Automated Validation of Accessibility of Brazilian Judiciary Agencies Websites

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Abstract—**There are several countries with laws to ensure that e-government websites meet accessibility requirements. Nevertheless, laws that regulate web accessibility do not guarantee an application. Therefore, it is necessary to check the web accessibility level of the websites in order to have a diagnosis of the current situation. The websites of Brazilian Judiciary Agencies are gateways to access for information and judicial proceedings information that the citizen needs. This project aims to develop a system capable of automatically verify the accessibility of Brazilian Judiciary Agencies websites for the benefit of citizens. Although the Brazilian accessibility guideline is eMAG, based on WCAG 2.0, the websites were evaluated only within the guidelines of Web Content Accessibility Guidelines (WCAG) 2.0, developed by the World Wide Web Consortium (W3C). They will focus on the analysis of the websites of Brazilian Judiciary Agencies, available on the website of the National Council of Justice (CNJ, Conselho Nacional de Justiça). As a result, we will have a picture of how accessibility is being fulfilled by the Brazilian Judiciary Agencies. Then, we obtained a picture of how the norms on accessibility are being fulfilled by Brazilian Judiciary Agencies. None of the reviewed websites met the minimum required by the WCAG 2.0 guideline. The Success Criteria violated by the websites were analyzed using the Pareto Principle, which can identify the main problems found in the websites analyzed.**

Index Terms—**accessibility, WCAG 2.0, Brazilian Judiciary, Pa11y, website**

I. INTRODUCTION

In relation to accessibility, specifically related to web accessibility, Brazilian legislation is well advanced, seeking to meet human rights and the precepts of people with special needs concerning accessibility in web systems. Checking what the Brazilian Legislation requires and the best practices recommended by the W3C, it is intended to evaluate the web accessibility of the websites of Brazilian Judiciary Agencies, observing the list available on the CNJ website [1], in order to analyze the main mistakes related to accessibility. The accessibility assessment will use the international web accessibility guideline developed by W3C, WCAG 2.0. With the Pa11y [2], [3] scripts to support and automate the analysis of institutional websites. Then, find out which institutional portals are standing out in relation to web accessibility. Moreover, find out the

main mistakes made by the analyzed websites. The automated accessibility assessment helps identify, on several websites, common Web accessibility error of Success Criteria in a short period of time. None of the reviewed websites met the minimum required by the WCAG 2.0 guidelines. The Success Criteria violated by the websites were analyzed using the Pareto Principle, which can identify the main problems found in the websites analyzed.

II. METHODOLOGY

Initially a bibliographical research was done in relation to the articles and similar works that validated the accessibility in the Web. A list of tools used for Web accessibility verification was found on the W3C website. Among the available tools was Pa11y, which supports the automated accessibility validation process, according to WCAG 2.0 guidelines. In order to verify how much the Brazilian Justice is accessible on the Web, object of use case of this work, the list of websites representing the Brazilian judiciary, available on CNJ's website [1], the collected and tabulated data were saved in a file, CSV extension, with information referring to the organ name, URL and a code to sort the organ type. Then, from each website the HTML content was extracted, and submitted to automated accessibility validation, according to the Success Criteria established in the WCAG 2.0 guidelines, using the Pa11y software to find the Success Criteria violated. The content of the HTML code, from the home page, of the portals of the Brazilian judiciary were collected from 6:11 p.m. to 6:13 p.m. on April 30, 2018. The collection lasted approximately 2 minutes, and took around 1.27 seconds per website, a high speed connection was used for internet access. After verifying the accessibility criteria of the analyzed sites, the results were tabulated in CSV extension files. These data were submitted for analysis in the RStudio [4], where the total errors committed for each site were verified, and the Pareto Principle identified the main Success Criteria violated.

III. WEB ACCESSIBILITY

"The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect." Tim Berners-Lee, W3C Director and inventor of the World Wide Web, says that the universality, access by all, regardless of disability is an essential aspect [5].

The Web is used as a resource in various circumstances of our lives: education, research, financial, work, commerce, relationship, fun and among other possibilities. Because it covers a number of areas, it is important the web to be accessible to all, including the disabled and the elderly, what can help them to actively participating in society.

