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Heritage Using New Information and
Communication Technologies**

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Recovering Brazilian Indigenous Cultural Heritage using New Information and Communication Technologies

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Abstract. The objective of this paper is to discuss the new demands imposed on museums, the possibilities to achieve them using new Information and Communication Technologies (ICTs) and to propose a platform to meet these requirements. The platform will provide services to the external public, the museum staff and researchers. The artifacts to be collected and interpreted will belong to Brazilian indigenous culture.

Keywords: Information and Communication Technologies; Web 2.0; social networks; cultural heritage.

1. Introduction

The traditional missions of the museum are to collect, preserve and interpret a collection of historical objects. However, today, museums are facing new demands, a world with fast changes, and technological pushes that can facilitate achieving these missions and maybe others.

With respect to indigenous cultural heritage, Brazilian museums have not still accomplished the three traditional missions. We have few museums, the collections are scattered around the country either in museums or private institutions, most of their objects are unidentified and broken into pieces. The history and culture of many indigenous peoples are lost to their own descendents and to the majority of Brazilian people. In spite of all these problems, we believe that technology and much effort can put the pieces together and bring back some of the history of the last centuries for the Brazilians of today.

Some of the recent efforts, in Brazil, have been towards patrimonial education, diversified interpretations of cultural objects and organization of archaeological parks as described below:

- Patrimonial education can disseminate knowledge about cultural and historical objects to a broader public, foster patrimony preservation and (valorizar) appraise local cultures. Education is a powerful weapon against the destruction and sack/plunder of archaeological sites and artifacts that are still common practices in Brazil. The Brazilian museums Emílio Goeldi (Morais 2008) and The Archaeological and Ethnographic Museum of the University of São Paulo offer many educational programs to schools and others.
- Diversified interpretations of objects allow a pleasant apprehension of the uses, practices, beliefs and rites associated to the exposed objects (Menezes, 2004:90-92). Museums can become a space to promote community identification and cultural diversity respect (Vasconcellos, 2004).
- Archaeological parks have not only cultural and archaeological importance but can also contribute to tourism and environmental preservation (Velos e Cavalcanti 2007). They aim at preserving and exposing a site *in loco* to public

visitations. Other effects from their organization can be quality of life and economical development of the surrounding population (Tresseras, 2005) and making Archaeology a more significant experience to a broader public (Bonanno, 2004). Velos e Cavalcanti (Velos and Cavalcanti, 2007) give examples of successful parks.

The objective of this paper is to discuss the new demands imposed to museums, the possibilities to achieve them using new Information and Communication Technologies (ICTs) and to propose a platform to meet these requirements. The paper is organized as follows: section 2 presents new demands, section 3 discusses available informatics technologies, examples of the use of these technologies in some museums are presented in section 4, a support platform based on Web 2.0 to attend the discussed demands is proposed in the following section. Section 6 closes the paper with contributions and future work.

2. New Challenges

New demands and possibilities for worldwide museums and their public have been identified in the International Cultural Heritage Informatics Meeting (Bearman 2007). Some of them are listed below:

- Museums lack space to display their whole collections. To make all the collection visible, museums usually provide public tours of their storage facilities, temporary exhibitions, rotation of objects, or, more recently, virtual exhibitions on the Web.
- Objects have to be linked to historical and social contexts that evolve over time with the research conducted by experts such as archaeologists, historians and others. Information involving these contexts can be spread in different institutions, public spaces and archaeological parks.
- Museums have to serve many different groups of people such as immigrants, youngsters and students, and a growing number of visitors with the increase of worldwide tourism. This public may have different languages, background and disabilities. The challenges include to communicate with them successfully according to their needs and interests.

- Visitors do not expect or read a large amount of information about objects in exhibitions. It is more appropriate to allow information exploration by each individual to offer fun and the knowledge each visitor is interested in.
- Museums have been questioned about the legitimacy of the ways their collections were obtained. They are being asked to repatriate artifacts to native communities and to countries from which their collections were obtained sometimes during war or by theft.
- Cultural institutions are receiving lesser shares of support from a traditional single patron – either the government, a foundation or private donors, and are expected to earn more of their operating costs.

