POSITION PAPER ON

CULTURE ACROSS CULTURES: A QUALITY CHALLENGE

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ABSTRACT

Cultural heritage raises a big challenge, as useful information can be found in many documents, linked by a variety of association mechanisms. Semantic web and universal access are two relevant issues in Web development. Adaptive and intelligent systems can help to overcome the hurdles of different cultures and traditions, as well as disabilities. Often, different cultures or traditions can share the semantics of specific information items but can conflict in their organization in the context. Therefore, user interface in cultural heritage environment must not only be compliant with *accessibility* and *usability* issues, but also have to cope with the *semantic interoperability*. In this framework, XML, as the basis for the exchange of structured information, the W3C Recommendations as a frame of reference, and the Semantic Web as the next challenge, play a basic role.

INTRODUCTION

Cultural heritage is tremendously rich in variety of possible associations, both between documents themselves, and towards documents pertaining to other disciplines. Documents concerning history, economy, religion, ethnology, can easily contain information relevant for a scholar interested in archaeology, art history, architecture or any other specific field. On the other hand, information available on the web is increasing in size.

The problem is well known, and search engines make use of sophisticated techniques to index and return information. However, the well-known effects of scarce precision and low recall can occur. If the user specifies poorly stringent selection criteria, will have afterwards to browse a high number of possibly long documents, were find the (somehow "hidden") relevant information is like to find a needle in a haystack. Similar considerations apply to the navigation following links present in documents. Some of them can lead to useless pages, either because they are just explicative, or because inserted by the designer even if of marginal importance (but some marginal links can lead to rare or otherwise almost impossible to find information). In all cases, indistinct links can disturb and lead to a "spaghetti navigation". Users need to access the complete universe of information, looking for any fragment of data that may be of interest. Obviously, this brings up some old and very well known problems, inherent to the hypertext approach itself: the "*lost in the hyperspace"* syndrome and the *cognitive overhead*. Users really want to avoid access to unnecessary or redundant information and would like to have the ability to follow only the relevant links, not all links inserted by the designer. Traditionally, high recall and high precision have been considered as a measure of effectiveness, but sometimes users are more concerned with high recall values, in other cases, with high precision values.

It follows that the real need is for *adaptive* and *intelligent* systems. In this context, the user interface is of relevant importance, as it must support several interaction paradigms and convey to the user the needed information,

In this paper we will describe various factors affecting the User Interface quality, namely accessibility, *usability* and *semantic interoperability* issues. We will also show as the last one is the most relevant, and how W3C ([W3C]) technologies, "standards" (Recommendations) and evolution trends are a coherent set towards the ultimate goal of User Interface quality.

USER INTERFACE QUALITY: SOME ISSUES

In the last 25 years the user interface problem has been widely investigated, passing from the early "*error proof*" to the more sophisticated *"user friendly"* (sometimes ironically addressed as *"idiot proof"*) interfaces. Subsequently, GUI was the key concept. Presently a large effort is devoted to *accessibility* and *usability*.

In the following, we will discuss the accessibility issue, making extensive reference to the activities in the World Wide Web Consortium, as a priority issue to be considered in User Interface quality. The usability issues will be briefly recalled, as widely covered by the literature, and somehow related to the specific environment and user group the system is addressed to. Subsequently, we will give a brief description of the Semantic Web, a going on initiative that must be considered as a frame of reference future projects will fit in. Finally, we will discuss some design issues.

ACCESSIBILITY

Web accessibility[1] is important for several reasons:

- use of the Web is spreading rapidly into all areas of society;
- there are barriers on the Web for many types of disabilities;
- millions of people have disabilities that affect access to the Web;
- Web accessibility has carry-over benefits for other users;
- some Web sites are required to be accessible.

In addition, we can't forget that the Web is the fastest-adopted technology in history, and for people with disabilities, it's sometimes a "mixed blessing": In fact it is displacing traditional sources of information and interaction, like schools, libraries, print materials, discourse of the workplace. Some of the traditional resources were accessible; some not.

The Web is becoming a key, but sometimes inaccessible, resource for *information gathering* (news, information, commerce, entertainment), *education* (classroom education, distance learning), *employement* (job searching, and workplace interaction), *civic participation* (laws, voting, government information, services). An accessible Web will mean unprecedented

1 "*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

access to information for people with disabilities. Further, *Web accessibility* is a cross-disability issue, as the Web can present barriers to people with different kinds of disabilities:

- *visual* disabilities (unlabeled graphics, undescribed video, poorly marked-up tables or frames, lack of keyboard support or screen reader compatibility);
- *hearing* disabilities (lack of captioning for audio, proliferation of text without visual signposts);
- *physical* disabilities (lack of keyboard or single-switch support for menu commands);
- *cognitive or neurological* disabilities (lack of consistent navigation structure, overly complex presentation or language, lack of illustrative non-text materials, flickering or strobing designs on pages).

