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AN AUTOMATIC AND METHODOLOGICAL APPROACH FOR ACCESSIBLE WEB APPLICATIONS

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Abstract:. *Semantic Web approaches try to get the interoperability and communication among technologies and organizations. Nevertheless, sometimes it is forgotten that the Web must be useful for every user, consequently it is necessary to include tools and techniques doing Semantic Web be accessible. Accessibility and usability are two usually joined concepts widely used in web application development, however their meaning are different. Usability means the way to make easy the use but accessibility is referred to the access possibility. For the first one, there are many well proved approaches in real cases. However, accessibility field requires a deeper research that will make feasible the access to disable people and also the access to novel non-disable people due to the cost to automate and maintain accessible applications. In this paper, we propose one architecture to achieve the accessibility in web-environments dealing with the WAI accessibility standard and the Universal Design paradigm. This architecture tries to control the accessibility in web applications development life-cycle following a methodology starting from a semantic conceptual model and leans on description languages and controlled vocabularies*.

Keywords: *semantic web, usability, accessibility, WAI, Universal Design paradigm, semantic conceptual model.*

1. INTRODUCTION

The fast development of information technologies is changing the way in which service providers interact with their customers and users. The commercial effort is focused on able users leaving disabled people out of their target. Old people, sensorial disabled ones, digital illiterates, etc. are being excluded from some services such as education, job search, leisure applications or games. It is called “digital breach” and it includes users that have troubles (disabled, digital illiterates or just people which are in adverse condition of light, stress, etc) for accessing information services. The parameters for the calculus of disability degree depends on the country, but in all of them the disabled population is considerable.

As interoperability and communication are possible among Technologies which Web is based on, and The World Wide Web Consortium (W3C) [26] standards like The Web Accessibility Initiative (WAI) [23] are the key to obtain it, thanks to languages, tools, etc. which establish the architectural base for the Web, it would be possible an Universal Web and for everybody. However there is a look-like empty technological space in the integration of all components of the accessibility in the development life-cycle of web

applications, due to the implementation high cost. There is a need of methodological framework that follows the WAI and carries out the satisfaction of every user.

The accessibility must be taken into account in first steps of the design process and development of a web site. There is a need for developing methodologies to offer accessible applications. Our proposal, based on Semantic Web, offers a technological opportunity to establish an automatic and low cost methodological approach for accessible Web applications [14].

The paper is structured as follow: section 2 establishes the basis for a universal design that is also the framework of the proposal. In section 3 works and initiatives which are developed in this field are explained, covering several aspects like the most outstanding normalization and standardization works, existing policies and standards. In section 4 an architecture consisting on a semantic model to structure information and to obtain accessibility in every sense including accessibility criteria in this model is described, separating the data model from visualization aspects and to automate the publication process in an accessible way. The last section includes some conclusions and further work.

2. A FRAMEWORK FOR UNIVERSAL DESIGN

Accessibility means to allow flexibility for user requirements taking into account his/her limitations. Its goal is to avoid the software design only for certain users' groups, imposing barriers from the very beginning. Web accessibility means that people with disabilities can use the Web. More specifically, web accessibility means that disable people can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging. Users with different types of disability may access the Web in different ways and overcome several barriers in the information access (browsers, multimedia devices, screen readers, speech recognition, etc.). The purpose is to reduce those barriers allowing full access to the information and services on the Web. The most important challenge when an accessible site is being developed is to understand that the information and services will be accessed in many different ways from any kind of device and software.

As organizations seek to define and implement policies for accessible web design, whether for internal use or in outsourcing development work, it is required to establish a practical framework for ensuring that discrimination does not take place. At the same time, issues relating to accessibility as well as usability and user experience may equally be addressed, due to the usability and accessibility are very close and both disciplines converge on a principal idea, the User Centred Design (UCD).

