

Results from Multi-dimensional Accessibility Assessment

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Abstract. This paper discusses the variability of websites accessibility using a multi-dimensional evaluation that considers specific sets of relevant guidelines according to different devices and different disability types. We use an accessibility evaluation framework that is able to explore different combinations of guidelines from web content accessibility and mobile web best practices. It was applied to evaluate a set of interesting case studies. The obtained results show that the web content presents different accessibility issues regarding specific disability types, always a subset of the universal accessibility assessments. Regarding the devices' dimension, results of the assessment show significant differences depending on the web resource representation for different devices. In all cases the dissimilarities between the general accessibility assessment and the evaluation for specific disabilities were visible.

Keywords: Mobile Web, Accessibility, Assessment.

1 Introduction

Making web sites accessible for people with disabilities is an integral part of high quality web sites, a growing market opportunity and, increasingly a legal requirement.

Still, existing web is often inadequate to people with disabilities. Developers frequently ignore recommendations and legislation and the cost/benefit analysis of conforming web pages is often disregarded or, at a first impression, unfavourable. Besides a strong overall dissemination and enforcement policy, which is occurring, it is important also as a form of indoctrination to address individual disability groups. That way, individuals' awareness will be definitely strengthened. Besides, if not directly on developers, just having a means of providing hints to users on whether a web site is accessible to them or not, may avoid frustrations or give means to specific disabilities associations to provide or reinforce adequate web site developments. Overall, it is thus important to understand the accessibility of web pages towards specific disabilities.

On the other hand, mobile devices are increasingly being used as a terminal to access the web. Here, although it is possible to have adequate representations for each category of devices, most web sites only have a default representation for desktops. Again, comprehending the impact of providing adequate representations for mobile devices should be relevant for users and developers.

Finally, on the confluence of mobility and accessibility, things get even worse. The intrinsic features and limitations of mobile devices along with the accessibility requirements are a hinder but also a challenge to comprehensive web content development and interaction.

Again the variability in the evaluation of websites according to the disability type dimension and the delivery context dimension needs to be addressed. This paper addresses these multi-dimensional assessment issues. It presents a multi-dimensional accessibility assessment approach allowing web content accessibility evaluation, regarding different selectable disability profiles and different delivery contexts. The assessments results of case studies carried out are presented and discussed.

2 Related Work

Two sets of guidelines stand forward in the quest to develop accessible web contents and mobile-friendly web contents exist. The Web Content Accessibility Guidelines (WCAG) [1, 2], defines a set of rules to make websites accessible to people with disabilities, whereas the Mobile Web Best Practices (MWBP) [3] defines rules for making websites more usable from a mobile device. Although their correlations are well documented [4], developers still are unfamiliar with each one, and their combination.

Also, if we take into account each disability and corresponding usage and accessibility constraints, the dimensions of the puzzle become even more intricate.

Several tools are already available for the assessment of web sites, in terms of their accessibility [5, 8] and in terms of their mobile usage [5, 7, 8]. In general though, they tend to adopt approaches where guidelines are applied indifferently of the target users, the target devices or the conjunction of mobile and accessibility constraints. Even if recent work [9, 10] is emerging that addresses some of these nuances, the fact remains that a comprehensive approach is still lacking addressing the variability of accessibility according to each disability type and device delivery contexts.

3 The Approach

The multi-dimensional accessibility assessment approach allows for web content accessibility evaluation, regarding different selectable disability profiles and different delivery contexts, such as mobile and desktop user-agents. Accessibility assessments based on WCAG guidelines conformance evaluation and disability type specific accessibility assessments based on subsets related to targeted disability types [10,13] can be performed.

Regarding the delivery context dimension the rationale for the selection and application of guidelines aiming mobile web accessibility evaluation for specific disability profiles considered the following steps [11,12]:

1. Get the WCAG guidelines sets relevant to the targeted disability type;
2. Select the related MWBP relevant to the targeted disability type;

3. Select the guidelines relevant to mobile web content adequacy regardless of the users' special needs;
4. Exclude guidelines that become irrelevant to the targeted disability type when accessing it from mobile devices.

