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The library: a cultural mine

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ABSTRACT
The paper proposes to consider virtual libraries on the Web as repositories of complex, digital documents to be not only viewed and searched, but also manipulated by users of different typologies. It presents a prototypal environment, the virtual desktop, in which content may be compared, manipulated, edited, etc. at the browser side. The solution is based on XML technologies such as RDF for designing purposes and SVG to render vector graphic.

KEYWORDS: virtual libraries, semantic Web, conceptual design, XML-RDF, XML-SVG

INTRODUCTION

Libraries, in their twofold function of collecting and safekeeping knowledge, are similar to Museum collections or, more often, to their stores; they are in charge of maintaining the integrity of their heritage as an evidence of the activities of producers of each single document, and as a memory support, of facilitating direct examination and research and also of improving popularization and education.
While the first two aspects are, from ancient times, matter of study and of huge efforts in order to suitably solve the general problem of cataloguing - just remember the Encylopédie of the Enlightenment movement -, the third is the most neglected, due to both the troubles linked to the direct vision and the lacking of reliable tools.
The aim of a virtual library is to put at users' disposition not only its catalogues - which are nevertheless indispensable -, but also its 'objects', exhibited on a virtual desktop instead of a precious case, unreachable to the hurried tourist urged by the following visitors or to students often badly involved in the communication project: all of them unable of critical meditation due to the shortness of visits.
This paper shows how the use of some technological standards recommended by the W3C (XML, RDF, SVG) may represent an adequate solution also to the needs of widespread fruition of the library as a part of the heritage, as long as tagging is guided by a deep analysis of the application and of its context performed by means of conceptual tools (like the E-R approach and heuristic rules from the IR field). Moreover XML-like technologies allow today to implement user Web interfaces comparable to those developed by proprietary tools, miming in a virtual space the most suitable metaphor, and offering a set of tools to manipulate objects directly on the browser.

DIALOG MODELS AND METAPHORS

The conversational (also called sequential or computational) and the asynchronous (also computational event-based) schema, are among the

many models of dialog suggested in the literature [1] and more often used in the human-computer interaction.
In the first case, the dialogue is of the kind query/answer and the user navigates in the hyperspace following one path among those suggested by the author. This type of Web applications exploits the fundamental characteristic of hypertext, that is navigation: the author is in charge of structuring contents so that the reader may explore them by following a personal path corresponding, in some way, to her or his needs, attitudes, interests, etc. The user maintains a passive role with respect to the content creation and manipulation, being only a 'reader', though a non-sequential one.
In the second case, the man-machine interaction is based on the contemporary availability of more tasks corresponding to different paths and metaphors. It is possible to strengthen user interactivity by, for example:

- manipulating pieces of content and reassembling them on the basis of needs and aims
- contemporary managing of documents under various format perspectives (texts, sounds, videos, graphs, images, etc.) to reach a level of expressiveness higher than in a separate, sequential display or to meet user requirements (i.e. temporary or permanent disabilities)
- following a link offering more destinations which the user can interactively select
- clipping and exporting some texts, images, etc. to compose a new document to be elaborated and integrated with other information
- allowing collaboration in the hypertext development which can be performed by different people, also working in remote sites, at different times, by means of network facilities, in order to exchange materials, discuss, and investigate.

The complexity is further increased if applications are conceived also as adaptive environments [4; 11], able to tailor content depending on the user's characteristics as a member of a group and as a person. Good solutions proposed in the past, however, were usually limited to local realizations on CD-Rom developed by means of proprietary software. Recent XML derived technologies allow to extend to the Web, in an open software environment, applications comparable with those obtained by Asymetrix Toolbook, Apple Hypercard, Macromedia Director, etc. on CD-Roms. It is now possible to follow the paradigm of the *virtual desktop* which provides for

- having all the wished "objects" at the same time on the desktop, each of them rendered by means of the best suitable metaphor (i.e., catalogue, map, space or time scales, etc.)
- building and keeping personal folders with documents, objects, annotations, sequences of selection, etc.
- managing "objects" on the desktop by a set of tools, offered by the browser; therefore, information is no more the final result of a procedure usually just performed elsewhere, but a semimanufactured product to be directly elaborated, arranged, commented, integrated, depending on users' needs, background, abilities, objectives, etc.
- modifying offered tools or building new ones (no designer nor

conceptual model can foresee all the future necessities)

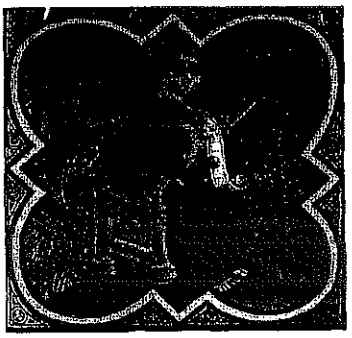
This paradigm is particularly attractive in the field of popularization and fruition of the cultural heritage, with its constraints of geographic distribution, its access and conservation requirements, and, at the same time, its constant and intrinsic impulse to personal research, investigation, creativity. It requires, however, a reflection on the meaning and role of 'documents' in the digital world.

