

A Web Content Management System to Create Accessible Web Sites

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ABSTRACT

This paper presents an approach for developing an accessible WCMS, based on an Open Source CMS. An analysis of current CMS available and their suitability to become accessible CMS is described, as well as, an analysis of the feasibility of including accessibility guidelines in a proposed WCMS. The paper includes an evaluation procedure to test usability of the resulting WCMS. Finally, some conclusions and future work are proposed.

Categories and Subject Descriptors

K.4.2 [Computers and Society]: Social Issues - *Assistive technologies for persons with disabilities, Handicapped persons/special needs*. H.5.2 [Information Interfaces and Presentation]: User Interfaces.

General Terms

Human Factors, Standardization and Verification.

Keywords

CMS, WCMS, WCM, Accessible CMS, Accessibility, Usability.

1. INTRODUCTION

Web accessibility is the practice of making Web sites accessible to all, particularly those with special needs [2]. The World Wide Web Consortium (W3C) promotes a high degree of usability for people with disabilities through its Web Accessibility Initiative (WAI) and its Web Content Accessibility Guidelines 1.0 (WCAG 1.0) that is a set of recommendations to create accessible Web content [4]. Nevertheless, when this content is generated using a Web Content Management System (WCMS), there are no guaranties that it will follows these recommendations. A WCMS is a content management system (CMS), implemented as a Web application. It provides flexible and simple tools for creating and managing content published in a Web site [1].

According to CMS Matrix and OpensourceCMS.com, that provide a Website for users in the community to download and review WCMS packages, there are a lot of available open source and commercial WCMS. Most of these systems spend its efforts

in providing mainly usable tools for easy and fast Web content creation; the quality of the content generated with these tools is not assured. These tools try to achieve fast delivery of rich content; however, they tend to generate data that do not fulfill accessibility standards [11]. A solution incorporated in many WCMS to avoid standards violation is to provide greater control to the user, who creates the content, granting access to the HTML code generated by the WYSIWYG (what you see is what you get) tools to improve Web site accessibility. Again, the WCMS user needs to know HTML and Web accessibility standards, which is not the case of all the Web masters or Web designers in organizations.

The following paper focuses on the further development of an open source WCMS that allows the user to easily create and manage high quality Web sites that fulfill accessibility standards, without excessive load on the Web designer about the knowledge of these standards. In addition, the proposed WCMS project seeks to serve as a tool for Ecuadorian Web developers that are enforced to produce accessible content according to the national policies.

This paper is structured as follows. First describes the methodology adopted for the development of the proposed WCMS. Next, the test procedure is described and the results obtained in the tests are presented and discussed. Finally, conclusions and future work are presented.

2. METHODOLOGY

In contrast to initiatives such as Edimaster Plus [11] and RiS-Kommunal [6], who prefer to begin the development of a new accessible WCMS from scratch, the authors chose to modify an open source WCMS, available and baptized in this research as “WCMS base”; similarly, to the Accessible Joomla Project (ae8)¹. The modifications made to this WCMS allow the user to create and manage Web sites with accessible content without the need for this user to know Web accessibility standards. The overall project followed the phases presented below:

- Definition of functional and non-functional requirements for the WCMS candidates to become the WCMS base.
- Selection of the best WCMS options to become the WCMS base from a pool of candidates.
- Study of the available accessibility guidelines and its Ecuadorian contextualization.
- Implementation of the accessible WCMS, built from the WCMS base, including the contextualized accessibility guidelines proposed previously.

¹ Web site of the Accessible Joomla Project: <http://www.a8e.org>.

2.1 Definition of functional and non-functional requirements for the WCMS candidates to become the WCMS base

A set of functional and non-functional requirements that should be met by the WCMS candidates for WCMS base, was defined. The functional requirements define the behavior of the proposed WCMS base, expressed in a group of functions and tasks that the system is required to perform; while the non-functional requirements define constraints on various attributes of these behaviors.

These requirements were used as constraints in the process of selection of candidates. Table 1 shows a summary of these requirements.

Table 1. Functional and non-functional requirements defined for the WCMS base

| Functional requirements |
|--|
| Content Management (articles, links, downloads, multimedia). |
| User administration |
| Template administration. |
| Content plug-in administration. |
| Web Menu administration. |
| Sections and categories administration. |
| General Web site options administration. |
| Non-functional requirements |
| Modifiability or extensibility. |
| Portability. |
| User friendly. |
| Usability. |
| Capability. |
| Availability. |
| Reliability. |
| Performance. |

2.2 Selection of the best WCMS option to become the WCMS base from a pool of candidates

The selection was made among several WCMS candidates that met the requirements defined in section 2.1. Literature and reports from independent open source research organizations [1] and local WCMS [15] at our University projects were evaluated to determine the best candidates.