A universal and inclusive design must be included in a methodological framework. Universal design tries to cover all kind of users ensuring the accessibility for a wide range of disabled users and at the same time that improves the usability for any other kind of non-disable users. Also, inclusive design which is derived from the UCD incorporates the active participation of disabled users in the design process [16]. On the other hand, a new perspective of adaptability must be taken into account, the "access for all" introducing user profiles in concrete domains is also a requirement [12], [15].

This work aligned within the universal design paradigm follows an inclusive design.

3. PRELIMINARIES

3.1. LEGISLATION, NORMALIZATION AND WAI STANDARDS.

To minimize the digital barriers in the Web the collaboration of different groups and organisations is absolutely necessary. Administrations play a main role in this process, they must promote the universal accessibility with the aim to ensure equal bases in the access to the information for all citizens. To do this, they own several Normalization and Legislation tools [18].

The lack of standards on accessibility makes difficult the proliferation of products and applications that would include disabled people, causing in some cases non-desirable market segmentations. To solve such accessibility issues, various efforts are underway worldwide. The W3C [26] has promoted the WAI [23] to publish the Web Content Accessibility Guideline (WCAG) [24] in 1998. The WAI helps to coordinate international Web accessibility efforts to bring together the technical and human component considerations. WAI includes working groups to produce technical specifications that support accessibility, User Agent Accessibility Guidelines (UAAG) [22], authoring tool Accessibility Guidelines (ATAG) [2], and evaluation tools. WCAG is widely seen as a standard to which legislation and policy can refer, directly or indirectly. Nevertheless, these guidelines do not cover all situations and resources may be inaccessible even when they conform fully to the guidelines [5].

Regarding to the legislation, there are examples in several countries that promote the accessibility for web sites:

In Australia and the United Kingdom, there is a Disability Discrimination Act 1992 (DDA) [25] Web sites are not mentioned in the legislation in an explicit way, but mention the need to make services accessible and usable by disabled people and initiatives will be in the way of following the WCAG by site developers. On the other hand, after a formal research study in 2004, the Disability Discrimination Commission of the United Kingdom investigated the accessibility of web sites concludes the need to extend WCAG because, in some cases, pages that did pass that WAI test were inaccessible in a way and almost certainly would have failed usability tests.

In USA, the amendment Section 508 of the Rehabilitation Act [19] arranges a set of rules for federal agencies in which the technology have to provide accessibility to disabled people. In simple terms, the legislation requires conformance with the Section 508 Standards, not part of the legislation itself, but a set of technical requirements, some of which specifically relate to Web accessibility. These requirements are very similar to - but not identical to, and not as extensive as - the WCAG.

In Italy, the legislation introduces requirements for accessibility of computer systems, with specific provision for Web sites [6]. The legislation, like Section 508, provides for the establishment of a set of technical requirements which will serve as a standard to be adhered for web site developers in order to ensure legal performance. Technical requirements reference the WCAG.

In Spain, Law Services of the Information Society and Electronic Commerce (LSSICE) [13], said that the administrations have to accomplish the WCAG “Double-A” level.

These examples show the diversity of approaches to the issue of Web accessibility and the protection of the disabled people rights.

3.2. WEB ACCESSIBLE APPLICATIONS

The lack of accessibility in the Web is clear, perhaps due to the ignorance, another reason may be that the benefits they could obtain for considering these clients did not justify the investment [17]. To introduce accessibility is very expensive so the accessibility in web applications is poor, and the number of people excluded of the information technologies is growing, however, luckily, nowadays there are some laws and standards to fulfill this gap.