New technologies could assist museums in meeting these expectations. For example:

- Online specific hardware and software can reach easier the young, new immigrants and the disabled online.
- They can integrate the information spread across many institutions providing interoperability and creating a historical or social context composed by many artifacts belonging to different institutions.
- Objects such as buildings, public spaces and monuments can make part of a context together with museums collections.
- They can promote different learning styles and local culture.
- They can provide personal richer and fun experiences by interactive multimedia. Interactive tools can allow a person's communication with the museum and other people sharing his/her experiences and opinions.
- Information bring by people can be selectively chosen to enrich museum information.
- Community-based social tagging and annotation are helpful in programs to alleviate tensions between the museums and the communities from which their artifacts came.
- Broadband enables rich forms of online tourism and wireless networks can enrich physical tourism and interpretation.

- Location-aware services can bring people museum content and knowledge where they are without requiring them to come into the museum's space.
- Museum knowledge bases can be sources of valued information, providing potential new ways to obtain more revenues to cultural institutions.

Nowadays, many museums have a collection database and Web pages. The most common ICT applications are Web sites allowing users to obtain information about museums and their collections or, in more sophisticated applications, to browse among the exhibits through a virtual environment. However, cultural heritage is no more considered a set of isolated objects, stored in museums or collections. Rather, objects have to be connected to additional information concerning specific historical and social contexts. Such information evolves over time to reflect new discoveries by researchers (Valtonia and Bertino 2007) and interactive participation by visitors (Salgado 2008). Moreover, information should be presented at different levels of detail and should support personalized tours (Aroyo et al 2007) and information discovery by users (Valtonia and Bertino 2007). The next section discusses how technologies can help museums achieving these new goals.

3. Available Technologies

Technologies such as World Wide Web, Internet, wireless networks, mobile devices, virtual reality, knowledge management can help museums to deliver information in new, more varied and interesting ways.

3.1. Data Digitalization

Cultural institutions have started to digitalize their artifacts, saving a digital representation of artifacts and also some metadata that describe their context. These data can be used by knowledge base systems to help researchers and museum staff in their work and to present more interesting information about collections to the external public.

3.2. Web 2.0

The Semantic Web (Berners-Lee, 2001) allows the Web to be used not only by humans but also by computer programs. The outcome of this innovation is the development of new applications that can benefit from distributed and aggregated data. The key technological support to do this is the RDF data model (<http://www.w3.org/RDF/>). This model considers as an atom of information, a statement that contains a source node, a property arc and a target node. At least the first two must be identified by URIs.

The Semantic Web vision also relies on knowledge formalizations known as ontologies. An ontology is a specification of a conceptualization (Gruber, 1993). It can be viewed as a conceptual model that has logic formalizations which rigorously describe the world. The Semantic Web can integrate heterogeneous data across the Web associating concepts of the real world - which may have or not digital representation - with URIs. It is possible to create a network of concepts through the Web. This model, also known as the Web of Data, allows the Web to be used not just as a set of documents interrelated through hyperlinks, but also as a semantic network of concepts.

Web 2.0 technologies (O'Reilly, 2005), such as blogs, discussion forums, social networks and wikis, have enhanced the interactivity and user-generated content on the original Web proposal by Berners-Lee (Berners-Lee, 1999). Blogs allow individuals to produce a diary of items in reverse time order, in which readers can add comments. Discussion forums offer opportunities for democratic discussions about different subjects. Social networks help individuals to participate in groups based on the same interests, to interact on-line and to share media. Wikis allow users to generate content cooperatively by easily updating Web pages.

Web 2.0 technologies provide new ways to interact with museums and to participate more actively in museums activities (Salgado 2006, Salgado 2008) by commenting on blogs or wikis, tagging, bookmarking (Filippini-Fantoni and Bowen, 2007), sharing images, videos or photos, interacting via social networks, personalizing museum tours (Aroyo, L. et al, 2007) (Samis and Pau, 2006) and others. Wikis and social networks are below.

