Web Accessibility in Africa: a Study of Three African Domains

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Abstract. Being the most used method for dissemination of information, especially for public services, it is of paramount importance that the Web is made accessible as to allow all its users to access the content of its pages.
In this paper, we evaluated 2250 Governmental Web pages from each one of three different African countries (i.e., Angola, Mozambique and South Africa). This report compares the accessibility quality and the level of structural complexity of these African countries government's Web pages. We found that hand coded pages tend to have larger number of HTML elements and also to present higher number of accessibility problems. Finally, it suggests some recommendations to repair the most common problems in these pages.

Keywords: Web Science, Web accessibility, automated evaluation.

1 Introduction

In many countries, the Web is the main vehicle used by governments to spread information, education, allow civic participation and other public services. It also is an important medium for receiving and providing information and interacting with society. Therefore, it is essential that the Web is accessible in order to provide equal access and equal opportunity to people with or without disabilities. Besides, an accessible Web has the potential to help people with disabilities and the elderly to participate more actively in society.

The United Nations (UN) estimates that approximately 10% of the world's population are persons with disabilities [2]. It is difficult to estimate how many people are affected by Web accessibility problems, nevertheless, if we move forward to an ideal situation, where only a reduced percentage of the population faces accessibility barriers, then technology is serving society in the right way.

The importance of Web accessibility is increasing in the international context, and especially in the European Union [1]. In Europe, more and more countries have legislation requiring that government Web sites be accessible. In contrast, developing countries in Africa have less stringent laws, if any [2]. Governments worldwide have several

stimuli to adopt accessibility. Demonstration of social responsibility by provisioning information and services to all citizens is one of them.

In this paper, we present a report of the state of Web Accessibility in three countries located in the African continent. The evaluation of accessibility we describe is based on the Web Accessibility Guidelines (WCAG) 2.0 [3].

1.1 Web Content Accessibility Guidelines 2.0

To help creating accessible Web pages, WCAG 2.0 defines guidelines that encourage designers/developers to craft Web pages according to a set of best practices. These guidelines are also used for accessibility evaluation.

WCAG 2.0 contains several guidelines written as testable sentences and chosen to address specific problems related with accessibility. Each guideline has a testable success criterion, which is supported by techniques that can be true or false when testing Web content against them.

Although, it is possible to use the guidelines to manually evaluate Web pages, due to the nature of this study (i.e., the large number of Web pages evaluated) we used an automated evaluation tool: QualWeb [4].

1.2 QualWeb

QualWeb is a Web automatic accessibility evaluation tool. The main advantage of this tool is the in browser context evaluation [6], i.e., after the Web browser processes the Web page and all resources are loaded. To this end, the Webkit-based Phantom[1] headless browser is used, allowing us to assess the page's code after browser processing. In terms of techniques, QualWeb covers 51% of the HTML and 73% of the CSS techniques.

An additional distinguishing feature of this tool is the ability to find different states of the Web page [4]. This means QualWeb is capable of interacting with DOM elements and detecting changes to the DOM of a page. QualWeb stores a new state if more than content is replaced after interaction (e.g., introduction of new HTML elements on the DOM tree). We consider the total number of states found, the level of complexity of a Web page as this reflects the dynamism we can find on the current state of the Web.

2 Experimental Study

For this study, the first step was to obtain a list of governmental Web pages for each of the three countries: Angola, Mozambique and South Africa. Starting from each of the main government's pages, we used a Crawler to look for clickable elements in it. Every time a clickable element redirected to another URL on the same domain name (gov.ao for Angola; gov.mz for Mozambique; or gov.za for South Africa), this new URL was kept as an object to be evaluated and the algorithm continued to execute.

[1] PhantomJS: http://phantomjs.org/

Using this method, we collected a sample of 2250 government Web pages, from each country.

Afterwards we performed the evaluation itself, on each one of these 2250 Web pages per country. Every Web page was assessed with the QualWeb evaluator to check for conformance with WCAG 2.0 HTML and CSS techniques. The evaluation produced a list of Warnings, Passes and Fails that are analysed in the results section. In the interest of classifying the complexity of the evaluated Web pages, the QualWeb feature allowing the identification of different page states was used to determine the total number of states in the pages evaluated.