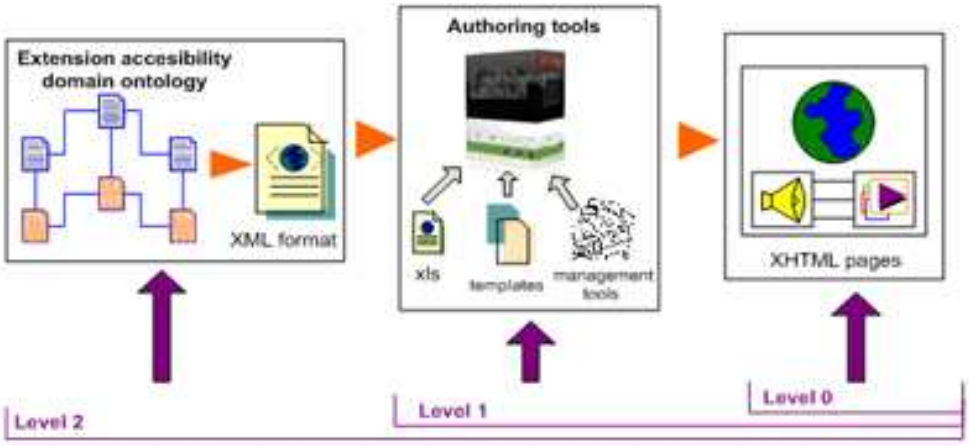

Figure 1. Architecture proposal

Since web accessibility is the ability for a person using software or hardware that retrieves understandable and fully web content [20], web developers should often to be aware of how to make and maintain their web sites. There are important initiatives, guides and technology as authoring tools, description languages, evaluation tools and assisted software, however, it is not trivial to keep dynamic Web pages accessible, it is also necessary the cooperation among industry, researchers, educators, government, and people with disabilities in the development and implementation of consensus-based accessibility solutions [4].

The migration to the accessible web sites from existing applications is a hard task and sometimes impossible due to the technology and the structure used may do not allow it or the migration cost is excessive. The best option is to create a new site, but, if accessibility guidelines are not followed from the beginning of the design process, the durability of the accessibility will be not ensured. The objective is to follow a methodology in order to establish automatic mechanisms.

3.3. ACCESSIBLE WEB APPLICATIONS FROM METADATA

The Web is a huge database increasingly growing, with sophisticated search and retrieval mechanisms. Their maintenance depends on the use of metadata. It is the forecast of the Web 2.0, in which meta-information is more important than information itself [10]. The W3C consortium has developed a description model for metadata, description languages and ontology tools for allowing the web semantic enrichment.

Main metadata approaches in the accessibility field are focused on the e-learning domain:

The TILE project [1] that presents a framework for accessibility integrating an object repository to fulfill users specials needs and includes a scheme for access preferences and content presentation.

Another interesting initiative is the IMS AccessForAll Meta-data Specification [12] promotes by IMS Global Learning Consortium Also, in this domain, the standard IMS includes profiles for accessible user relationships with resources and services.

Finally standards as The Learning Object Model (LOM) developed by IEEE LTSC [21] is defined as the attributes required to fully or adequately describing a Learning Object. Currently the IEEE Learning Technology Standards Committee [11] and the Dublin Core Metadata Initiative [8] are collaborating on the development of interoperable metadata for learning, education and training leans on LOM and unifying LOM and Dublin Core Metadata Element Set (DCMES) [7].

4. PROPOSAL OF THREE LEVELS

Accessible web applications require methodologies and techniques that automate the accessibility from first steps of the design. In this work authors propose a simple architecture for developing a web portal.

Components of the architecture are: a semantic model and an extension that is the approach of this work. The semantic model consists of a knowledge ontology that structures the information. The extension introduces a set of accessibility criterion to the knowledge base. This knowledge will be stored in XML [9] format for their use in an authoring tool as a content management system, to develop accessible webs trough templates and accessible style sheets that separate the content to the representation to publish web pages in XHTML language [27]. Finally, the selected tool must be extended with efficient management and publication mechanisms in order to fulfill accessible guidelines as WACG and ATAG. Figure 1 shows the proposed architecture.

We have considered tree essential architectural levels:

- **Level 2**: related to the knowledge ontology in which, the definition of new data types necessary to obtain accessibility, as language or alternative transcriptions, are included in the metadata.
- **Level 1**: implementation of mechanisms that, using the semantic model extension and the accessibility information applied in the level 2, allow extending authoring tools with accessibility criteria. In this level development of accessible templates and design of XLS style sheets are required.
- **Level 0**: representing the accessibility in the content that is going to be published.