However, Web accessibility is not only an unmissable target for helping impaired persons, it is also a *marketplace* issue, and few organizations can afford to deliberately miss this market sector. In fact, 10% to 20% of the population in most countries has disabilities, and average age of population in many countries is increasing. Even if not all disabilities affect access to the Web (for example difficulty walking, heart condition, etc., don't, while vision, hearing, dexterity, short-term memory ploblems do), we must consider that aging sometimes results in combinations of accessibility issues (like vision and hearing changes, dexterity).

Moreover, accessibility contributes to better design for other users, and therefore to Universal Design:

- **multi-modality** (support for visual, auditory, tactile access):
  - benefits users of mobile phones with small display screens, Web-TV, kiosks;
  - increases usability of Web sites in different situations, like *low bandwidth* (images are slow to download), *noisy environments* (difficult to hear the audio), *screen-glare* (difficult to see the screen), *driving* (eyes and hands are "busy");
- **redundant text/audio/video** can support different learning styles, low literacy levels, second-language access;
- **style sheets** can support more efficient page transmission and site maintenance;
- **captioning** of audio files supports better machine indexing of content, faster searching of content.

Due to its importance, a number of governments require Web accessibility for certain kinds of sites, often for government Web sites first, sometimes other sites, to implement anti-discrimination policies, or policies that directly address Web accessibility. Information on requirements in different countries (European Union, Denmark, France, Ireland, Italy, Portugal, United Kingdom among the others) is available ([WA-Policies]).

The Web Accessibility Initiative at W3C

The World Wide Web Consortium (W3C) is an international, vendor-neutral consortium, with more than 500 members, which plays a central role in development of Web Technologies, promoting evolution and interoperability of the Web. W3C operates from three host sites: MIT in the USA, INRIA in France, Keio in Japan, has outreach offices in ten countries, and has five "domains" (Architecture, Document Formats, Interaction, Technology and Society, Web Accessibility Initiative)[2].

The Web Accessibility Initiative (WAI) works across all the other domains of the W3C and internationally in all three host sites of W3C. It is supported by a variety of government, industry supporters of accessibility and organisations, including European Commission (DG XIII, Telematics Applications Programme for Disabled and Elderly). WAI enables different "stakeholders" in accessibility to work together at the design table. Because Web accessibility is a problem on many levels, WAI has five levels of work:

- ensuring that Web technologies support accessibility
- developing guidelines for accessibility
- developing tools to evaluate and facilitate accessibility
- conducting education and outreach
- coordinating with research and development

Some of these activities have a direct impact on User Interface quality issues, as we are going to detail in the next subsections.

<u>Ensuring that Web Technologies Support Accessibility</u>

WAI coordinates with other W3C working groups to ensure that Web technologies support accessibility. The following specifications already include support for accessibility:

- *HTML 4.0 accessibility features* ([HTML-AF]) include style sheet linkage, alternative representation, navigation, improved table mark-up;
- *CSS2 accessibility features* ([CSS-AF]) include layout, fonts, user control, aural CSS;
- *SMIL accessibility features* ([SMIL-AF]) include synchronization of captioning and audio description;
- *MathML* semantic representation of math content ([MathML]).

In addition, WAI is working on accessibility issues in many current areas of W3C technology development.

<u>Developing Guidelines for Accessibility</u>

Guidelines play a critical role in making the Web accessible, by explaining how to use Web technologies to create accessible Web sites, browsers, or authoring tools. WAI has three different guidelines to address these different needs:

- **Web Content Accessibility Guidelines** 1.0 ([WCAG]) which explain to authors how to create accessible Web content. WCAG 1.0, developed by *Web Content Guidelines Working Group*, became a W3C Recommendation on May 5, 1999, and is made by 14 guidelines with over 60 checkpoints. It identifies three *priority levels* and three *conformance levels*.

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2 *Document Formats* and *Interaction* Domains are new domains originated by a restructuring of the former User Interface Domain.