At the end of this process, four WCMS emerged as clear candidates: Joomla!², Drupal³, Plone⁴ and Jossie⁵.

The WCMS were evaluated by four local experts in Web development using a tool that assesses four areas of functionality, three based on Robertson's categories [13]: Content Management, Publishing and Presentation. The fourth category was named Further Characteristics that evaluate aspects such as: Technical

² Web site of the Joomla! Project: <http://www.joomla.org/>.

³ Web site of the Drupal Project: <http://drupal.org/>.

⁴ Web site of the Plone Project: <http://plone.org/>.

⁵ Web site of the Jossie Project: <https://proyectossw.espol.edu.ec/projects/jossie/>.

Architecture, Grade of development, Support, Popularity, Usability, Accessibility and Download speed. Each one of the categories contained features that described the category (*i.e.* content management was described by 14 features, presentation by 6, and so on). Each feature was rated using the scheme shown below:

- (0). This feature is not present.
- (1). Very bad
- (2). Bad.
- (3). Fair
- (4). Good.
- (5). Very good.

The score obtained for each feature was used to rate its category. For instance, to obtain the score for Content Management for JOOMLA, we calculated the average based on the scores of the features in this category. Results of this evaluation are presented in Table 2.

Table 2. Summary of the functionality evaluation

| | Further Characteristics | Content Management | Publishing | Presentation |
|--------------|-------------------------|--------------------|------------|--------------|
| JOOMLA v1.5 | 4.56 | 4.14 | 4.50 | 3.85 |
| DRUPAL v6.13 | 4.18 | 2.83 | 3.17 | 3.35 |
| PLONE v3.2.3 | 4.00 | 3.36 | 1.33 | 3.42 |
| JOSSIE v0.9 | 3.72 | 3.91 | 3.33 | 3.71 |

Overall, it is evident from table 2, that Jossie and Joomla obtained the best scores in most of the categories, specifically in Content Management, Publishing and Presentation.

Table 3. Summary of the heuristic evaluation.

| | Heuristic principles | | | | | | | | | |
|--------|----------------------|------|------|------|------|------|------|------|------|------|
| | H1 | H2 | H3 | H4 | H5 | H6 | H7 | H8 | H9 | H10 |
| JOOMLA | 0.33 | 1.00 | 0.56 | 0.17 | 1.00 | 0.67 | 0.00 | 0.19 | 1.33 | 0.00 |
| DRUPAL | 3.00 | 1.50 | 1.33 | 1.00 | 0.75 | 2.50 | 1.40 | 0.86 | 2.00 | 1.75 |
| PLONE | 1.67 | 1.00 | 1.11 | 0.50 | 0.38 | 2.17 | 0.80 | 1.00 | - | 1.50 |
| JOSSIE | 0.67 | 0.25 | 0.33 | 0.00 | 0.63 | 0.17 | 0.20 | 0.57 | 0.00 | 0.25 |

The WCMS candidates were also evaluated using ten usability heuristic principles, proposed by Nielsen [7]: (H1) Visibility of system status, (H2) Match between system and the real world, (H3) User control and freedom, (H4) Consistency and standards, (H5) Error prevention, (H6) Recognition rather than recall, (H7) Flexibility and efficiency of use, (H8) Aesthetic and minimalist design, (H9) Help users recognize, diagnose, and recover from errors and (H10) Help and documentation.

The authors followed the process suggested by Nielsen when rating usability problems [7]. This process consists on rating each principle, based on a 0 to 4 scale, resulting in an impact factor

describing the fidelity of the application of the analyzed heuristic. For instance, an impact factor near to zero means almost no usability problem and a factor near to 4 indicates that it is needed to solve the problem immediately [9].

Table 3 summarizes the evaluation of the 4 WCMS, according to the process described before.

The impact factors for Jossie and Joomla were far from 4 and near to 1, as shown in Table 3. Thus, from the usability and functionality perspectives the best WCMS were Joomla and Jossie. These results cannot be contrasted to other studies because the principles and characteristics evaluated in this research are different from the ones used in other studies. However, a research presented by Michelinakis [5] indicated that Typo3, Drupal and Mambo scored better in their study, even though their focus was more on business perspective than in usability.

To reduce the time involved in training to learn a new tool such as Joomla, and to promote research projects developed locally at ESPOL, Jossie was chosen as the WCMS base for further modification.