2.1 Results

Our evaluation yielded differences in the HTML documents in terms of number of HTML elements, between domains of different countries (Figure 1). The pages of South Africa (za) present a higher number of elements with an average of 846.37 elements per page, followed by pages of Angola (ao) with an average of 360.17 elements per page and finally by the pages of Mozambique (mz) with an average of 344.60 elements per page.

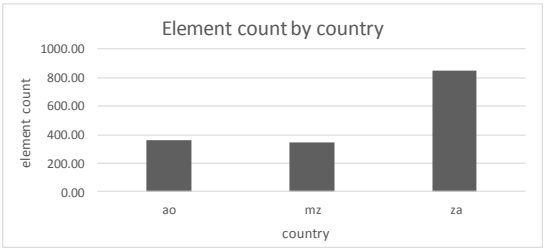

Fig. 1. Average number of elements per page for each country's governmental pages.

Figure 2 presents how the evaluation outcomes (fail, pass and warning) differ between the African countries' Web pages. A *failure* occurs in the cases where the evaluator can detect automatically and unambiguously if a given HTML element has an accessibility problem. A *pass* ensues from elements that, unambiguously, are classified as having no accessibility problems. *Warnings* are raised when the evaluator can partially detect accessibility problems, but which might require additional inspection (often by experts). Table 1 presents the percentage of outcomes (pass, fail and warning) by country. Inspecting these results with additional detail, the Web pages have the following evaluation outcomes:

- **Fail**: Even though the compliance with accessibility techniques is quite different in all three countries, the common factor between the Web pages of Mozambique and South Africa is that fails are slightly above 50%. In addition, the Angolan Web pages are just above 40% for fails.
- **Pass**: Angola's governmental Web pages register the highest percentage of passing elements, reaching over 40%. Mozambique ratio decreases to around 37% and South Africa registers the lowest value, around 19%.

- **Warning**: Mozambique's Web pages elements register the lower percentage of warnings, around 10%. Followed by Angola's Web pages with 13% and South Africa with 27%. The three countries have total of fail and warning above 50%: Mozambique just above 60%; Angola around 55%; and South Africa approximately 80%. South Africa registers the highest total of potential accessibility problems.

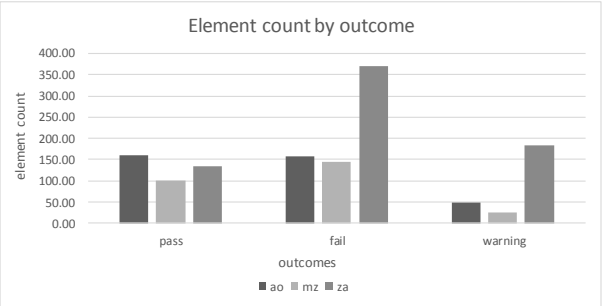

Fig. 2. Average number of HTML elements by evaluation outcome by country.

Table 1. Distribution of evaluation outcomes (absolute values and percentages) by country.

Country	Pass	% Pass	Fail	% Fail	Warning	% Warning
Angola	159.66	**43.61%**	157.92	**43.14%**	48.51	**13.25%**
Mozambique	101.45	**37.42%**	143.77	**53.03%**	25.88	**9.55%**
South Africa	133.47	**19.46%**	370.05	**53.94%**	182.45	**26.60%**

Evaluation by technique

In the following analysis, we will focus on the accessibility results by technique, identifying the more compliant and the more infringed techniques for each country. Figure 3 shows the techniques where occurred passes and their average. All three countries present higher pass values for techniques C23 and C19. The third higher pass value is C8 for South Africa, C9 for Mozambique and C21 for Angola. These techniques evaluate the following conditions:

- C23 – if div elements in main content have background colour;
- C19 – whether text is incorrectly altered to "look" as if it has an align right or centre;
- C8 – for paragraphs and headings, looks for a wrong usage of extra spaces between letters to simulate the letter spacing property;
- C9 – whereas decorative images are specified in CSS rules and therefore removable when disabling CSS;
- C21 – checks if the line-height property is used with relative values and if these values range between the ones recommended.