Wikis

Wikis (<http://en.wikipedia.org/wiki/Wiki>) can be a helpful instrument to aid collaboration between users involved with museums. They provide facilities for a group of users to create and to update Web sites easily via a Web-based interface (Ebersbach et al., 2006; Bowen, 2006, Bowen 2008). The group having allowed access to a certain wiki can build knowledge in the set of interlinked pages constituting this wiki (Thomas et al., 2007). Wikis can be used for educational and professional (Mader, 2008) purposes. The on-line encyclopedia Wikipedia is the most famous wiki where many museums are already present (<http://en.wikipedia.org/wiki/Category:Museums>). Two of the free software systems for implementing a wiki are MediaWiki (<http://www.mediawiki.org>) used by Wikipedia and TWiki (<http://twiki.org>).

A general Museums Wiki has been established using the Wikia facility (<http://museums.wikia.com>). The Museums Wiki is intended for museum-related material that is too detailed for inclusion on a more general wiki site like Wikipedia. It was established in 2006 (Bowen et al., 2007).

Museums can produce educational wikis (Mader, 2006; Wang & Turner, 2004; Richardson, 2006) to carry out projects about their collections in cooperation with schools. Another option is to install wiki software directly on a museum Web page. This gives the museum more control over the wiki and integration with the other museum pages. A museum wiki has to offer usability, to enforce access rights for distinct users such as staff, external public and others, and to provide measures against vandalism.

Social Networks

A social network consists of nodes (representing individuals or organizations) interconnected by one or more specific types of relationships as friendships, interests, preferences, among others. The network is responsible for sharing ideas among people who have interests and goals in common, and also values to be shared.

Social network sites have attracted millions of users. One example is Facebook (www.facebook.com) that started in 2004 and now has over 63 million users. On Facebook, network site administrators and other users have personal profiles, featuring information about themselves and clearly identifying what roles they play at

the network. In 2007, Facebook opened up its architecture so that any developer could create applications for the site and share with other users. This facility made Facebook unique among social networking sites. Another change, in 2007, allowed an organization or institution to create its own page. Within the open application structure, the institution's administrator can install required applications to make the organization's page more suitable to its goals and users.

For museums, social networks open more opportunities for members and external public to get more information about the museums and their activities, to give opinions and ideas, and to create new forms of public participation in museum exhibitions (Salgado, 2006). Roberto (Roberto, 2008) argues that exhibitions are good candidates to attract visitors' participation in museums networking sites.

3.3. Virtual Reality

Virtual Reality (VR) (Mosaker, 2001) techniques allow one to reconstruct and render complex three-dimensional models. However, VR applications require in most cases specialized hardware or accessories such as high-end graphic workstations, stereo displays, gloves or 3D goggles.

3.4. Panoramic Images

Panoramic images allow the visualization of information according to a certain context and the creation of customized tours. They help integrating information belonging to different institutions and presenting additional knowledge. The integration of heterogeneous data is obtained by using ontologies describing the relevant concepts of the domain. Panoramic images can be displayed through Web interfaces or by totems in real museums. Panoramas are used in many domains but mostly in cultural heritage (Zheng et al, 2003)(Pan et al, 2004; Horry et al, 1997; Nakano et al, 2004) to show city tours, museums, landscapes and archaeological sites. Compared with Virtual Reality techniques, panoramic images only require a browser and an Internet connection.

Another form of using panoramas is through hotspots (Hoeben & Stappers, 2006) where users can click active areas of the panorama. The activation triggers the presentation of some media or another panorama.