For the first step each WCAG guideline relevance can be established regarding each disability type [10,13,].

For the second step, standard mapping between WCAG and MWBP [4] is used as the first approach.

For the third step guidelines referring to aspects relevant for mobile usage adequacy that do not relate to any disability group accessibility specific issues such as character encoding, clarity, content format preferred, content format support, cookies, etc. that do not have a relation with any disability type or WCAG best practice issue, rather are critical to general mobile devices interaction. Guidelines such as “page size limit” or “link target format” are good examples of these.

In principle, then, the conjunction of these two MWBP subsets, i.e., WCAG related and accessibility independent, along with the disability specific WCAG set will constitute the whole relevant set that should be used to assess content for given disability. However, a deeper analysis revealed some interesting, potentially controversial, issues.

Consider a blind disability type or a user that by rule turns of the images download option on its user agent of his/her mobile device. Applying MWBP image related tests for guideline conformance (e.g. images specify size) can result in failure results irrelevant for that specific usage. In fact, not having specified the image size will not change at all the user experience since the image will not be downloaded anyway. Those cases are reflected on step 4 of the method has guidelines that can be excluded from the relevant sets for specific disability types such as the visual impaired.

This approach was reflected in a proof of concept tool, MWAAT, which fully addresses its basic concepts [11]. This provides the necessary support to web developers, designers and assessment experts to conduct rapid, yet specialized, accessibility assessments focused on different disability types for web sites tailored also to mobile devices.

4 Multi-dimensional Accessibility Assessment Scenarios

Using the abovementioned method and tool, we accessed different web site resources, simulating the access from a default desktop and mobile OK delivery contexts [3]. We evaluated the accessibility of the received web content representations on the following web resource evaluation scenarios:

- Web site's default representation accessibility evaluation for:
 - All disability types
 - Blind disability type
 - Deaf disability type
 - Color blind disability type
 - Motor impaired disability type

- Web site’s mobile OK representation mobile accessibility evaluation for:
 - Mobile adequacy evaluation (no disability)
 - All disability types
 - Blind disability type
 - Deaf disability type
 - Color blind disability type
 - Motor impaired disability type
- Web site’s default representation mobile accessibility evaluation for:
 - Mobile adequacy evaluation (no disabilities)
 - All disability types
 - Blind disability type
 - Deaf disability type
 - Color blind disability type
 - Motor impaired disability type

For simplicity reasons, the tables for each case study are organized as follows:

- The first one reflects the accessibility evaluation for the default representation according to the scenarios presented above, namely, the assessment for no specific disability, for blind, deaf, colour blind and motor impaired disability types, in this order.
- The second table reflects the mobile accessibility evaluation for the mobile representation. On this second table, the first row (Disability: NONE) depicts the mobile assessment not considering accessibility issues whereas the next ones follow the abovementioned organization.
- The third table reflects the mobile accessibility evaluation for the default representation, using the same ordering of the second one.

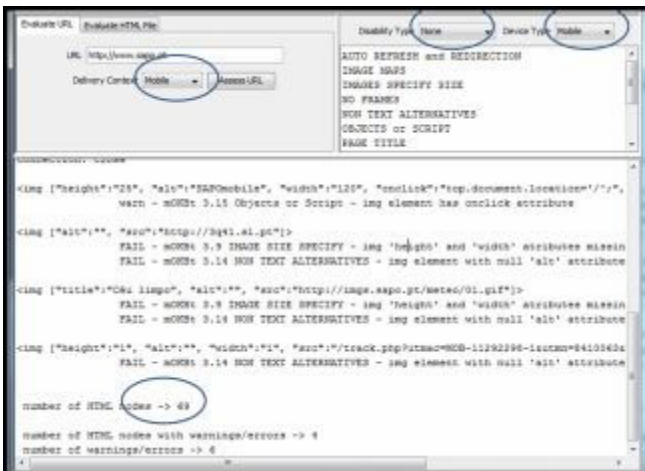


Fig. 1. Web portal mobile OK representation mobile adequacy evaluation

The fourth percentage column represents the ratio between the number of nodes with warnings and the number nodes. The last column represents the ratio between the number warnings and the number nodes. Warn=Err signifies that fails and warnings were counted together.