- **Authoring Tool Accessibility Guidelines** 1.0 ([ATAG]) which explains to developers how to design authoring tools that are accessible to authors with disabilities, and that produce accessible Web content, conformant to WCAG 1.0. ATAG became a W3C Recommendation on February 3, 2000, and is aimed at better support for creation of accessible Web content: WYSIWIG editors, conversion tools (word processors, presentation software), tools that dynamically generate Web pages from databases, image editors, site management tools. The ATAG guidelines address creation of valid content, strategies for prompting, alerting, help, validation, and accessibility of the user interface.

- ***User Agent Accessibility Guidelines*** *1.0*, ([UAAG]) became a Proposed Recommendation March 10, 2000, and are now at the stage of Working Draft (22 June 2001). They explain what the software developers can do to improve the accessibility of mainstream browsers and multimedia players so that people with hearing, cognitive, physical, and visual disabilities will have improved access to the Web. UAAG 1.0 explains the responsibilities of user agents in meeting the needs of users with disabilities. *Techniques for User Agent Accessibility Guidelines* ([TUAAG]) provides implementation detail.

Developing Tools to Evaluate & Facilitate Accessibility

An *Evaluation and Repair Interest Group* and an *Evaluation and Repair Working Group* ([WAI-ER]) coordinate discussion and development on *tools to facilitate accessibility* ([WAI-Tools]). There are several areas of work:

- **Evaluation** of site accessibility: coordination with developers of tools such as CAST's *Bobby*, development of "*Techniques for Accessibility Evaluation and Repair Tools*", developing a *reporting tool for manual Web site review* ([Bobby], [WAI-AERT]);
- **Retrofitting:** tools to walk through inaccessible sites and make them accessible
- **Proxy conversion tools**: gateways to *extrapolate missing alternative text* ([ALTifier]), *linearize tables* ([WAI-Tablin]), etc.

USABILITY

Usability is widely discussed in many papers and books, whose the most widely diffused is probably [Nielsen2000], often quoted as a textbook. We will not discuss this topic in detail, just reminding that usability issues are of big concern, and must be carefully considered in designing Web sites and user interface.

Several factors affect achieving usability for a computer system. System must provide functions that accomplish the intended tasks, are understandable and clearly visible through the user interface, fit in the user's context. Layout and input/output devices must be suitable for the target user group and their physical work environment. It is therefore evident as design for accessibility can be of great help for usability, even if the two concepts address different goals.

Usability requires a design allowing the presentation and input/output devices to vary. This can be accomplished separating the presentation from the remainder of the application, getting the benefit of adaptability to new requirements with limited costs and the possibility of having interfaces tailorable to different user needs and abilities. Once again, some hints and techniques from WAI Guidelines can be useful to achieve different goals.

THE SEMANTIC WEB

W3C technologies support the client server load balancing and allow the implementation of adaptive interfaces. However, the real challenge of next years is the *Semantic Web*. According to the vision of Tim Berners-Lee, the Web has a layered architecture (Figure 1), whose complete development will require several years.