An accessible website facilitates the use of assistive technologies, used by people with disabilities to alleviate the difficulties they face, since the standardization of the website meets the requirements used by assistive technologies at the time of their interaction.

In a commercial website, the visual aspect is used to attract consumers, but for governmental entities that offer various services to the population, what should be taken into account is accessibility, making content available to all people, regardless of disability.

The World Wide Web, or simply Web is the information space available on the internet, and to access to information, we use the Uniform Resource Identifier (URI).

A. People with Disabilities in Brazil

According to Brazilian Institute of Geography and Statistics (IBGE, Instituto Brasileiro de Geografia e Estatśtica), in 2010, 45.6 million people (23.9% of the Brazilian population) reported having at least one type of disability [6]. Making information accessible to people with disabilities is relevant not only for legal reasons, but also for something more important, for ethical reasons [7]. Brazilian Federal Decree 3298, dated December 20, 1999, categorizes disabilities in physical, auditory, visual, and mental or multiple (association of two or more disabilities) [8]. See Table I for the application of web accessibility compared to the disabilities classified by Brazilian legislation.

TABLE I.   BENEFITS OF WEB ACCESSIBILITY

Disabilities	Benefits
Physical	Easy to navigate using keyboard
Auditory	Audio and video with subtitles, transcriptions and translations
Visual	Image with 'alt' text, font size, contrast
Mental	Low complexity of interactions
Multiple	Combination of previous possibilities

IV. WEB ACCESSIBILITY GUIDELINES

Based on the review of 135 articles on the use of accessibility guidelines for web development, based on IEEE, ISIWOK, ACM, EMERALD, GOOGLE, SCOPUS, WILEY and ELSEVIER, it was found that the most referenced guidelines were WCAG 2.0 (107 articles), WCAG 1.0 (67 articles) and Section 508 (30 articles), of these articles, similar works, 25 articles evaluate the accessibility of websites. Table II shows the year of research, amount of evaluated websites, guidelines found, and the country of the analyzed websites. Among other guidelines, we also have:

eMAG - Brazilian accessibility guideline, that was specified by the Brazilian government, based on the WCAG 2.0 guideline [9].

JIS X 8341-1: 2010 - Japanese accessibility guideline, was specified in Japanese national industry standards and based on the WCAG 2.0 guideline [10].

DDA standards (Disability Discrimination Act) - Australian guideline, based on WCAG 2.0 [11].

Stanca Act - Italian accessibility guideline, based on WCAG 2.0 [12].

TABLE II.   MAIN EVAL WEB ACCESSIBILITY STUDIES

Year	Websites (amount)	Guideline	Country (ISO 3166-1 alpha-3 code)	Author
2006	140	WCAG 1.0	ZAF	[13]
2010	155	WCAG 1.0	MYS	[14]
2010	256	WCAG 1.0	GRC	[15]
2011	4	WCAG 2.0	CND, USA	[16]
2011	15	WCAG 1.0, WCAG 2.0	USA, WAN, GBR	[17]
2012	100	WCAG 1.0, WCAG 2.0	GBR	[18]
2012	36	WCAG 2.0	SAU	[19]
2012	10	WCAG 1.0	BGD	[20]
2012	66	WCAG 1.0, WCAG 2.0	PAK	[21]
2012	160	WCAG 1.0, WCAG 2.0	AUS	[22]
2012	40	DDA Standards	AUS	[11]
2013	122	eMag	BRA	[23]
2013	38	Section 508	USA	[7]
2013	5	WCAG 2.0	AUS	[24]
2013	10	WCAG 1.0	BRA	[25]
2014	60	WCAG 2.0, ITS-530S2	USA	[26]
2014	15	WCAG 2.0	IND	[27]
2014	33	Section 508, WCAG 1.0, WCAG 2.0	ARG, BOL, BRA, CHL, COL, ECU, GUY, PRY, PER, SUR, URY, VEN, ESP	[28]
2015	39	WCAG 2.0, eMag	BRA	[9]
2015	60	WCAG 2.0	ROU	[29]
2016	25	WCAG 2.0	TUR	[30]
2016	976	Stanca Act, WCAG 1.0	ITA	[12]
2016	1	eMag	BRA	[31]
2018	348	WCAG 2.0	ATG, ARG, ABW, BOL, BRA, CHL, COL, CRI, CUB, DMA, ECU, SLV, GCA, HTI, HND, JAM, MEX, NIC, PAN, PRY, PER, PRI, DMA, TTO, URY, VEN,	[32]
2018	26	WCAG 2.0	ZAF	[33]

