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An Integrated Environment for Cataloguing and Online Presentation of Museum Exhibits

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ABSTRACT

The paper presents an integrated environment which enables museum personnel to catalogue and at the same time publish online museum exhibits. The system is based on international standards and is highly customisable to cater the needs of a variety of museum types. Moreover, the underlying database allows storing for the same exhibit documentations for different audiences and in multiple languages, while it is extendable to accommodate new media types, languages, exhibits and information categories. The administrative part of the environment permits the restriction of certain functions to specific personnel roles, enforcing thus a general museum security policy regarding access to and modification of information. The environment presented is currently in use at the Athens University History Museum.

Keywords: Museum, online museum exhibits, integrated environment, cataloguing.

1. INTRODUCTION

Museums are often regarded as organisations with a sole purpose of accumulating and preserving artefacts of cultural or scientific importance. This notion has been changing during the past decades and the profile of museums has been enhanced with educational and entertainment characteristics. Nowadays museums utilise their exhibits to educate and at the same time entertain their visitors. The advent of the Internet has given the means to museums to reach out and make contact with new audiences. The new technologies are also causing a convergence between the computing systems used for exhibition and those used for collection management[1]. Long established, large museums with the necessary infrastructure digitise and publish their collections on the web. Hermitage[2] and Louvre[3] are among an ever increasing number of museums that offer a wealth of information for their online visitors. However, for smaller museums which lacked even the basic resources for cataloguing their exhibits this was a restricted task.

To date, a number of studies have been carried out on the issues relating to developing websites in general and specially for museums. Kohrs and Merialdo[4] studied techniques for personalising content in the context of the web and tested these techniques in the context of museum websites. Takahashi *et al.*[5] described a paradigm for unified and global access to heterogeneous and distributed multimedia contents of museums, while Marucci and Paterno[6] gave an example of a museum on the web which does not disorient the user, and Hong *et al.*[7] described two methods for querying the exhibit database. Finally, Lepouras and Vassilakis[8] presented an adaptive system for virtual reality museums on the web, while Lepouras *et al.*[9] presented a distributed system for online museums.

In the framework of "Digitisation and Online Presentation of Athens University's History Museum" a project sponsored by Information Society (http://www.infosoc.gr/infosoc/en-UK/default.htm) on an integrated environment for cataloguing and online presentation of museum exhibits has been developed which caters the requirements outlined in the next section.

2. MUSEUM REQUIREMENTS

During the initial phase of the project a requirements analysis was carried out aiming to capture not only the constraints set by a History Museum curator but from other small to medium sized museums as well. To this end, experience from curators of diverse content museums was utilised ranging from zoology and palaeontology to archaeology and criminology museums. These requirements were later distilled in specifications and adopted in the environment's design.

The basic requirements derived from this phase were:

- Support for cataloguing and presentation for a variety of exhibits: The environment should be able to support the cataloguing for a range of different exhibits such as books, pictures, scientific equipment, archaeological exhibits, natural history exhibits, and art objects. Furthermore, the system should allow the use of taxonomies (i.e. systematic categorisation) which is especially useful for natural history museums.

- Support for presentation to diverse target groups: Online visitors to museums originate from a variety of educational, cultural and economical backgrounds and have different interests, educational needs, available time and cognitive abilities. To this end, the system should cater for multilingual and multicultural variations. Additionally, the system should offer the possibility to museum curators to form different, customised collections of exhibits to address the needs of diverse target groups.

- Support for museum metadata standards: Information concerning the title of the object along with a physical description, the location of the object, the availability of an exhibit for loan, conservation treatments is among the most common kept for each artefact. The museum should be able to exchange this information with other museums. To this end, adoption of international standards is of the essence.

- Minimisation of total cost of ownership: The environment should be based on open source technologies to better support extensibility and to minimise cost of acquirement. In addition, since most small to medium sized museums have limited resources and cannot afford to employ permanent IT personnel, maintenance of the website content should be easy enough to be carried out by non-IT personnel.

Based on these requirements we have proceeded with a detailed design of the underlying database and the user interface.

3. ENVIRONMENT DESIGN AND IMPLEMENTATION

The information integrated museum system employs a database for storing and retrieving all information used by both the cataloguing and the web presentation subsystems. Using a database ensures flexibility in information storage options and good performance, especially for retrieval operations, while offering possibilities for creating customised complex reports, when requested by the museum management. The database schema for the integrated museum system was created in the system design phase, and targeted the following major design goals:

(i) Full support for functional requirements: The database schema should be able to fully support all functional requirements identified in the analysis phase, both regarding the information elements that need to be stored and the queries that need to be evaluated for creating web pages and reports for museum personnel. In order to determine the database information elements, both the user requirements and international standards, including Dublin Core[10], CIDOC[11] and Spectrum[12] were considered, to ensure the widest applicability of the integrated system.