Taking into account these tree levels, the accessibility is included from the beginning of the process, getting that the knowledge may be carry out along all design processes.

Web development components interact in a joined way, are stand-alone and if the accessibility is not implemented in one component (called weak component), the rest of components will be affected [4]. Following this theory, we believe that the accessibility loss increases according to the step in which the development of the web application will be closer to the final product. In this sense, our proposal tries to acquire the accessibility from the first component in the web application development life-cycle for avoiding the existence of weak components. This approach also makes easy that the most sensitive phases as such maintenance or content edition will be accessible in an automatic way.

Table 1. Accessibility metadata items

ACCESSIBILITY SEMANTIC METADATA	REQUIRED METADATA
AlternativeText	Metadata on alt text description
AlternativeImg	Metadata on alt image tag
AlternativeLongTextDesc	Metadata on long text tag
AlternativeAudioDesc	Metadata on audio
AlternativeVisualDesc	Metadata on visual description
AlternativeAudioVisualDesc	Metadata on audio and visual description
langText	Metadata on text language

First step in a web development application consist on the identification of all objects that must be published. Then, for each object, a set of properties or items must be defined and analyzed in order to get accessibility. In a first approach, accessibility items that need to be taken into account in the level 2 are represented in table1.

Description elements, in which these accessibility items must be included, are five: text, image, audio, visual and audiovisual items. All accessibility elements are properties that must be included in an optional or mandatory way in the development of accessible web applications. Figure 2 shows a first approximation to the element image and the properties that must be encapsulated in order to get the accessibility.

```
<!ENTITY logo SYSTEM "url" NDATA JPEG >
<!ENTITY sound SYSTEM "url" NDATA MP3 >
<!ELEMENT audioimage (image, alt, longdesc)
<!ELEMENT image (figure, audio)>
<!ELEMENT figure logo>
<!ELEMENT audio sound>
<!ATTLIST  audio text CDATA #REQUIRED
                 lang  xml:lang #REQUIRED>
<!ELEMENT logo >
<!ELEMENT alt #PCDATA>
<!ATTLIST  alt text CDATA #REQUIRED
               lang  xml:lang #REQUIRED>
<!ELEMENT longdesc #PCDATA>
<!ATTLIST  longdesc text CDATA #REQUIRED
               lang  xml:lang #REQUIRED>
<!ELEMENT audio>
<!ELEMENT image PCDATA>
```

Figure 2. Accessibility semantic metadata

Suppose we have an image that must be introduced in our web portal. The WCAG properties that must be required are alt and longdesc (figure 3). The alt property contains a string that may be a title, a url, etc., the longdesc property provides a description, and all of them must be declared as mandatory in order to carry out the first level of conformance of the WCAG. Also, the language for the content of these properties is introduced by the data type xml:lang. Additionally, the image element has associated an audio element for adding description audio and sound to it.

If this scheme is created and all images in the web portal fit to it, we ensure the accessibility in level 2.