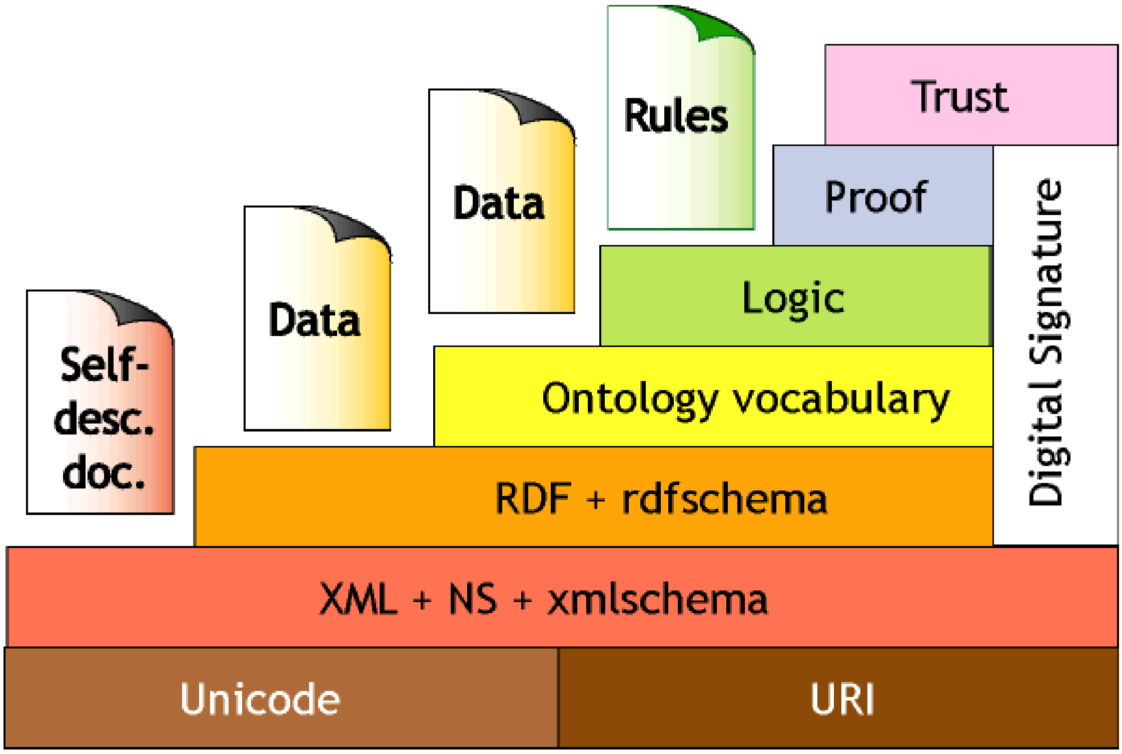

Figure 1 - Layered Architecture of the Semantic Web
(http://www.w3.org/2000/Talks/1206-xml2k-tbl/slide10-0.html)

To understand the framework, we remember that the Web must be seen as a Universal Information Space, navigable, with a mapping from *URI (Uniform Resource Identifier*) to resources. In this framework, the adjective semantic means *"machine processable"*. The Semantic Web, much like XML, is a declarative environment, where we specify the meaning of data.

As clearly explained in [TBL2001], for the semantic web to function, it is needed that computers have access to s*tructured collection of informations* and set of *inference rules* that they can use to conduct automated reasoning. The challenge of the semantic web, therefore, is to provide a language that expresses both *data* and *rules* for reasoning about data and that allows rules from any existing knowledge-representation system to be *exported* onto the Web. In considering the importance of the Semantic Web, we must look at the scaling factor and the intrinsic complexity of some sectors like the cultural heritage[3].

Going in more detail, Figure 1 clearly shows the importance of XML, which allows users to add arbitrary structure to their documents, and RDF, which can be used to express the meaning, asserting that particular things have properties (like *author-of*). A third component is the *Ontology Vocabulary*, intended as a source that formally defines the relations among terms. Ontologies can have a significant effect in enhancing functioning of the Web (looking for concepts, relating the information on a page to the associated knowledge structures, etc.). Fine grained *digital signature* allows to sign different components, like ontologies, inferences, data, the user can trust in.

Just for completeness, it must be noted that there is a lot of enthusiasm and effort put in the development of the Semantic Web, but also some concerns, especially recalling similar experiences in the area of Artificial Intelligence. However, there are several cases where people changed their mind towards a more positive attitude, when looking in more detail to the Semantic Web, and undoubtfully it is a way to explore.

SOME DESIGN ISSUES

The Framework

As we have seen, two of the long-term targets for the web are the semantic web and the universal access. As *semantic web*, we intend a document space where information is machine processable, so implementing a true "*universal information space*" This means to develop a software environment that permits each user to make the best use of the resources available on the Web. *Universal access* aims to make the Web accessible to all by promoting technologies that take into account the vast differences in culture, education, ability, material resources, and physical limitations of users on all continents. It is easily seen that the second goal is somehow making the first even more difficult. Processing information is difficult having a common understanding of a specific knowledge domain; when we have to cope with different cultures or mental habits, it can become impossible: semantic web is a really big challenge.

User needs in accessing information have been widely addressed by researchers, and some possible solutions have been proposed: among them, *information filtering*, *user profiling* and *two-level hypertext* seem to give good results with a fairly low overhead and complexity ([Signore1995a], [Signore1995b], [Signore1996], [Signore1997b]).

A layered architecture, where users access data through the mediation of *intelligent agents* (acting both on the client and the server side) allows the addition of intelligence to the system, leaving room for future interesting enhancements, and can be a first significant step towards the semantic web. In this framework, a basic role is played by XML ([XML]), as the basis for the exchange of structured information. However, it is important to stress that XML by itself is not the panacea, and we should carefully consider the pros and cons of a deep structuring and tagging, having the risk of returning to the early days of relational or even

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3 Just to point the importance of semantic interoperability and difficulties we can match in the specific context, the reader is referred to ***Aquarelle*** project (http://aquarelle.inria.fr/aquarelle/welcome.html).

hierarchical database technology. We must remember that *data indexer and user must share the same knowledge base* to be effective in searching and finding the relevant information: the ever increasing size of the web just aggravates this problem.