The different received HTTP response contents were evaluated according to the referred approach.

We see from the Web Portal Web site mobile adequacy evaluation example that, although it supports a mobile OK representation, the Web content even in that representation still maintains several non-adequate issues such as on click events with associated Java scripts that most mobile devices do not support, and they maintain on several tag, the absence of the height and/or width specification with the resulting rendering issues therefore derived.

On the next section we present the aggregate results obtained from the performed evaluations.

5 Multi-dimensional Accessibility Assessment Results

The tables bellow present the summary results for three cases studies, covering the evaluation scenarios presented above.

- **Web portal assessment case study:**

Default Representation - Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
ALL	1453	71	5	73	5
Blind	1453	6	0	8	1
Deaf	1453	0	0	0	0
Color Blind	1453	65	4	65	4
Motor Impaired	1453	6	0	8	1

Fig. 2. Web portal default representation accessibility assessment results

Mobile Representation - Mobile Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
NONE	69	4	6	6	9
ALL	69	4	6	13	19
Blind	69	4	6	7	10
Deaf	69	4	6	6	9
Color Blind	69	4	6	10	14
Motor Impaired	69	4	6	9	13

Fig. 3. Web portal mobile representation mobile accessibility assessment results

Default Representation - Mobile Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
NONE	1453	137	9	142	10
ALL	1453	137	9	215	15
Blind	1453	77	5	85	6
Deaf	1453	137	9	142	10
Color Blind	1453	137	9	207	14
Motor Impaired	1453	137	9	150	10

Fig. 4. Web portal default representation mobile accessibility assessment results

- **Web magazine assessment case study:**

Default Representation - Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
ALL	2583	204	8	210	8
Blind	2583	41	2	47	2
Deaf	2583	0	0	0	0
Color Blind	2583	163	6	163	6
Motor Impaired	2583	41	2	47	2

Fig. 5. Web magazine default representation accessibility assessment results

Mobile Representation - Mobile Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
NONE	71	1	1	1	1
ALL	71	1	1	2	3
Blind	71	0	0	0	0
Deaf	71	1	1	1	1
Color Blind	71	1	1	2	3
Motor Impaired	71	1	1	1	1

Fig. 6. Web magazine mobile representation mobile accessibility assessment results

Default Representation - Mobile Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
NONE	2587	226	9	378	15
ALL	2587	227	9	589	23
Blind	2587	203	8	268	10
Deaf	2587	226	9	378	15
Color Blind	2587	227	9	542	21
Motor Impaired	2587	226	9	425	16

Fig. 7. Web magazine default representation mobile accessibility assessment results

To start with, consider the accessibility dimension. The first table of each case study showed some figures that raise interesting questions. Primarily, it is clear that most of the specific disabilities have much less issues than the general case, since each disability relevant set of guidelines is a subset of the available tests. Furthermore, a deeper analysis of the evaluation results showed that even when the numbers are similar between disabilities, the actual raised issues generally correspond to different guidelines.

This reinforces the decision of having a specific disability testing option, since for example, for the deaf case the site is completely accessible. At the other end, the color blind case, that has a significant number of issues, can be easily explained by the fact that most of them are warnings regarding the contrast of background and foreground colors. In fact, the actual contrast is not tested and might be correct. Looking now at the mobility dimension, we should focus the attention on the first line of the second and third tables of each case study. Here it is clear that the mobile representation (second table) presents a much smaller page size than the default representation (third table) in all case studies. This occurs since all sites have a mobile specific content representation, which usually offer a much simplified version of the site. For sites without this feature the results of the second and third table would be the same.