Panoramas are still used in a limited way because they are not integrated with the rest of the information typically available at Web sites or database technologies

(Valtonia and Bertino 2007). In spite of that, Valtonia and Bertino (Valtonia and Bertino 2007) believe they can become a new medium in the cultural heritage domain if the interaction with information is facilitated. For this, they propose:

- The notion of semantic hotspots which dynamically link regions of a panorama with the information stored in data sources.
- Customizing visits according to the users' interests and the meanings of the elements in panoramas.
- Enhancing the information presented in a panorama by guiding the attention of the end-users to the elements which are more relevant to a specific theme. For this, they introduce a methodology based on narration. A narration is a description of a story or an interpretation of available information. It can be used by domain experts to connect semantic hotspots in panoramas. These semantic connections create a context that is a customized presentation of the cultural heritage information.
- Creating a knowledge base for the computerized collection providing organization and retrieval of knowledge. Concepts and their relations are captured by ontologies. These ontologies integrate heterogeneous data and form an architecture of concepts representing the information in the domain. The ontology schema is enriched with a new class called "Narration" that contextualizes data in a novel way.
- Allowing contexts and narrations to be added to the knowledge base dynamically.

4. The Use of Technologies by Some Museums

This section describes the use of technologies by some worldwide museums.

Emílio Goeldi Museum, Belém, Brazil

The Emílio Goeldi Museum in Brazil was founded in 1895. It has three bases: two of them are located in the city of Belém, Pará, and one in the National Forest of Caxiuanã. The museum has collections of archaeological artifacts of many indigenous peoples and a Zoobotanic Park with collections of the fauna and flora of the Amazon

forest. Moreover, it is a very active center on research in many areas such as Botanic, Zoology, Human Science, Ecology, Geology and Archaeology, and educational programs involving local communities. Its collection has 110,800 registered items and 1,800,000 to be registered. Most of the collection consists of ceramics artifacts.

The museum through its Web page, <http://www.museu-goeldi.br/>, makes available information about services, events, virtual tours in the Zoobotanic Park, educational programs and a virtual school about Amazonic subjects.

Archaeology and Ethnography Museum of the University of São Paulo, São Paulo, Brazil

The Archaeology and Ethnography Museum (Museu de Arqueologia e Etnografia – MAE) was founded in 1989 and has about 120 thousand pieces. Its collection comprises Mediterranean and Middle-East Archaeology, American Archaeology with emphasis on Brazilian Prehistory, Brazilian and African Ethnography. The museum concentrates its efforts on research, restoration and education.

MAE has a Web page, www.mae.usp.br, with information about the museum and some photos of its collection.

Amersham Museum, Amersham, England

The Amersham Museum Wiki (<http://amershammuseum.pbwiki.com>) was set up in 2007 by Amersham Museum (Bowen 2008), a small local museum in southern England. The aim of the wiki is to allow those with knowledge of the history of the town of Amersham in Buckinghamshire, especially of its buildings, to contribute information and images.

Newark Museum, New Jersey, USA

The Newark Museum, has its own wiki on its Web site (<http://www.newarkmuseumpr.org/mwiki/>), based on MediaWiki technology (Bowen 2008). Any visitor can view the pages, but users must register to create or edit pages. The wiki includes resources associated with a contemporary photography and video

art exhibition (September 19, 2007 - January 6, 2008), *India: Public Places/Private Spaces* (<http://www.newarkmuseumpr.org/mwiki/?title=India>). However, many of the pages on the wiki are not relevant to the museum, showing that it is necessary to control information entered by external users.

Canada Science and Technology Museum Corporation, Canada

The Canada Science and Technology Museum Corporation operates three of Canada's national museums: the Canada Agriculture Museum, the Canada Aviation Museum, and the Canada Science and Technology Museum. The Corporation's Membership Program (Dawson et al, 2008) is one of the most successful means of identifying a base of clients who contribute significantly to its attendance and revenue targets. The Membership Program is still in its early stages of utilizing social media to attain its marketing and communication goals. Within days of the first mention of the Facebook Group, in the Summer 2007 edition of the Membership Newsletter, 35 individuals signed up to the Group. In January 2008, that number has more than doubled to 79 individuals with little to no advertising. Group members are posting comments for open discussions, posting photographs they have taken during museum visits, and reading information that may lead them to or enhance an onsite visit.

Museum of Fine Arts, Boston, USA

The Museum of Fine Arts made its collection of more than 350,000 objects available on-line (Fleming, 2008). The Museum provides both a searchable collection database and specific collection tours which allow for a more selective and guided experience. Data integration and visualization is achieved using Visualizing Cultures (<http://visualizingcultures.mit.edu>). This platform developed by MIT enables scholars, teachers, and others to examine large bodies of previously inaccessible images and to compose original texts with unlimited numbers of full-color, high-resolution images.