Basic design principles

Some basic principles can guide the architecture design:

- simplicity;
- no centralization;
- light tagging;
- weighted and semantically taggged links.

A fundamental choice is to keep the design as simple as possible, so remaining adherent to the ideas that have been the basis of the hypertext and the web. The *simplicity* of the proposed solution is evident in both the underlying principles and the architecture. In designing the architecture, we must consider as a fundamental issue that the web philosophy absolutely *excludes any centralization*. Architectures that rely on some central site will be in contrast with the ideas that lead to the development of the web. ([TBL1999]).

The rationale behind the *light tagging* is the idea of emphasizing the data type, more than the specific role played by the single, atomic information item. This approach leads to the definition of a limited and rough general set of semantic categories, than can be shared by everybody. Such semantic categories can be used both to define a user profile and to semantically characterize various parts of the documents. It is evident that such approach can appear very poor, compared with sophisticated indexing strategies and exhaustive lists of concepts. However, we must remember that searching information can be effective only if user and indexer share the same knowledge base. The most sophisticated indexing strategy, based upon subtle concepts, is totally useless if the user's knowledge of the specific topic is far more generic; (s)he will probably never find the appropriate words to express the concept (s)he is looking for. Therefore, we can have the case of *low recall*. In the reverse case, where user has a deep knowledge in the specific field, using too generic concepts could cause *low precision*. However, the proposed framework could work in this case, too. Very specialized document[4] collections could enrich the topics offering to the user the possibility of searching and navigating thesauri, to specialize the search terms. This will constitute the result of a "negotiation" between the user and the site. The more generic semantic categories will suitably work towards less specialized sites, where serendipitous findings can originate from such a generic semantic tagging.

To avoid the presence of useless links, so reducing the well-known problem of cognitive overhead, links can equally be marked with the generic semantic categories, and, to be more effective, weighted according the relevance of the link itself.

It is worthwhile to note that light tagging, emphasizing the data type, can help in reaching the objective of "universal access", irrespectively from culture or traditions differences, and can

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4 We will generically talk of "document collections" irrespective the sites will provide just a set of (somehow indexed and searchable) "pages", or dynamically access Information Retrieval Systems, or produce "documents" from a database (relational or XML).

easily suggest the appropriate interaction paradigm (or metaphor) independently of the subtleties of the specific role played in the document DTD. Just as an example, think as meaningless can be dates, for people adopting different calendars (e.g. Gregorian, Jewish or muslin calendars.). As shown by experience, it is not so rare the case when different culture or traditions can share the semantics of specific information items (ENTITY, in XML jargon) but can conflict in their organization in the context (DTD, in XML jargon). This can originate irreconcilable positions or endless discussions about what will be an ENTITY or ATTRIBUTE, and where it will fit in the *"right*" DTD.

Almost all of these requirements must be adequately supported by the User Interface, that should be flexible enough to support several interaction paradigms, query formulation and refinement, different presentation of the information, dynamic reconfiguration of the document content, and so on. Many of the W3C technologies can help in implementing the required features.

CONCLUSION

User Interface quality can largely affect the success of any information system (intended in general sense). In the Information era, giving access to everybody, irrespectively from his/her abilities or culture, is a must. Systems designed for specific areas (like cultural heritage) exhibit some additional degree of complexity, due to the need of taking into account *different cultural traditions* of the potential users.

Accessibility is a primary requirement, nobody can accept to leave people with disabilities out of reach of the online information available on the Web. Accessibility can be obtained following the WAI guidelines. The experience clearly shows that in many cases a little effort can give extremely relevant improvements, even if some goals are not so easy to achieve.

Usability takes into account the intended tasks and the user community the system is addressed to. Usability can take advantage by adopting some techniques intended for design for accessibility.

However, even a site accessible and usable can show significant *semantic barriers* to an effective access to information. This is particularly true in semantically richer environments, where different concept organizations require quite sophisticated, or even impossible, identification of semantic equivalence. Semantic Web promises to cope with this kind of problems, too, and his building blocks must be carefully considered and harmonized in building new applications.

User interface must support several, interchangeable interaction paradigms or metaphors (at least map, time, classification), and should be able to tailor the page content and presentation to the real user needs and abilities.

ACKNOWLEDGEMENT

Many thanks are deserved to all who kindly helped me in preparing this paper, with useful suggestions or illuminating discussions. A special acknowledgement goes to the W3C Team, which maintains up to date documentation on the official site: some content of this paper comes directly from the W3C Web site pages, especially those about the WAI activity.

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