A. WCAG 2.0

The Web Content Accessibility Guidelines (WCAG) version 2.0, or WCAG 2.0, according to the World Wide Web Consortium - W3C and Web Accessibility Initiative - WAI, covers the main Success Criteria for more accessible web content. Unlike the WCAG version 1.0 that had checkpoints to evaluate accessibility, the WCAG 2.0 version uses the Success Criteria which are

machine-testable criteria, some of which are classified like **errors** when inflicted, and others **warning** and **notice** that depend on the manual interpretation of a specialist [34].

B. Classification of Success Criteria

The Success Criteria are checked in an automated or manual way by reading the source code, and classified in:

Error - by automated HTML analysis.

Warning - identified as a potential problem, needs manual verification to confirm the fault.

Notice - this is a possible problem, but it lacks manual inspection to identify whether it meets the standard. Could be a false positive.

This research appraise the Success Criteria classified as error, due to the possibility of verifying by machine.

C. Principles of WCAG 2.0

WCAG 2.0 is divided into 4 principles that meet accessibility, in which the violation of one of them renders accessibility as unfeasible. Understanding the principles:

1 Perceptible - Information components (interface) must be perceptible to all human senses.

2 Operable - Information navigation components must be operable by all possible interfaces. (For example: Mouse and or keyboard)

3 Comprehensible - Information and interaction should be easy to understand and understand.

4 Robust - Content must support, over time, various user agents (content interpreters).

For each principle we have a set of guidelines, in this paper it will be presented only the guidelines that are classified like error, because they are evaluated in an automated way.

Fig. 1 shows a summary of the Success Criteria that can be measured by a machine.

D. Overview of Guidelines Codes

This session shows the codes and information of WCAG 2.0 guidelines, Fig. 1 presents more details about the relationship between the principles, guidelines, Level of Compliance, and number of Success Criteria.

Guideline 1.1: Text Alternatives - Provide text alternatives to any non-text content, so that it can be changed to other forms that people need, such as large print, braille, speech, symbols, or simpler language.

Guideline 1.3: Adaptable - Create content that can be presented in different ways (for example, simpler layout) without losing information or structure.

Guideline 1.4: Distinguishable - Make it easier for users to see and hear content, including separation of the foreground from the background.

Guideline 2.2: Sufficient time - Provide users with sufficient time to read and use content.

Guideline 2.4: Navigable - Provide ways to help users navigate, find content, and determine where they are.

Guideline 3.1: Legible - Make text content readable and understandable.

Guideline 3.2: Predictable - Make web pages appear and operate in a predictable way.

Guideline 4.1: Robust - Maximize compatibility with current and future user agents, including assistive technologies.

Principle	Guideline (code)	Success Criteria (amount)	WCAG 2.0 (Levels of Conformance)		
			A	AA	AAA
1	1.1	11			
	1.3	24			
	1.4	4			
2	2.2	3			
	2.4	7			
3	3.1	8			
	3.2	1			
4	4.1	5			
Total		63	50	54	61

Figure 1. Summary of success criteria WCAG 2.0

V. INSTITUTIONAL WEBSITES OF THE BRAZILIAN JUDICIARY AGENCIES

Institutional websites or portals are the main form for citizen access the justice on the internet. The Brazilian Judiciary Agencies have 94 websites, Fig. 2, which are mostly websites of State Justice, Electoral Justice and Labor Justice.
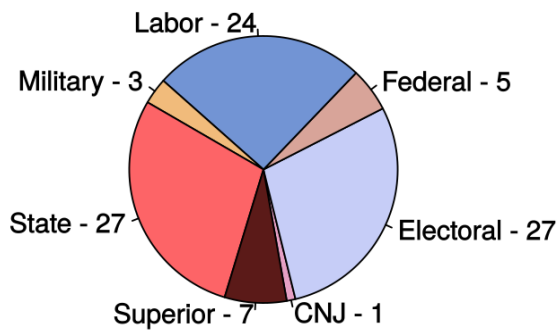
Figure 2. Groups of judiciary agencies websites