THE ELECTRONIC DOCUMENTS

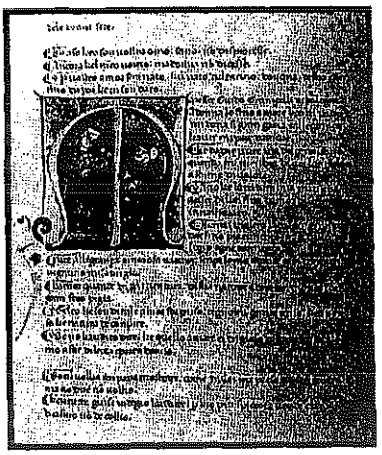
The concept of document, which is fundamental for information professional, is no more easily defined in the electronic publishing perspective. Electronic documents are manipulable, linkable, searchable, and these characteristics are unusual in the traditional documents. A new definition must be found, such as: *document is a unit consisting of dynamic, flexible, non linear content, represented as a set of linked information items, stored in one or more physical media or networked sites; created and used by one or more individuals in the facilitation of some process or project* [10]. Within the above definition, by example, also bibliographic descriptions; paratextual characteristics (glosses, notes, etc.); metatextual characteristics; arrangement annotations, call numbers, etc. may be viewed as a unique document together with the information (books or other) to which they are related. Furthermore also display requirements and information structure are essential parts of the electronic document representation. The example in figure 1 illustrates the idea of a cultural object as composed of many pieces of knowledge, which must be suitably represented as far as digital format and representation metaphor.

The example considers material related to a Codex of the XIII Century, such as images, images of texts, their transcriptions in Ascii formats, and also videos, sounds, voices, etc. having one or more structure, one or more display representations, many links to other pieces of the same cultural object or to other objects.
Other related information is: context descriptors; searching constraints and requirements (in the content, in the structure, in some sections, etc.); instructions to aggregate and represent information in significant ways.

Illustrations (image format):



Original texts (image format):



Transcriptions Of The Original Texts, Such As:

MADONNA, IL FINO AMOR CHED EO VO PORTO
mi dona si' gran gioia ed allegranza
(ch'aver mi par d'amore)
che d'ogni parte m'aduce conforto,
quando mi membra di voi la
'ntendanza,
a farmi di valore,
a cio' che la natura mia me mina
ad esser di voi, fina,
.....

Bibliographic Information (with structure):

Document Id: Canzoniere Vaticano Latino 3793
Reference: Letteratura italiana, diretta da A. Asor Rosa
Le opere. Vol I. Dalle Origini al Cinquecento
Publisher: Torino, Einaudi, 1992

Figure 1: An example of document as a cultural object

XML AND THE CONCEPTUAL MODEL

XML (eXtended Markup Language), the W3C recommendation for structured data on the Web, is a suitable solution to consistently build a virtual desktop for above documents, and separates display concerns from the content, which is mandatory to reuse data in different navigation environments without replicate them [12].
However, XML calls for a precise, a priori definition of the markup items (tags) for each document (or set of documents) to be created: it is the Document Type Definition (DTD) which states the valid elements and attributes and their constraints [8]. The creation of a DTD is usually naif, mainly based on the personal experience and background of the developer, whereas it must be considered, in our opinion, a complex process.
The following piece of text illustrates some examples of the troubles usually met in tagging a document in the cultural heritage field.

> Il Vaticano Latino 3793 (V) e' il più ricco dei canzonieri duecenteschi (sec. XIII), contenendo 999 componimenti, a differenza di L (Laurenziano Rediano 9), che ne conta circa 430, e di P (Banco Rari 217) con 180 testi. [.....] Della straordinaria importanza di V si accorse l'erudito marchigiano Angelo Colocci (1474-1549), che lo commentò, realizzandone una copia integrale, ...