(ii) Extensibility: The database schema should be able to accommodate new media types and/or information elements with the minimum number of changes. For new media types (such as panoramas, novel 3-D model representations, etc.) in particular, it was highly desirable that they should be readily supported by the database with no modification at all, since such types emerge as new capturing devices and/or digital media formats.

(iii) Performance: The system should be able to rapidly generate web pages, both for the cataloguing and for the web presentation subsystems. Besides

quick formulation of web pages, the overall information storage and delivery architecture should be tuned to ensure that performance enhancement mechanisms, such as client and proxy server caches, could be fully exploited.

The cache exploitation consideration led to the decision that images, audio, video and other media contents would be stored on the filesystem, rather than within the database. Indeed, if images were stored within the database, they would have to be extracted from it and sent to the requesting client (i.e. a browser) in the context of a dynamic request; the default behaviour of browsers is to not cache the results of dynamic requests, thus any subsequent need for retrieving the same resource would lead to a retransmission of the same data, penalising thus the overall performance. Although certain browsers were found to honour explicit cache control specifications stating that the pertinent document (image, audio, video, etc.) could be stored in the cache and reused later on, the caching behaviour was not consistent across all browsers, thus filesystem storage was opted for. For these items, the database—instead of the content itself—stores pointers, in the form of path names.

The core database schema for storing the museum information content is depicted in Fig. 1. This core schema illustrates only the basic tables used for storing information, and is complemented with additional tables, mainly for storing various aspects of data related to exhibits, such as maintenance activities, reproduction rights, exhibit parts, material and physical dimensions, etc.

The central concept in this database schema is the *exhibit*, with each exhibit representing a distinct, self-contained artefact that is hosted by a museum. The administrative interface for entering exhibit information is illustrated in Fig. 2. As can be seen from the menu zone, information captures a number of exhibit facets, with each of them possibly related to different museum personnel and/or website visitor roles or profiles. The way information is organised in different screens serves a twofold purpose:

(i) Each portion of information is for specific role, e.g. the information related to “Reproduction” (rights and charges) is of interest only to the museum administrators and the financial department. Thus roles not interested in specific information are protected from facing overwhelming amount of information, either by simply not choosing specific links and/or by customising their workspace so as not to display certain links at all. The system administrator may enforce certain links to be invisible to specific roles.

(ii) By limiting user access to designated links, system administrators may enforce the museum security policy regarding access to and modification of information thus protecting data confidentiality and integrity. At a database level, the information