Visualizing Cultures has negotiated with many institutions on-line publication of images for educational purposes using a commons license. Visualizing Cultures offers a growing number of titles, referred to as "units." The content of a unit includes an essay and images, the visual narrative that expands themes from the essay, and other media components (video, animation or interactive content). This first

pioneering set of units visualizes diverse aspects of Japan in the modern world. Units in development move into China and beyond.

The Visualizing Cultures project is based on standards produced by the Open Knowledge Initiative (OKI - www.okiproject.org), a consortium of MIT, Stanford and other institutions. The Initiative develops and promotes specifications that describe how the components of a software environment communicate with each other and with other enterprise systems by defining standards for Service Oriented Architecture (SOA). Another work by J. Paul Getty Trust, Categories for the Description of Works of Art (CDWA) Lite (http://www.getty.edu/research/conducting_research/standards/cdwa/cdwalite.html), may become a popular XML schema for facilitating museum data exchange. The CDWA Lite schema has only nine required elements. This reduces the burden on an institution when mapping data from its collections databases to the schema. Although with a reduced set of core elements is still enough to enable meaningful discovery information.

Museum of Archaeology of Milan, Milan, Italy

This museum is using a Hyperstory Authoring Tool, called 1001stories (Bolchini 2007), that captures the essential features of multichannel hyperstories and can be customized to produce a specific hyperstory. This framework addresses:

- translating conceptual narrative structures into a suitable interactive format,
- filling these structures with multimedia contents, and
- delivering the resulting hyperstory on different channels.

1001stories includes a suggested workflow for building a hyperstory in an efficient way and a set of content production suggestions for the development team. The information architecture of hyperstories is a simple tree-like structure composed of the following predefined node types:

- *Cover*, which acts as “Home” and introduces the story;

- *Ancillary Information*, which may contain arbitrary information about the story (e.g., about authors, the development team, institution, sponsors and others);
- *Story Topic* (*Topic* for short), which represents a “piece of a story” of any semantic nature, depending on the application domain (e.g., describing facts, persons, events, places, objects and so on); and
- *Story subtopic* (*Subtopic* for short), which denotes a sub-subject of the related topic.

The content format of each node type is pre-defined for each delivery channel. On the stationary channel, for example, a Topic or a Sub-Topic is composed of a title, a subtitle, a descriptive text, an audio narrative and a dynamic visual media object – a sequence of images, a (2D or 3D) video, or an animation – synchronized with the audio narrative. The audio and the dynamic media start playing automatically when a user enters the corresponding Topic or Subtopic.

There are three types of navigation links (Garzotto 1999):

- *Index*: from a node to each node in a group of nodes, and back
- *GuidedTour*: sequential bidirectional navigation
- *Automatic Guided Tour*: forward sequential navigation in which the activation of the “next” link is triggered automatically by the system.

An example of 1001stories use is in the hyperstory called “Milano Romana Tecnologica” (i.e., “*Milan* at the time of the *Roman* Empire presented through *Technology*) built by students in a primary school (Garzotto and Paolini, 2008).

MuseumFinland Portal, Finland

MuseumFinland (Hyvönen et al., 2005; <http://www.museosuomi.fi/>) is a semantic portal for publishing heterogeneous collections. It makes extensive use of Semantic Web technologies. One of the main contributions of this work was the idea of differentiating the syntactic interoperability from the semantic interoperability. The same group has recently made interesting contributions on how to model relevant content of cultural heritage using events and situations.

Brooklyn Museum, New York, USA

The Brooklyn Museum Information Systems department created ArtShare (<http://www.facebook.com/apps/application.php?id=7723691927&ref=pr>), an application that allows Facebook users to select works of art from the museum collection (Bernstein, 2008). This application is also available to other museums and artists to share their own collections or art work. The Museum Facebook page is designed so that visitors can easily interact with all the available features directly on the page.