The range of dates 1474-1549, for example, may be associated to three different events: the life of Angelo Colocci; when the Codex was commented; when it was copied.
A possible tagging choice like <life_time>1474-1549</life_time> is therefore a simplification as tags should take into account multiple layers of significance. As far as the time in which the Codex was assembled, it can be identified in the first sentence by the terms "sec. XIII", but also by the adjective "duecenteschi": the choice of tagged terms is not, in this case, trivial as it may have a deep influence on searching the document.
In our opinion, the complexity of

modelling such documents, identifying all objects involved in the applications, calls for trusted design methodologies, such as the Entity-Relationship approach (E-R), to describe the 'universe' of the application [5]. Furthermore, once the objects of the application have been recognized, they have to be described as far as content (and sometimes their structure), in a way suitable to be matched with users' queries, thus producing the so called surrogates or auxiliary data [2]. Experience in surrogates creation may help in defining tags, to give them the role of metainformation able to represent in a less ambiguous way "knowledge" and "meaning" of the document content: methods derived from the Information Retrieval (IR) practice could be therefore suggested to increase the significance of search results [9].

If the system is designed so that XML documents have to be manipulated by specialized personnel, tag definition may be oriented to user understanding. In the following new example, the tagging model is consistent with the interests and skill of experts in the field:

> *... the basilica is mentioned for the first time already in the <dating>year 375</dating> and its importance ... The existing building almost entirely dates back to the <construction>Xth century</construction> ...*

On the other hand, markup items may be machine-oriented, if their main aim is to be automatically managed by some programs (agents, page builders, etc.), as in the following example, where tags partially lose their meaning with respect to human readers, but present richer structures suitable for automatic filtering:

> *... the basilica is mentioned for the first time already in the <item type="date" role="citation">year 375</item> and its importance ... The existing building almost entirely dates back to the <item type="date" role="foundation" >Xth century</item> ...*

From the above two examples it may be argued that there may be multiple XML documents which are referred to the same pieces of information, and IR experience is not sufficient to guide to a unique representation. This creates problems, for example, in querying, as a user query might be independent of the way documents are defined.

In the perspective of the semantic Web design, the Resource Description Framework (RDF) gives a standard way to identify, beyond all possible document structures, the 'objects' involved in the applications and their relationships [3]. In fact, the first tagged group of the two statements above results in the same RDF assertion:

> *triple (date_of_citation, religious_building, year 375)*

This type of annotation points out available resources like a subject (*religious_building*), a direct object (*year 375*), and their predicate - another resource - (*has date_of_citation*), where all labels represent Uniform Resource Identifiers (URIs) [12].

A PROTOTYAL DESKTOP ENVIRONMENT

Following above considerations, a prototypal virtual desktop has been developed to allow access to

hypermedia documents regarding an ancient Codex. The aim is to test weather this environment presents advantages with respect to a traditional HTML hypermedia application (from the user point of view), in which the generic interaction process traditionally comprises the following steps (not necessary in consecutive order):

1. accessing to an information node;
2. reading or viewing or listening;
3. activating an available tool offered by the host;
4. accessing to new nodes by selecting available associations;
5. performing again one or more of the actions from 1. to 4.

However, the interaction process is influenced by the particular purpose of the application: the interface must enable the user to interact in a suitable way (with respect to her mental schema), by suggesting various associations and adequate metaphors (with respect to the user requirements and to the digital format of the data). In the particular case of the relation user-library a possible process (once a user profile has been identified) could be:

1. to identify a subject and a period: by example the Italian literature of the Middle Age;
2. to obtain the lists of available objects regarding the selected choices;
3. to select and display an object of interest: by example the text on G.Guinizzelli;
4. to inspect available associations as far as type and metaphor;
5. to follow one or more associations;
6. to search for objects related to a particular subject;
7. *to add annotations;*
8. *to establish new associations;*
9. *to modify some object by elaborating its forms and contents by means of offered tools;*
10. *to compare objects;*
11. *to arrange objects on the desktop;*
12. *to build user-tailored paths;*
13. *to save new material;*
14. to perform again, if necessary, some or all the previous processes.

The steps 1.-6. correspond to available actions in a traditional Web application; the 7.-13. are feasible (by a user and in the Web) only with browsers allowing modifications by users.

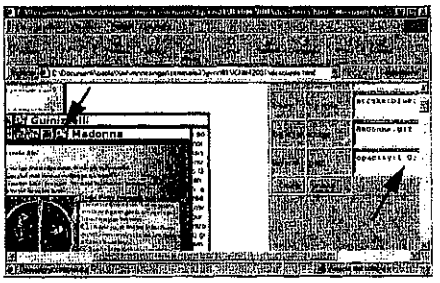


Figure 2: In the desktop space more windows are open; the arrow on the left points to the buttons and in particular to the editor; by the editor the user may change the opacity value (see the arrow on the right) of the image in the red square to increase readability