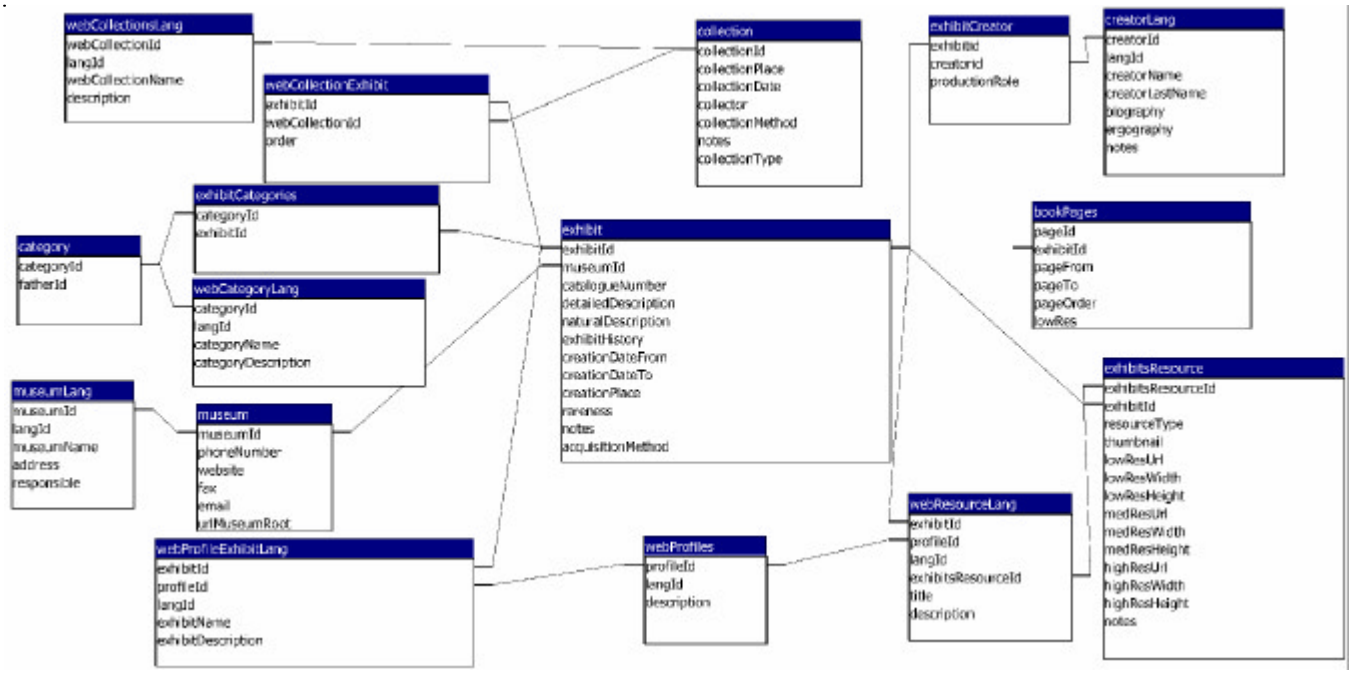

Figure 1. Core database schema for integrated museum system.

Figure 2. Administrative interface for cataloguing museum exhibits.

managed in each screen is stored in a different table: this enables the exploitation of SQL's discretionary access control mechanisms, i.e. granting data retrieval and/or modification privileges to certain users on specific tables. Database-level security mechanisms complement the access control features integrated in the management application, thus delivering adequate security provisions for most museum environments. Splitting the data across different tables does not affect performance, since tables storing exhibit information facets are typically accessed individually using the exhibit's Id as filtering criterion (which is part of the primary key in each table), thus only *selection* operations, rather than joins, are performed in the database. Reports necessitating the combination of multiple facet tables are not often executed, while the performance penalty induced in such cases due to splitting of information in multiple tables has been quantified to be less than two per cent.

Two additional issues worth noting in Fig. 2 are the *multilinguality capabilities* of the integrated system and the support it provides for *multiple profiles*. Regarding the multilinguality capabilities, the user can select the *user interface language* when s/he logs in the administrative interface. The user interface language selection affects the language in which menus, labels and messages are presented to the user. Multilingual capabilities, however, apply to the *content* entered and managed through the administrative interface. Each museum may choose the languages it wants to store and maintain in. The administrative interface provides the required facilities for managing content multilinguality: the "Language" combo box appearing in each screen hosting multilingual content may be used to switch between available languages and enter or update original content or translations in the languages chosen by the museum.

For *multiple profiles*, the museum may designate *visitor profiles* that should be available in the web portal; the default setting for available user profiles is *Researcher*, *Visitor* and *Student*, which the requirement analysis has identified as major web portal visitor groups that (potentially) need to be presented with different information. Indeed, researchers need to be presented with details which are not of interest (or even boring) to common visitors, whereas students need to be presented with specially tailored descriptions and texts, possibly edited with the aid of museo-pedagogues. Museums addressing different target groups may customise this preset. For each piece of information that is presented through the museum web portal, the administrative interface displays a distinct input area for every chosen visitor profile, allowing thus museum content providers to enter the appropriate information.

The *collection* (*webCollectionsLang* and *webCollectionExhibit*) tables provide the database underpinnings for organising exhibits into collections. One important provision made in the database design is to allow exhibits to participate in multiple collections, with each such participation possibly conveying a different *museum message*. For example, the regal decree announcing the founding of the Athens University is interpreted differently when viewed in the "Athens University History" collection than when viewed in the "19th Century Calligraphy" collection. Museum curators are therefore relieved from the physical world restriction that each exhibit may participate in a single collection/exhibition arrangement (since it has only one physical instance), and are enabled to formulate collections best suiting the museum organisation and/or web visitor needs, including exhibits in as many collections as needed. Each collection is tagged with a flag (collectionType) indicating whether the collection serves museum administration/organisation purposes (e.g. exhibition of room A, artefacts donated by a specific donor, etc.), or is crafted for presentation through the web or even both.

The concept of *categories* supported by the integrated system is an important provision for museum curators, since it provides a concise and effective means for describing properties of exhibits, while these descriptions can be used in browsing, searching and organisation activities. In more detail, categories form a *hierarchical concept tree*, with each level specialising the concept represented at its parent level. Each exhibit may be linked to any number of categories at arbitrary tree levels, associating thus the exhibit with the relevant concepts. Users (either museum staff or web visitors) are able to drill down the concept hierarchy to locate exhibits correlated with specific concepts and/or use these concepts in queries to narrow the scope of their searches. Figure 3 illustrates the administrative interface for category management, and shows selected levels of concept hierarchies created for the Athens History University Museum. At database level, information regarding categories is stored in the following tables of Fig. 1: *category* (lists available categories and maintains parent/child relationships between them), *webCategoryLang* (hosting multilingual category descriptions) and *exhibitCategories* (stores associations between categories and exhibits).

