that most tested Websites can achieve an acceptable level of compliance and as future work they will focus on optimizing this combined approach originating a guide to help develop more inclusive Websites.

A very recent study published in *Interacting with Computers* journal, from the seniors researchers, Brajnik & Vigo (2019) took a step forward as they realize “the fact that several Web accessibility metrics exist may be evidence of a lack of a comparison framework that highlights how well they work and for what purposes they are appropriate.” So, it wasn’t a matter of guidelines compliance, yet criteria that can be used to assess the quality of existing metrics and to analyse some of the automatic ones. They propose and demonstrate a feasible framework that comprises validity, reliability, sensitivity, adequacy and complexity of metrics in the context of four scenarios where the metrics can be used. The insights obtained lead to “focus more on quality aspects of accessibility metrics with the long-range goal of improving the effectiveness of accessibility engineering practices.”

Most part of the studies presented referred that the results obtained, after applying WCGA or any metrics (automated or not), were very accurate, but only useful to confirm the formal aspects of the Website. In other words, it wasn’t possible to conclude whether it is, in fact, fully usable by users with disabilities. The accessibility of the Website cannot be summarized using a single, quantitative accessibility score, only observing real users interacting with the interface, can be conclusive about the real degree of accessibility of the Website.

Pereira, L. S., et al., (2015), “in order to ensure the access of the visually impaired to all information provided online it is necessary to remove existing barriers on the Websites through several existent approaches, from recommendations to Web development to validations of existing Websites” developed a methodology for a preliminary Web accessibility evaluation method through the identification of critical items with the participation of visually impaired users. Only during the user’s navigation through the Website would be possible to detect interaction issues. So, “in this scenery, this study uses previous researches on the subject and Web accessibility rates in order to identify those barriers commonly founded by these users with total visual impairment, as well as to come up with a list of recommendations in order to optimize the evaluation process.” This research contributed with a methodology to conduct evaluations with insights from the real users and the visually impaired users.

With regard to user’s participation, Borsci, S., et al. (2015) presented a paper, on a scale of satisfaction assessment involving disabled users in the usability testing of Websites, in the International Conference on Human-Computer Interaction. They implemented a usability test with blind and sighted users to observe the differences between the two evaluation. As they say, “the insight of disabled users could be a key factor to improve the usability of those interfaces which aim to serve a large population, such as Websites of public administration and services. If the Website is usable it must be accessible, once usability encompasses accessibility Yesilada, Y., et al. (2015)

To sum up this brief review, although the few studies with real users, the recommendations from the literature indicate that not to stick with assessing compliance with WCGA or other standards for Web accessibility but, complement the study, whenever possible, with real users.

Now and in what regards to the assessment methodology itself, we could observe a wide range of automated tools mentioned above. While doing this, an obvious question arises: should we use only automation tools, manual tools or a combination of both?

As the literature says, through the more influential authors in the last 30 years like Nielsen, J., Loranger, H. (2006), Rutter, R., et al. (2007), Brajnik, G. (2008), Foley, A. (2011), Stephanidis, C., & Antona, M., (2014), Shawar, B. A. (2015), (Crespo, R. G., et al., (2016), Silva, A. B. P. D. (2017), Gonçalves, et al. (2018), (Abascal, et al., 2018), (Acosta-Vargas, P., et al., 2018), Stephanidis, C., et al., 2019), the automated tools are very useful, providing significant insights to the evaluator, specifically in what regards to formal Website's structure. On the other hand, manual tools can become impractical in medium or large Websites.

Recently, Mucha, J. M. (2018) conducted a study with a combination of automatic and manual testing for Web accessibility where his "research confirmed the hypothesis that outcomes from manual and automated Web accessibility evaluation can be combined on the grounds of implemented guidelines. The study has shown that there is no need to choose either manual or automated method of accessibility testing. Both methods can be deployed in a synergistic way and complement each other." The integration of manual and automated evaluation (WTKollen testing tools), can cover up to 57.9% of the criteria of WCAG 2.0 on Level AA. Previously, the maximal coverage for testing, using only one method (either automatic or manual) was equal to 42.1% and 28.9%, respectively.

An integrated methodology to assess Web accessibility, combined with manual and automated methods, can become a very useful tool to uncover different type of inconsistencies. In the next section a proposal is depicted, which can be used, simultaneously by the experts as well as the non-experts.

III. Methodology: Methods, techniques, and tools

This section is proposed as a methodology grounded on the review of the literature and on the information analysis provided by the WAI form the W3C to assess the level of compliance of a dynamic Website along the standards defined by the accessibility guidelines for Web content, WCGA 2.1 [5]. The main guidelines are grouped into four principles: Perceptible, Operable, Navigable and Robust.

We believe that the first step in assessing the accessibility of a Website is to conduct a preliminary study, to detect the most evident accessibility problems with the Easy Checks – A First Review of Web Accessibility, a document provided by WAI (Easy Checks – A First Review of Web Accessibility). This can be performed by free automated Tools (WebDev Toolbar, which is an extension added to the browser).

This first review covers just basic accessibility issues; we can confront this result with a more robust assessment to evaluate accessibility widely in order to fix the main issues.

According to the specifications found in the WAI, also supported by the literature, one of the most effective strategies to test the accessibility of a dynamic Website would be:

- 1. Define the scope of the evaluation**
- 2. Use tools for automatic assessment of accessibility on the Web**
- 3. Manually evaluate examples of representative pages**
- 4. Summarize and present the results**

The action plan must consider specifically the compliance with the requirements displayed on table 1.