The prototype presents to the users a rectangular space, the virtual desktop, and some menus, allowing to select available tools and pieces of information. They appear on the desktop as windows (see figure 2) that the user may close, reduce to an icon, move in the desktop space, put forward-backward, duplicate, by using buttons on top of the window itself. The button next to the window title activates an editor: depending on contained data and user's permissions, the editor allows to

modify the content of the forward window or its display form. All these tools correspond to the points 9. and 11. of the second list above; also operations like 7. and 8. become possible.
More than one window may be contemporary present on the desktop, in accordance to point 10. A "tools" menu contains, for some users, a "save" facility, in order to save on the local/remote archive data elaborated by the user at the browser side (see point 13.).
Within the text, hotwords are in blue (in figure 3, "i modelli poetici siciliani"). They indicate source anchors that, once clicked, may show to the user a set of possible choiches such as, in the figure 3, "biography" (a text), "iconography" (an image), and "history" (an URL to another site). The destination content may be different, like in the example, or may present the same content under various metaphors or reproduction media.
An example of content modification suitable to the user purposes is illustrated in figure 2. "Madonna", i.e. an image, is accessed: by clicking on the editor icon (see the green arrow on the top left), the user may change the opacity value (see the purple arrow on the right) of the image within the space enhanced by the red rectangle so that characters in its background may be clearly read.
The prototype shows the feasibility of some of the facilities listed above for new hypermedia applications in the cultural heritage field. It is important to remember that the effects of the user dialog with the application are, in most cases, limited to the browser side, having no effects on the content and organization of the materials stored on the server (unless the user is an authorized one).

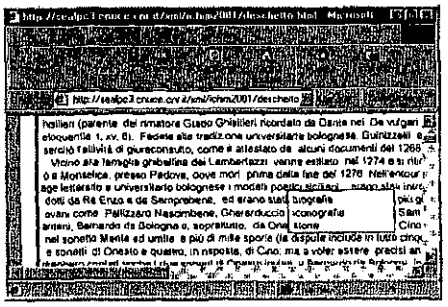


Figure 3: A single source anchor corresponds to more choices to different destinations

In this application development the SVG standard has been adopted: proposed at the end of '99 (and now at the stage of recommended candidate). It represents vector graphic on the Web, and produces many advantages with respect to similar proposals and approaches: it agrees with the 'open source' principle of Internet; it is XML; it is highly and carefully documented; it allows to identify and to group objects helping modification, transformation, animation, and accessibility; it is fully compliant with the DOM (Document Object Model) [12] and proposes a wide set of events, methods and properties to improve interactivity and programming; it is an ASCII, not a binary format, thus allowing to associate meta-information directly to objects or object parts.
The overall metaphor presented by the prototype interface is windows-like (as far as both display and behaviour of active elements, of windows, icons, buttons, etc.) which is extremely diffused and avoid interpretation and training problems by the users: however, SVG [12] is apt to design interfaces following more expressive metaphors.
As regards our application SVG allows:
a) to build metaphors for the retrieval of

textual or non-textual formats in a homogeneous way [6] (for example, parts of an image can be accurately addressed and their properties modified (see the example in figure 2);
b) to render the same XML fragment of information under different perspectives (for example, a poetry to be read - text - or listened - played -);
c) to let user modify display properties, content, position of the retrieved information;
d) to design and develop objects to be programmed also at the client side;
f) to execute all above operations, and many others, not in a closed application developed by proprietary binary software, but on the Web by means of standard browsers and open source software.

CONCLUSIONS

Whereas in traditional hypermedia applications on the Web the user usually maintains a static role with respect to the content creation and manipulation, in the virtual desktop the man-machine interaction is based on the contemporary availability of more tasks corresponding to different paths and/or metaphors: the user may choose and follow one of them, then suspend to perform a new task, resume the first one and so on, in an asynchronous fashion; in this way it is possible to strengthen user interactivity. In this perspective the user may be 'creative': the complexity of such an application is so increased because the reader is able to self-tailor content.
Recent XML technologies allow to extend to the Web, in an open software environment, the design and development of interfaces following the paradigm of the *virtual desktop*.
The risks of the well known hypertext drawbacks of "cognitive overhead" and "to be lost in the hyperspace" are however increased, as they are associated to the degree of freedom allowed to the user. Therefore design issues become particularly important for the development of robust, reusable, reliable structured hypermedia applications, that is applications having a coherent information structure both at logical and presentation levels, resulting in a regular, consistent, and predictable navigation environment. Also system controls on users' actions are needed to keep the integrity of the application. It is wise, for example, to maintain separation of pieces of information from links to easy check and avoid the user generation of dangling, inconsistent or duplicated links [7]. Also navigation tools must be emphasized in terms of context recognition, backtracking, etc.
The aim of this contribution, however, is to give prominence to users' role in interaction with hypermedia applications on the Web.

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