A final issue worth discussing regarding the database is the support it provides for *multiple levels of detail* supported for all multimedia resources (images, video, audio, etc.) that are stored in the integrated system. Indeed, the integrated system should store (a) digital formats with very high resolution, to be made available to researchers or even be used for reproduction purposes and (b)digital formats with low and medium resolutions, to be made available through the web (these resolutions entail files of small sizes which can be effectively delivered through the Internet, impeding also unauthorised high-quality reproduction, which infringes the museum's intellectual property rights); at the database level, storage of multiple resolutions is enabled through the provision of appropriate fields in the pertinent tables (exhibitResource and bookPages in Fig. 1), allowing for storage of low, medium and high resolutions, as well as a thumbnail for each resource. Of these, the first two are made available through the web, while the later is restricted for use within the museum environment only. Naturally, the thumbnail is used

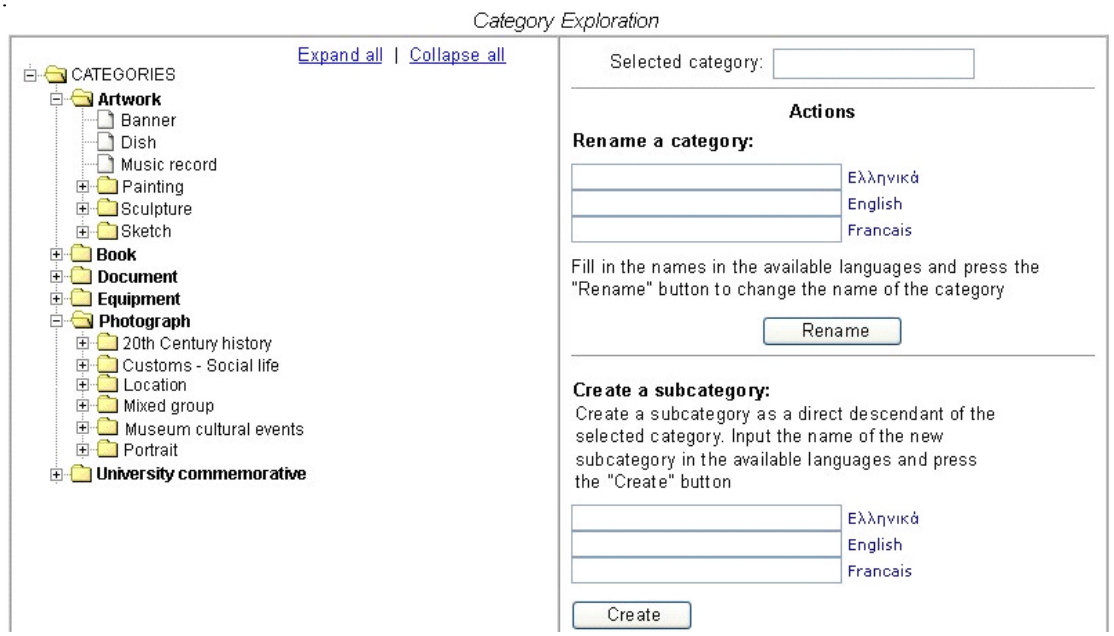

Figure 3. Administrative interface for managing categories.

for providing users with a quick visual overview of the resource contents.

As shown in Fig. 1, information regarding book pages, a special case of exhibit resource, is stored in a separate table (bookPages) than other resources (exhibitResource). This decision stems from the different information storage needs identified in the analysis phase for these resource types and more specifically:

- bookPages are strongly associated with a numbering scheme, which dictates their order in the original publication and enables the reproduction of this order upon presentation. This requirement does not hold for other resource types, which are generally unordered.
- bookPages need no additional description to that provided for the book as a whole, while generic exhibit resources in general do. For instance, an exhibit entry regarding the Victory of Samothrace statue may be associated with multiple resources; pictures of the statue from multiple angles, images representing the statue without the boat added to it during the Roman period, close-up detailed images from the broken wings area, 3-D dioramas of the statue in the environments it is believed to have been placed in different years, etc. Obviously, each such resource needs a description to help visitors understand what the resource depicts and how it should be interpreted.

Since the information storage needs for these two resource types are diverse enough, it was decided that different tables should be created at the database level to store the data corresponding to instances of these types. As shown in Figure 1, page numbering is embedded in the bookPages table, while resource descriptions (for non-page resources) are separately stored in the webResourceLang table, since for a single resource multiple descriptions need to be maintained, to cater for multiple languages and visitor profiles.

4. FUTURE WORK

The environment presented is currently in use at the Athens University History Museum (http://history-museum.uoa.gr/). The system holds 10 major collections with 581 categories of exhibits, 1342 artifacts of which more than 200 are books with more than 14,000 digitised pages. All of the documentation is available in three languages: Greek, English and French. For the future an extension is planned which will allow the dynamic synthesis of virtual-reality museum. The engine will automatically create a web-based virtual-reality museum based on user's preferences and profile.

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