2.3 Study of the available accessibility guidelines and its Ecuadorian contextualization

To contextualize the accessibility guidelines to Ecuador, it was mandatory to explore the accessibility principles and design ideas, promoted by organizations that work for making a more accessible Web to people with disabilities. The guidelines of the two most important organizations in this area were used: Web Content Accessibility Guidelines 1.0 (WCAG) [10][14], proposed by The World Wide Web Consortium (W3C) and Norma UNE 139803 proposed by the Spanish Association for Standardization and Certification (AENOR). These accessibility guidelines were analyzed as well as their applicability to the Ecuadorian context. Finally, 42 contextualized guidelines⁶ were obtained and classified into nine groups, as follows:

- **Basics Principles.** Provide a technical outline of using W3C technologies when are needed, disambiguation of obsolete objects and metadata information availability on web pages in order to be a support for user orientation.
- **Presentation.** Include web site accessibility without style sheets and no blinking or flashing content.
- **Structure.** Aim to enhance Web sites visualization by identifying new sections through headers and listing with the right HTML elements.
- **Images and multimedia.** Should be handled as visual information source where is mandatory to attach some alternative information as a support, for example: alternative description on images, subtitles or an audio description on videos.
- **Programmatic objects.** This group covers guides that assist to develop alternative ways to deal with scripts, applets and flash animations.

- **Frames.** Nowadays, frames are the less technologies used on Web sites, because there are many others options for displaying multiple documents at once, like AJAX request.
- **Tables.** One of the most misused HTML tags for laying out websites; therefore, guidelines to achieve the right information display were included.
- **Forms.** Also should offer an accessible support for multiple validation ways, either by user or admin side validation scripts.
- **Navigation.** Accessible Web sites should provide aids that enhance the navigability through keyword shortcuts.

Similarly to other authors that evaluated the validity and reliability of different checkpoints taken from WCAG [3], we evaluated three characteristics: feasibility, validity and ambiguity about the 42 guidelines proposed. Each characteristic was rated using a 6-point scale being 0 the lowest score and 5 the highest. Six Ecuadorian expert web developers participated in this stage of the evaluation.

Table 4 shows that the nine groups of guidelines obtained similar scores in the categories. Interestingly, none of the group of principles was qualified as ambiguous. However, it is important to notice that the group of Programmatic objects scored a bit lower than the other groups. According to the experts, the lack of knowledge, among the Web developers, of the available Web technologies at Ecuador is the reason of these scores in this group.

Table 4. Summary assessment of the groups of Web accessibility guidelines

| | Ambiguity | Feasibility | Validity |
|----------------------|-----------|-------------|----------|
| Basics Principles | 0 | 4 | 5 |
| Presentation | 0 | 5 | 5 |
| Structure | 0 | 5 | 5 |
| Images | 0 | 4 | 5 |
| Programmatic Objects | 0 | 4 | 4 |
| Frames | 1 | 5 | 5 |
| Table | 0 | 5 | 5 |
| Forms | 0 | 5 | 5 |
| Navigation | 0 | 5 | 5 |

2.4 Implementation of Accessible WCMS

Once the accessibility guidelines validated were identified, the next step was to implement the accessible WCMS. After an exhaustive examination of the code and guidelines, it was recommended to differentiate three groups of guidelines:

1. Those that the WCMS could manage using automatic accessibility verification process (17 guidelines).
2. Those that the WCMS could not manage using automatic accessibility verification process (13 guidelines).
3. Those that according to a certain scenarios cannot be part of the WCMS (12 guidelines).

⁶ Available online at <http://www.cti.espol.edu.ec/guidelines.pdf>

For the guidelines of the first group, the most remarkable implementation decision was to redesign the administrator tools. This decision was taken to provide a sequence of steps for creating accessible content like tables and comprehensible multimedia for screen readers, e.g. the WYSIWYG administration component was readjusted to include special inputs such as: caption and summary on table creation; alternative text on the image attaching process; and synchronized links of audio and text to support video transcription. Figure 1, exemplifies the previous situation.

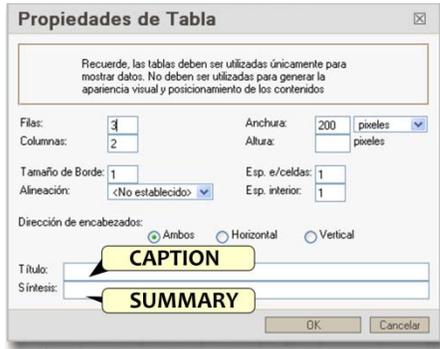


Figure 1. Screen shot that shows special inputs in table creation.

For the guidelines of the second group, automatic accessibility verification was impossible to develop, like checking if the alternative texts in images are appropriate or if there are contents that should be marked up as quotes. For instance, even though, the developers decided to show detailed advices to avoid accessibility problems, it might occur that a blinking image is inserted in the site, despite the advice of the WCMS. Figure 2 exemplifies the previous situation.