The applications available on the Facebook page are the following:

- Wiki: the museum wiki provides up-to-date academic information. Scholars are invited to contribute to the entries in the museum Wiki by e-mailing the museum to gain access.
- Rich Site Summary (RSS): RSS is a format for delivering regularly changing Web content to subscribers. Available feeds now include Exhibitions, Blogs, Podcasts, Events, *Target First Saturday* schedules, Press Releases, and more.
- Blogs: the various blogs were integrated into the museum Web site (<http://www.brooklynmuseum.org/community/blogosphere/bloggers/>). Readers can follow the subjects in which they are most interested using a number RSS feeds. The blog provides feeds for a wide range of subjects and authors, and for categories such as *Rarely on View*, *On Loan*, *Recent Acquisitions*, *Architecture and Planning*, *Egyptian Art*, *Technology*, and others. Information is thoroughly vetted, like any other official publication from the museum; but the blog allows direct communication from staff. Staff members' posts are written on the blog and retain each author's identity with a small picture and short biography. Tags integrate posts with appropriate exhibition pages on the site.
- Flickr: for each Flickr group, there is an account in addition to "Brooklyn Museum" where the person is identified as an employee of the Museum and link to his posts on the Museum blog. Then Flickr users can get to know the person behind the Brooklyn Museum profile. In addition, any time a visitor

makes a comment or a staff member answers a question, the author's name appears. Photographers can upload their own photos to a Flickr group related to a certain topic. Participants can submit only one photo to the group, the Brooklyn Museum's curator of photography reviews users' submissions and selects a few to discuss on the museum blog during the run of the exhibition.

- YouTube: the museum began sharing videos with the community using the video-sharing Web site blip.tv (<http://brooklynmuseum.blip.tv/>). They chose to do this because blip.tv permits unlimited file size and length. This allowed the museum to host a single video rather than, splitting a long artist's talk in half, as it would be required on YouTube, for instance. The Brooklyn Museum had a YouTube profile (<http://www.youtube.com/user/BrooklynMuseum>) in addition to the one at blip.tv, but the material did not capture much of an audience. In order to increase audience, the museum created a contest in which participants could upload their videos in their own personal YouTube accounts. The museum linked the submissions on the museum Web site using YouTube playlists (http://youtube.com/view_play_list?p=77760CA9EE2ED053) and standard embed code, which allowed for easy identification of the participants and also ensured that the view count for each video would be featured on the contributors' personal profiles. The videos submitted for the competition were viewed four to five times more than anything else previously posted on YouTube.
- Electronic Books: The permanent collections have wall labels featuring visitors' responses to some works of art - they call these "Community Voices." Visitors are invited to create written responses to objects, and their comments are subsequently mounted next to the work on view. The museum extended this idea to the Web by replacing paper comment books with electronic comment kiosks in special exhibitions. This ensured that visitors' comments would be visible both in the gallery and on the Web site. Comments can also be submitted directly from the Web site (http://www.brooklynmuseum.org/exhibitions/brushed_with_light/). For the museum, the advantage is that electronic books make it easier to review visitor feedback in real time as opposed to slowly circulating paper comment books

after an exhibition's closing. For the visitors, electronic books can enrich their personal experience viewing how others are interpreting exhibitions and objects, and, possibly, engage in conversation.

- Cell phones audio: existing audio tours for some exhibitions were migrated to the new Guide By Cell system. In addition to cost-cutting, cell phones have allowed visitor feedback immediately. Visitors can record comments at any time in the tour. In this way, the visitor is given a voice, similar to our "Community Voices" labels and the electronic comment books.

Etruscan National Museum of Tarquinia, Italy

Computer scientists and archaeologists of the University of Milano have collaborated to create an interactive panoramas system for the dissemination of Etruscan heritage spread in several European museums. For this, they propose a knowledge base integrating heterogeneous data sources using ontologies, panoramic images, semantic hotspots and narrations (Valtonia and Bertino 2007). These notions were previously described in subsection 3.5.