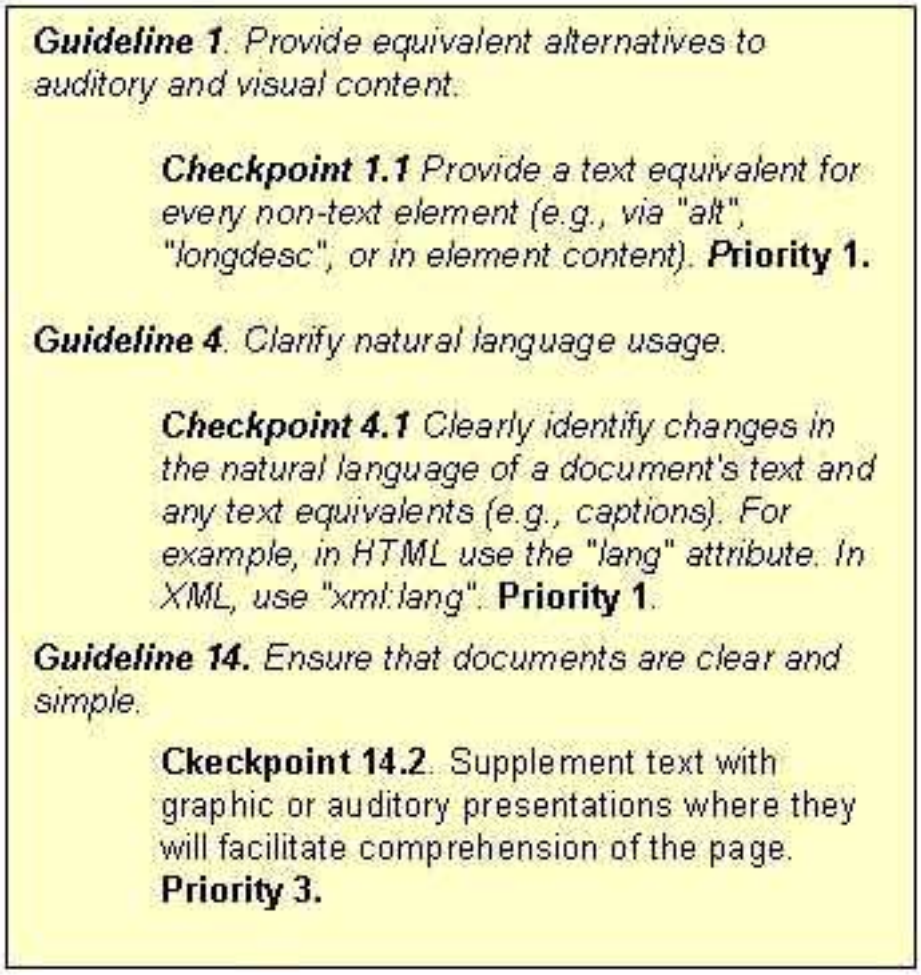

Figure 3. WCAG rules and checkpoints

4.1. METADATA INCLUSION IN LEVEL 2

Metadata are documentation about data and objects, in this way, metadata may contribute to describe web resources enhancing the information retrieval and therefore the automatic accessibility.

In order to reach the semantic web, several specific metadata sets has been developed by research groups and consortiums. One of them is the IMS standard that, in the scope of

the accessibility, leans on the concept of the redundancy for all resources in an e-learning portal. Although we consider that this standard is a good proposal, we believe that it is more oriented to the adaptability because it is designed for several user profiles.

A more general standard is the Dublin Core (DC) Metadata Initiative, an open forum devoted to the development of interoperable metadata standards. The DC describes a set of fifteen elements that covers the resource content, intellectual property and instantiation [8]: title, creator, subject, description, publisher, contributor, date, type, format, identifier, source, language, relation, coverage and rights.

Our proposal is oriented to open portals and, the level 2, although does not cover all the accessibility guidelines, fulfils the level A of the WCAG guidelines. We consider that extending the DC with our proposal, we may obtain accessible web applications in level 2, due to DC provides a sufficient set of properties to annotate all resources.

5. CONCLUSIONS

Web design methodologies must be developed towards the unification of every web design agents, both technological and human, following an user centered and inclusive design in the sense that the user must be actively taking part in the process. On the other hand, partial developments must be efficient enough to get accessibility without increasing costs. The approach of this work tries to follow this line carrying out the accessibility criteria in the first steps of the design, using a semantic model to guaranty the last accessibility and by means of automatic process.

Further work includes the formalization of the accessibility items set described in subsection 4.2. A deep study must be done in order to find all accessibility items of the level 2. Some described items have been proved in a specific domain [14] and are being applied in the web portal of the national project CESyA [3] whose purpose is to research and promote initiatives to facilitate the communication of disable – blind, deaf and deaf-blind- people.

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