Figure 2. Screen shot with advice presented in the process of image insertion.

Finally, there are a last group of guidelines that cannot be implemented because the WCMS does not provide support for creating and adjusting forms or frame managing, among others.

3. TESTING THE ACCESSIBLE JOSSIE

A test suite that involves five scenarios for the implementation of accessibility guidelines was designed to test the usability of the proposed WCMS (Accessible Jossie) with six Web developers.

Below it is a description of each scenario that incorporates common tasks, a Web developer faces when creating Web-based content:

- Metadata management (Scenario 1): This scenario includes general configuration changes like adding a title, description and keywords to a Web site.
- Image management (Scenario 2): More than image insertion, this scenario also includes an aggregation of descriptive text.
- Tables' administration (Scenario 3): This scenario includes a table creation process with: a descriptive title, summary and legible headers.
- Multimedia administration (Scenario 4): This scenario consists of a video addition to an article with the synchronized textual and audible transcription.
- Text formatting (Scenario 5): This scenario includes the evaluation of the module that allows users to change the text format in the Web site.

This part of the assessment was planned to evaluate specifically efficacy and efficiency of the administration console on which the accessibility guidelines are implemented. Six expert Web developers participated in this test, who executed the tasks for each scenario; the time needed to perform the scenarios was recorded.

In addition, four usability interface features in the administration console were evaluated, using a 5-point Likert scale (1 lowest value – 5 highest value). The usability interface features evaluated were: easiness of use, consistency, warning messages visibility, and relevance of warning messages content.

It is important to mention that the test procedure was executed in a natural setting, such as room with other people in the organization where the developers work.

4. RESULTS

All the Web developers participating in the test procedure could execute the tasks required in each scenario, resulting in an efficacy of 100%.

Table 5 presents for each scenario, the expected time, average time, minimum and maximum time; and, difference between expected and average time that helped the researchers to evaluate efficiency of the Administration console of the proposed WCMS.

Table 5. Summary of the time taken by scenario

| Scenarios | Expected time (min.) | Average time (min.) | Minimum (min.) | Maximum (min.) | exp. - avg. time (min.) |
|------------|----------------------|---------------------|----------------|----------------|-------------------------|
| Scenario 1 | 3 | 3,167 | 2 | 5 | 0.17 |
| Scenario 2 | 2 | 3,833 | 3 | 5 | 0.83 |
| Scenario 3 | 6 | 7,333 | 4 | 11 | 1.33 |
| Scenario 4 | 3 | 2,833 | 1 | 4 | 0.17 |
| Scenario 5 | 2 | 3,167 | 2 | 5 | 1.17 |

As can be seen in table 5, the ranges of time per scenario vary widely; especially, in scenario 3. One factor for obtaining this result was stated by some of the developers and was that: “the proposed WCMS asked me to include information that it has never been required before.” Another negative factor affecting

this result is the environmental noise surrounding the tester. Nevertheless, the results for this part of the evaluation are relatively positive.

Table 6 depicts the developers' perception for each usability interface feature. In general, the results in this part of the evaluation were also very positive, most of the developers rated high to very high each usability feature. However, the visibility of the advising messages was rated fairly and very similar to what it is observed in the rating of the relevance of advising message content feature. Therefore, it is needed further work on the design of the advising messages.

Table 6. Accessibility perception scores.

| Usability feature | Average | Minimum | Maximum |
|---------------------------------------|---------|---------|---------|
| Easiness of use | 4,33 | 4 | 5 |
| Interface consistency | 4,50 | 4 | 5 |
| Advising message visibility | 3,50 | 2 | 5 |
| Relevance of advising message content | 4,00 | 2 | 5 |

5. CONCLUSIONS

In this paper, we have presented our approach for developing an accessible WCMS, as well as the evaluation usability process to assess it. Our approach focuses on modification of an existing WCMS that met a set of functional and usability requirements. This approach required significantly less developers' resources.

Some of the guidelines included in the proposed WCMS were implemented easily thanks to the current available technology, yet some complex accessibility aspects could not be included automatically.

The Web developers that participated in the evaluation of the proposed WCMS perceived it as an easy to use tool that liberates them from checking every time for accessibility requirements for the Web. Nevertheless, from the results we can conclude that more work is needed to make it available to web developers concerned about accessibility for communities with special needs.

6. FUTURE WORK

We plan to incorporate in the next version of Jossie the suggestions of web developers that collaborated in this research. Additionally, we foresee to test efficiency in web developing using: a) Accessible Jossie and b) other tools using the accessibility guidelines proposed as part of this research.

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