The services offered by the websites of the Brazilian Judiciary Agencies to citizens are: search of court cases, news, certificates and ombudsman. In order to bring the citizen closer to justice, it is intended to evaluate the accessibility of the portals of the Brazilian Judiciary Agencies through the list of websites made available on the homepage of the CNJ [1], in order to analyze the main mistakes made by the web accessibility.

VI. AUTOMATED VALIDATION OF WEB ACCESSIBILITY

Automated accessibility testing is the starting point for the use of assistive technologies.

The automated test is done via computational verification of the HTML obtained from the websites analyzed. The Success Criteria, considered errors, of WCAG 2.0 are used in performing the automated tests.

With the list of websites of the Brazilian Judiciary Agencies, made available on the CNJ webpage [1], the HTML content of each page was downloaded, and during this process information about each website was also collected: HTML size and web server technology of the website . The flowchart of data collection and the WCAG 2.0 error checking using the Pa11y library is shown in Fig. 3.
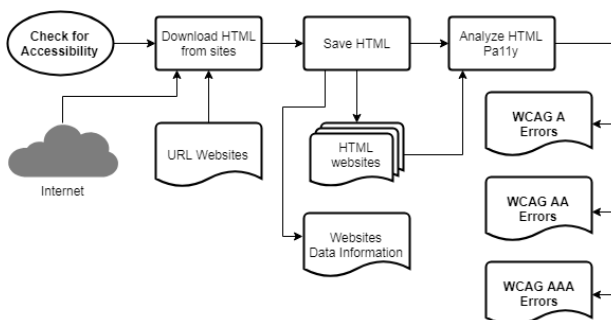

Figure 3. Flow of data collection and processing.

The process of validating web accessibility starts at the stage of **downloading HTML**, at this stage is done the acquisition of the data by script *test.py*, from the internet, the HTML content of the websites is downloaded, as listed in the list of URL of the portals informed in the *sites.csv* file. In the **Save HTML** phase of the portals, the data is stored in the websites directory, which organizes the data separated by files with the name and HTML of each portal.

And in the **Analyze HTML** phase the *accessibility.sh* script runs the **Pa11y** software that performs Web accessibility validation according to levels of conformance WCAG 2.0, creating files with the validation of each analyzed website. Finally, the data is reorganized by the *cleanup.py* script that generates the *wcag2.csv* file. Another script *convertdata.py* that separates the type of error and counts the total errors that occurred in each website. As results, we have the relation of WCAG 2.0 errors (*wcag2.csv*), portals information (*infosites.csv*). The graphs presented in this work were generated using RStudio [4], for this the *a11y.R* script was created, which uses the data from the *sites.csv*, *wcag2.csv* and *infosites.csv* files.

A. Pa11y

Pa11y is software included in the W3C accessibility toolkit [35], and can validate the accessibility of websites within the WCAG 1.0, WCAG 2.0 and Section 508 guidelines. Pa11y can be executed by command line interface, result exports reports in the CSV extension that helps with the accessibility check.

The name Pa11y originated from the term A11y which is an abbreviation for the term "Accessibility", that is, a numeronym that is a way of replacing the middle letters of a word (in the case 'accessibility') by changing the number of letters between first and last letter of the word (in case 11) [3].