Table 1. Action Plan

ACTIONS	REQUIREMENTS
<p>Action 1. Define the scope of the assessment.</p> <p>the scope must be stated in order to define boundaries of the study.</p>	<p>A1.1. Specify the level of compliance (A, AA or AAA) with WCGA 2.1;</p> <p>A1.2. Select a sample of representative pages of the Website for manual evaluation according to certain criteria and;</p> <p>A1.3. Select a URL (uniform resource locator) for the Website or an expanded selection, for automatic and semi-automatic evaluation.</p>
<p>Action 2. Use tools for automatic assessment of Web accessibility.</p> <p>It is recommended the use of at least two tools as it helps to eliminate potential errors in the identification of accessibility problems.</p>	<p>A 2.1. It is advisable to use at least two tools in the sample of selected pages, e.g. Wave [12], Taw [13], and to run at least one tool throughout the site (or in the selection of expanded pages);</p> <p>A 2.1. In this way, the validation of mark-ups is obtained, including the syntax and style of the pages;</p>
<p>Action 3. Manually evaluate examples of representative pages.</p> <p>Manual assessment is somewhat less objective than automatic, with the exception of the directives defined by the WCGA, which are carried out directly, with little room for subjectivity. But it will not be entirely preventable due to the high number of situations that are not likely to be integrated into automatic tools.</p>	<p>A 3.1. Examine the pages using at least three graphic browsers, in different versions and platforms.</p> <p>A3.2. Examine the pages using specialized text browsers, e.g. Lynx [14], Opera [15] and specialized voice browsers, e.g. the Home Page Reader [16], Jaws [17].</p> <p>A 3.3. Read and evaluate the content of the pages, checking that the text is clear and simple in its entire length, in a manner appropriate to the purpose of the Website.</p>
<p>Action 4. Summarize & present the results.</p> <p>Refer to the problems and best practices identified on each type of page; the representative URL, as well as the method by which it was identified. Recommend particular attention to the aspects described below.</p>	<p>A 4.1. Correct the accessibility barriers identified through the conformity assessment process;</p> <p>A 4.2. Expand the positive aspects of the Website;</p> <p>A 4.3. Ensure continuous maintenance, as well as Website monitoring.</p>

This preview review, in addition to enabling the identification of significant accessibility barriers, to be eliminated before carrying out the evaluation with users, also helps to define the key points to be tested posteriorly with users.

IV. User's Involvement in Assessing Accessibility

Although checking compliance with accessibility standards remains mandatory, the participation of the users, as we mentioned earlier, helps to understand how the Website really works. The test using disabled users or elderly users permits identify problems that will not be detected using only conformity guidelines assessment.

One of the first studies carried out in the United Kingdom in the early 2004, it's an evaluation report of the commission on the rights of people with disabilities, in which presents great differences between the results obtained in the evaluation according to the standards or according to the users. Means that standards compliance and users tests are not mutually exclusive; on contrary: should be used simultaneously, combined in a proper way naturally.

User involvement bring many advantages, but it is not enough to determine whether a Website is accessible or not, and must be jointed with the assessment of compliance, with the rules to ensure the accessibility of the Website to users with different degrees of disability.

Years later, Aizpurua, et al., (2016) explored the relationship between Web accessibility and user experience (Norman, D. Nielsen, J., 2016) and concluded that understanding the interplay between the user experience (UX) and Web accessibility is key to design Web sites that beyond access, could provide a better UX for people with disabilities.

According to the WAI (2020) disabled or elderly users can be included in a wide variety of assessment activities, from brief consultations to large-scale usability studies, specifically:

- 1. *Informal assessment*** of a specific issue, e.g., someone using a screen reader (speech synthesizer) or a special browser that allows you to use only the keyboard and not the mouse.
- 2. *Testing the formal usability*** of a Website according to a specific protocol to obtain quantitative and qualitative data from specific tasks performed by users. These usability tests can be optimized and address specific accessibility issues.

Last but not the least, according to a WAI document, (*involving users in Web Accessibility Evaluation, 2020*), conducting informal assessments throughout development is more effective than usability testing at the end of the project. The inclusion of users at the beginning of the project helps to understand accessibility issues in the real world, such as people with disabilities or the elderly who use the Web with adaptive strategies, (e.g., increasing the font size in a common browser) and assisted technologies (e.g. screen readers, screen magnifiers, speech recognition software, selection buttons instead of the mouse and keyboard). Resulting in better end products for users and ensuring a more efficient Website development.

V. Conclusion and Future Work

Trough out this work was described a methodology, grounded by the literature, for assessing the accessibility of a Website, combining automatic, semi-automatic and manual tests. Compliance with the WCGA 2.1 guidelines was the starting point of the assessment, and once verified, guarantees the accessibility of the Website to a group of users with certain physical disabilities.

As near future work we foresee to apply this methodology to a Website of a digital secretariat of a higher education institution, in order to obtain compliance with accessibility level A: the minimum necessary to guarantee access to the Website by a group of users with low disabilities, such low or lack of vision, or deafness, which allows them to attend or work in an institution not directed to cases of serious disabilities. The evaluation will focus primarily on technical aspects. Thereafter will carry on usability tests with users with physical disabilities, once their experience (UX) helps to ensure the effective application of the technical solutions found WAI (2020).

Results will be published into a user-friendly report format, with recommendations, and made available to the webmaster of the institution, in order to certificate the website as accessible and in compliance with level A WCGA 2.1. Hopefully, soon a logo from W3C will be posted in the homepage.

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