- **Web financial portal assessment case study:**

Default Representation - Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
ALL	1424	35	2	35	2
Blind	1424	9	1	9	1
Deaf	1424	0	0	0	0
Color Blind	1424	26	2	26	2
Motor Impaired	1424	9	1	9	1

Fig. 8. Web financial portal default representation accessibility assessment results

Mobile Representation - Mobile Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
NONE	252	4	2	7	3
ALL	252	4	2	11	4
Blind	252	3	1	3	1
Deaf	252	4	2	7	3
Color Blind	252	4	2	11	4
Motor Impaired	252	4	2	7	3

Fig. 9. Web financial portal mobile representation mobile accessibility assessment results

Regarding all the case studies and the percentage of issues raised, it is noticeable that the web magazine shows the best improvement rates (9% to 1% in nodes and 15% to 1% in warnings), from the default to the mobile representations. The Financial Portal shows no improvement, but the site is already quite good, in its default format

Default Representation - Mobile Accessibility					
Disability	Nodes	Nodes with Warn/Err	%	Warn/Err	%
NONE	1424	46	3	46	3
ALL	1424	46	3	81	6
Blind	1424	20	1	29	2
Deaf	1424	46	3	46	3
Color Blind	1424	46	3	72	5
Motor Impaired	1424	46	3	55	4

Fig. 10. Web financial portal default representation mobile accessibility assessment results

(third table). Finally the Web Portal case study shows minimal improvement (9% to 6% and 10% to 9%). A deeper regard at the HTML content and the evaluation results showed the existence of an advertisement using java script code, not supported by many mobile phones, and some tags with unspecified image height or width attributes. Considering the first two lines of the second table of each case study, corresponding to the mobile representation mobile accessibility assessment, one can observe that the number of warnings augments as expected from the mobile adequacy case to the mobile accessibility case (Web Portal: 6 to 13; Web Magazine: 1 to 2; Web Financial Portal: 7 to 11). This reinforces the notion that assessing mobile adequacy is not the same than assessing mobile accessibility.

Comparing the same two initial rows with the ones of the third table, it is patent that, regarding absolute numbers, the gain in accessibility is enormous when comparing the mobile representation version with the default one, both in terms of number of nodes with warnings and total number of warnings. Looking at percentages, that is also true for most case studies.

The exception is the number of warnings in the web portal's case (last column of the tables). Again, the explanation falls on the existence of the aforementioned advertisement.

Overall, the verified improvement in the accessibility of the mobile representations versus the default ones is in accordance with the well-known overlapping of guidelines.

Nevertheless, this overlapping is not complete, far from it, and sometimes the reasons and the corrective measures are different between the mobile adequacy issues and the accessibility ones.

Finally, it is worth comparing the rows of the second table (or of the third, which follows a similar pattern). In all case studies the differences the general accessibility evaluation and the specific disability ones are noticeable, as referred in the analysis of the first table. An interesting one is the blind disability evaluation scenario. Particularly in the web magazine case the mobile accessibility issues disappear. A more detailed analysis of the results shows that the issue found on the mobile adequacy (first row) that disappears in the blind assessment (third row) is referring the missing image size specification, which is considered irrelevant in this later one.

6 Discussion

The paper presents and discusses the results obtained on the evaluation of different web resources, accessed from different delivery contexts and for different disability types. The different representations of each web resource, for each of the different delivery contexts, were assessed according to different evaluation scenarios: including standard accessibility without regard to any particular type of disability and accessibility considering specific types of disabilities such as visual, hearing, color blind, motor and cognitive impairments.

The results obtained allow asserting that web contents, as expected, have much less accessibility problems regarding each specific disability types than when assessed from the indiscriminate general case. Deeper analysis of the results showed that even when the numbers are similar between the different types of disabilities, the real problems raised correspond generally to different guidelines that are not observed.

Looking for mobility dimension, it was clear that the representation mobile presents a much smaller size than the default representation in all cases of study. This asserts that these websites have a particular representation to be accessed from mobile contexts, which usually offers a simplified version that is more suitable.

In relation to the absolute numbers, the gain in terms of accessibility is huge when comparing mobile representation with the default representation, both in terms of number of nodes as in number of warnings and errors. Looking for the percentages, the same is true for most cases of study.

In general, the expected improvement in accessibility of mobile representations versus standard representations was observed. In all cases the differences between the general accessibility assessment and the evaluation for specific deficiencies were visible.

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