The semantic model for the Etruscan ontology has been derived from a well-known cultural heritage ontology, the CIDOC Conceptual Reference Model (CRM). CIDOC/CRM was defined by the CIDOC Documentation Standards Working Group and CIDOC CRM SIG. It is intended to promote a shared understanding of cultural heritage information by providing a common and extensible semantic framework that any information can be mapped to (Croft et al 2006). It consists of 132 properties that associate the 81 discrete concepts. This model was specialized in order to develop an ontology specific to the Etruscan culture. One of the extensions was adding a new class called "Narration" to representing the new notion of narration created in this project.

Besides representing the knowledge base structure, the ontology is also used to integrate and support access to information from heterogeneous data sources. The integration is carried out by expressing the elements defined in each logical schema in terms of the classes forming the ontology and of a proper a set of mapping information. This means that each entity defined in the database must be associated

with an Etruscan entity class expressing the same semantics. Once such a relation has been established, all the entity's attributes must be mapped as well.

The notion of narration was introduced to contextualize the data in a novel way by relating different types of artifacts. It is composed by a text and a context. There are two different types of narration:

- direct narration: the text is a domain expert's interpretation of a given group of invariable and limited number of objects. Its context is defined by means of an explicit description of the relations between the text and the objects involved in it. For instance, a direct narration can concern the function of a specific trumpet as musical instrument.
- indirect narration: the text is a more general document that deals with arguments involving a group of artifacts. This narration focuses on a given topic expressing the network of relations that connect the text with the set of artifacts related to it. For instance, an indirect narration can deal with the theme of the music in ancient Etruria.

Through the use of the narrations, it is possible to connect panoramic images containing objects in several museums and to offer users a virtual visit presenting experts' knowledge and customized according to the visitors' interests. The semantic hotspot integrates panoramas with narrations. Hotspots dynamically link relevant regions of a panorama with the information stored in data sources. When the visitor clicks on a region associated with a semantic hotspot, she/he can access additional information about an artifact. When the visitor selects a narration among the ones prepared, the system extracts and highlights the semantic hotspots in the panorama which are related to the selected narration.

The described approach has been applied to develop a virtual tour available from the National Museum of Tarquinia Web site. The application is accessible both through the Web and by the multimedia installations placed inside the museum.

Summary

Museums are seeking new ways to present their collections and to attract more public. The most common way is through Web pages where people can find more

information about the museums and photos of some objects in their collections (Emílio Goeldi Museum and Archaeology and Ethnography Museum of the University of São Paulo). More interactive software such as social networks and wikis are becoming popular and attracting attention of cultural heritage institutions. The Brooklyn Museums use social networks to provide many applications such as blogs, wikis, electronic books, Flickr and YouTube. Other uses of social networks include receiving comments and photos from museum members and giving information to attract more visitors to the museums grounds (Canada Science and Technology Museum Corporation). Wikis are usually updated by experts (Brooklyn Museum) but, in the case of the Amersham Museum Wiki, local people are invited to contribute with information and images about the history of the town. The Newark Museum experience shows the necessity of controlling wikis to avoid irrelevant information to be entered. External public participation is also being promoted to enrich personal interpretations of exhibits through blogs and electronic books (Brooklyn Museum). With the goal of making visits more interesting, museums are providing personalized tours (Museum of Fine Arts in Boston with the Visualizing Cultures platform, and Etruscan National Museum of Tarquinia with panoramic images). Semantics and ontologies are being used for integration of heterogeneous information and for construction of personalized tours (Visualizing Cultures, Etruscan National Museum of Tarquinia, Finland Museum, Astudillo et al. 2008). Education is another primary aspect contemplated by distance learning (Emílio Goeldi Museum) and special programs for school based on story telling (Museum of Archaeology of Milan).

5. An Interactive and Collaborative Platform for Brazilian Indigenous Cultural Heritage

This platform consists of a knowledge base system offering services for experts in the domain, museum staff and the external public. The platform will be based on Web 2.0. The goals of this platform are:

- to integrate data from different museums and institutions. In the case of indigenous cultural heritage in Brazil, this will include also digitalization of the majority of available artifacts.
- to provide services for archaeologists to visualize artifacts in 3D, to identify and catalog artifacts, to virtually construct broken ceramics into a whole object, to

enter information about artifacts and others. Some workflows will be available for experts in order to facilitate and coordinate their work.