The first observation that can be made is that HTML techniques present lower values of pass comparatively with CSS techniques. This can be explained by the fact that CSS

techniques are more specific than HTML ones, which means that an automated evaluation can more easily determine pass for these, while HTML return higher number of warnings.

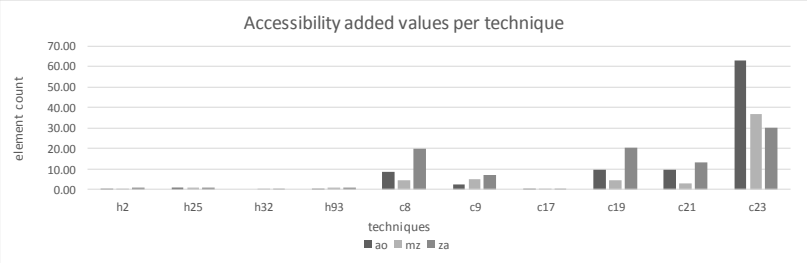

Fig. 3. Average number of passes by technique per country.

The average number of possible problems and problems (fails and warnings) per technique is presented in Figure 4. All three countries present higher values in techniques C15 and C7. For South Africa and Angola, the subsequent high value technique is H30, while for Mozambique is H73. Respectively these techniques evaluate the following conditions:

- C15 – if anchor and input form components present a visual alteration when interacted with;
- C7 – whether anchor elements are followed by a span tag with a textual description of the link hidden by a CSS rule;
- H30 – if the link text describes the purpose of the anchor;
- H73 – checks the correct usage of the summary attribute in tables.

From these results, we can deduce the most common elements with potential accessibility problems. In South Africa and Angola these are anchors or input form components, and in Mozambique tables are added to these.

Incompliance with certain techniques is more pronounced in some countries. For instance:

- H33 – if a title attribute supplements a link, is a more common problem in South Africa (average of 24.61), comparing with the other countries (average of 2.95 for Angola and 1.50 for Mozambique);
- C23 – which presents an average of 9 elements with problems for Angola, being negligible in the other two countries;
- H39 – verifies the usage of caption elements to associate data tables captions with data tables, shows the same behaviour as H33, with an average of 39.58 for South Africa (average of 1.10 for Angola and 11.42 for Mozambique).

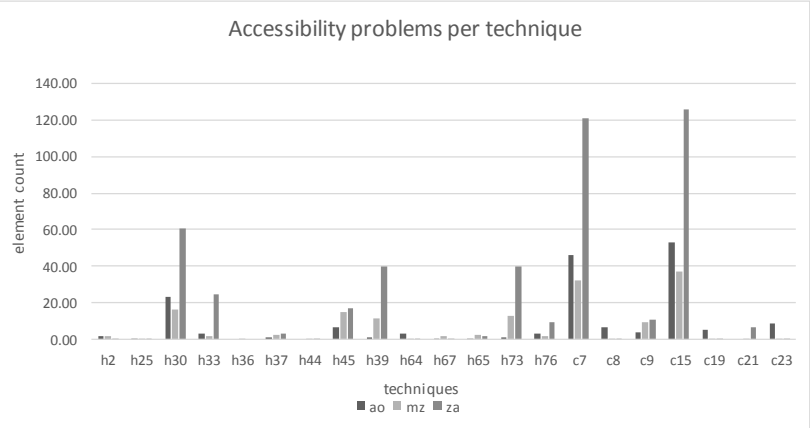

Fig. 4. Average number of fails and warnings (possible problems) by affected technique.

Level of Complexity

We found that the average complexity for the three different domains is approximately 1. The results gathered for Mozambique and South Africa show that the highest level of complexity is 2 (found in 2 Web pages). For the Angolan Government pages, the highest level is 3 (found in 3 Web pages), while 17 pages had level 2.

From these results we can conclude that, for these countries, dynamic changes to the governmental pages layout or interaction elements (thus excluding changes to their content) is not common. When these changes are required, a new page will be loaded, instead of changing the DOM.

3 Discussion

We found there are differences between the three African domains government's Web pages accessibility quality. The South African Government's Web pages have a larger number of HTML elements, but also present a larger percentage of elements raising fails and warnings, comparatively with the Web pages from Angola and Mozambique. This goes towards the conclusions of *Lopes et al* [5], where it was found that the size of the pages influences its quality (i.e., smaller Web pages have less accessibility problems than bigger ones).