VII. RESULTS

The analysis of the data is based on the Pareto Principle that uses the 8 rule, in which 80 percent of the effects come from 20 percent of the causes. Fig. 4 shows the total sum of the Success Criteria that were violated by Brazilian judicial websites, in which the 4 main Success Criteria violated represent 4/12 (33.3%) of the effects that cause approximately 80% of errors. About main Success Criteria that were violated by the Brazilian Judiciary Agencies websites. Below the 4 main ones:

- 1.4.6 Contrast (Enhanced);
- 1.3.1 Information and Relationships;
- 1.4.3 Contrast (Minimal);
- 1.1.1 Text Alternatives: Non-text content;

These non-exclusive violations of the Brazilian Judiciary websites, in a study evaluating the accessibility of websites of 26 universities in South Africa [33], in its conclusion, found that all analyzed websites have the violation of Success Criteria 1.1.1, equivalent to provide an alternative text for non-text content such as video, audio and image. Another similar study in 2010, evaluating the accessibility of 155 websites of the Malaysian government [14], identified the low use of alternative text for non-text content, equivalent to 1.1 checkpoint of the WCAG 1.0 guidelines.

A recent study in Latin America about accessibility in websites of 348 universities [32], of these 157 in Brazil, has revealed the same problem related to Success Criteria 1.1.1, about the lack of alternative text in images that do not have the "alt" attribute is filled in.

In this work, Success Criteria 1.1.1 appears among the 4 most violated by the Brazilian Judiciary Agencies, that is, 58 percent of the analyzed websites inflict at least once this Success Criteria. Apparently, the correction of the problem is done by simply filling in the "alt" attribute, but the correct completion of the object description according to the context is very important for usability.
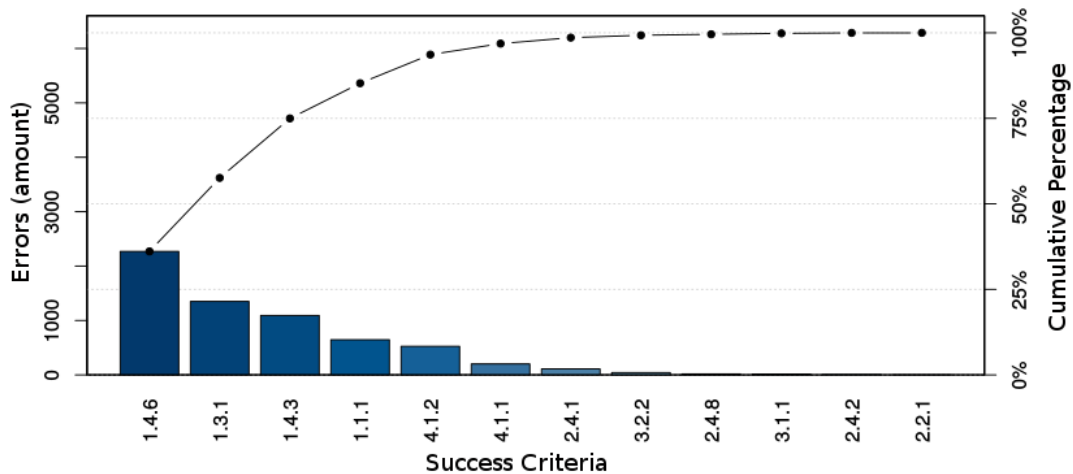

Figure 4. WCAG 2.0 success criteria violated by websites.

VIII. CONCLUSION

People with disabilities are still ignored during the website development process, because none of the websites reviewed meets the minimum Success Criteria of the WCAG 2.0 guideline, Level A, which has 50 Success Criteria. Similar situation is verified in the articles presented in Table II, the same occurs in other countries. In the analysis performed, if only 4 types of Success Criteria were obeyed, Fig. 4, we would have approximately 80% fewer web accessibility failures in the websites of the Brazilian Judiciary Agencies. Errors could be avoided if developers observed the specification of the HTML standard, such as the correct completion of HTML tag attributes (Guideline 1.1). On the other hand, it has been observed that some websites presented a similar set of violation of Success Criteria, between 50 and 54 accumulated violations. These websites are part of the Regional Electoral Courts group, and visually they use the same Content Management System (CMS) to develop their portals, which can be an advantage, because a fix in CMS would help all other websites in the same group. Furthermore, an accessible CMS would be useless when it is fed with a content that violates the WCAG 2.0 Success Criteria. The Training on web accessibility, in addition to web developers, should be expanded to the authors and content publishers of websites.

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