- to offer customized tours according to specific themes and user profiles.
- to extend a standard ontology of cultural heritage for Brazilian indigenous cultural heritage.
- to allow user selective participation in exhibits through electronic books and social networks.

The main components of the platform in their layers (Figure 1) are:

- Resource Layer: Museum repositories and metadata described in XML, RDF catalogs containing several ontologies (artifacts, circumstances, social context, and others) and user profiles storing information about a user such as age, language, educational level and previous visits,
- Service Layer : RDF Generator that generates RDF information from an institution, Workflow Selection Service, Workflow Execution Engine, Access Control over resources, Customized Tour Service.
- Interface Layer: The platform will be used by people with different educational levels and languages, experiencing different environmental conditions and/or means of access. This fact poses several challenges such as: the developers can no longer know who their target users will be, and artifacts are no longer bound to the technological specifications of a pre-defined interaction platform (Savidis 2004). In this scenario, interfaces can not be considered as static artifacts designed to well-known users. The interfaces should adapt or be adapted to different contexts of use. The proposed framework explores and improves techniques on context-aware interfaces (Moran 2001).

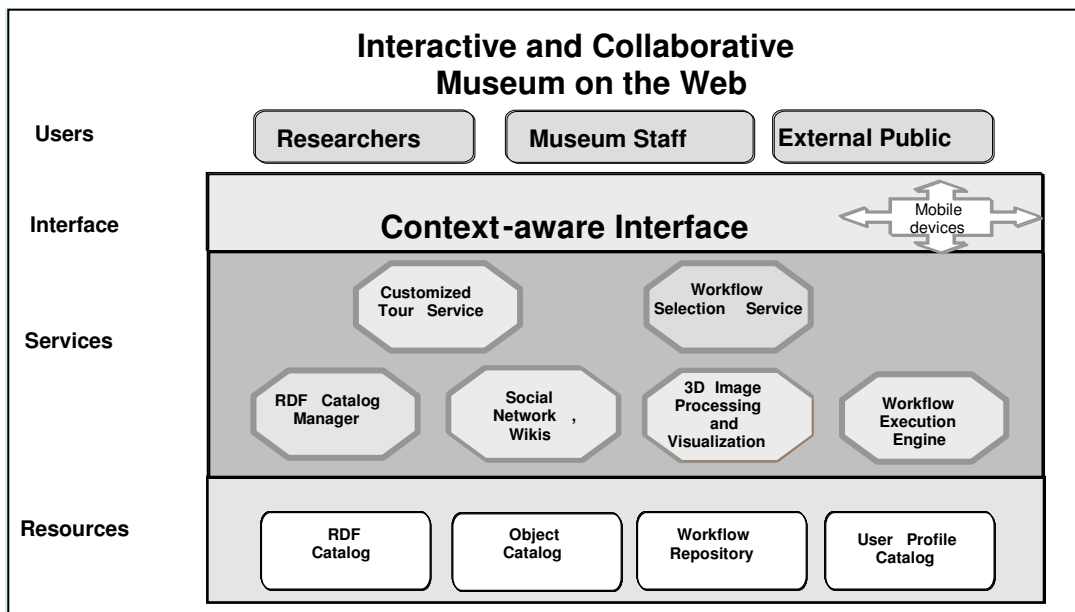


Figura 1. The platform architecture

6. Conclusions

This paper describes new challenges imposed on museums and some of the informatics technologies available to solve them. There is a special section dedicated to what museums are using today. The main goal of the paper is to propose a platform for Brazilian indigenous culture heritage scattered around many institutions. The problems in Brazil are even more challenging because most of the artifacts are not even identified and many are broken in the case of ceramics objects. Therefore the platform will deal not only with providing interesting ways for cultural dissemination but also with tools to help archaeologists and other experts to develop their work in a collaborative way.

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