Concerning the techniques, it was observed that CSS techniques have a greater influence on the positive accessibility values for all the countries domains than HTML techniques. Techniques C23, C21, C19, and C8 were found to be the ones with highest compliance levels.

When considering potential accessibility problems (fails and warnings), we perceived that they also have higher values in CSS techniques but the difference to HTML techniques is not as pronounced as we found when analysing passes. The techniques most often violated were C7, C15, H30 and H73. It is interesting to note that what we

observed for one of the techniques with more problems, H30 (which verifies if the link text describes the purpose of the anchor), is consistent with what was already seen in a previous accessibility study of two hundred of the most used Web pages in the entire world [6].

The majority of the HTML problems found are related with the accessibility quality of tables, specifically when they do not have captions and summary elements, and if links do not have text descriptions. If those were carefully reviewed and redone the accessibility quality of the pages would considerably improve.

The results show that government Web pages would greatly benefit from reviewing their CSS, since the majority of their problems are located in techniques C7 and C15, especially for the South African government's Web pages. Problems with these techniques can be solved by adding a description of the link given in the anchor element, inside a span tag and hidden by a span CSS, as recommended by the WCAG 2.0 description. For technique C15, the solution would be to ensure that every anchor link and input box changes its colour whenever it is interacted with. People would greatly benefit from this visual aid and contrary to technique C7, it is much easier to enforce. Correcting these situations would help separate the normal paragraph's text and the interactive text in the anchor element, as well as help signalling which form input element is selected at a specific instant when it is being interacted with.

After finishing the automated evaluation, we performed a manual inspection of some of the government's pages from each country. This inspection was performed following the indications of the WCAG 2.0. For the South Africa's Web pages we observed that: the limitations of the several divisions of the pages was not always clear; link elements were confused with parts of the text; the general structure was quite similar to a newspaper and did not denote a lot of accessibility concerns. For Mozambique's Web pages, decorative images do not have either alt or title attributes when they should have them with empty values; some colours are also perceived as being too bright; table captions were also almost inexistent; there are also some flash objects directly embedded without any textual descriptions. For Angolan Web pages, since they generally follow the same structure, they all could benefit from adding captions to tables and textual descriptions to images and anchor elements. We can see that some of the issues found manually confirm the findings of the automated evaluation.

It was also possible to detect that Angola and Mozambique's Web pages benefited from tools that help code generation (such as Flyout and Plone, respectively). On the other hand, South African pages, taking into account the quantity of comments in the code and its specificity, were probably manually coded. This probably contributed to the bigger number of CSS problems, because code generators avoid several CSS problems, such as the use of relative font-sizes.

Regarding the level of complexity of the Web pages, we found that dynamic changes to the pages' DOM are mainly used to change the content of the pages and not to add new elements to the page (i.e., less structural complexity). In what concerns the accessibility quality, the slightly higher complexity found in Angolan Web pages does not reflect any significant change in the overall accessibility score.

4 Conclusion

The Web is the main vehicle used by many governments to spread information, education, allow civic participation and other public services. If these pages are not accessible they fail to reach their target population.

In this paper we evaluated 2250 Governmental Web pages from each one of three different African countries: Angola, Mozambique and South Africa. This report shows that the South Africa Government Web pages have more elements than the other countries but have less quality in terms of accessibility. The Angolan Government Web pages scores the best ratio of passes when comparing with the other countries. Mozambique's pages have the lower rating of fails and warnings combined. Regarding the level of structural complexity, we did not find major differences between the different countries' Web pages.

A manual inspection of a sample of the pages suggested that Angolan and Mozambican Web pages might have benefited from the support of code generation tools during their development, while this is not so clear in South African Web pages. The accessibility evaluation, concomitantly, has shown more accessibility problems in South African pages, with some of these problems being in some cases more easily addressed and prevented with the use of code generation tools.

This overall view of the current state of accessibility in these African governments Web pages by WCAG 2.0 techniques facilitates establishing a set of recommendations to repair the most common problems.

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