Virtual Archival Exhibition System: 
An Authoring Tool for Developing Web-based Virtual Exhibitions

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Abstract

This paper describes the design and development of a Virtual Archival Exhibition System (VAES) that facilitates the authoring of web-based virtual exhibitions that can be tailored to serve the needs of various user groups. VAES is a joint collaborative project between the National Archive of Singapore (NAS) and Nanyang Technological University (NTU), Singapore. Based on an XML-based metadata database, VAES provides tools for users to create, update, extract, and search metadata of artifacts and exhibitions stored in the database. The actual digital artifacts (information objects) are reused by referencing as necessary without duplicating the artifacts. Dublin Core (DC) elements and non-DC elements with layered tags are used to describe and provide tailored information of each artifact for different users. In VAES, a virtual exhibition is created based on the pre-defined exhibition metadata and artifact metadata stored in the database. An authoring tool provides a direct manipulation work area for users to browse, display and layout the exhibition page content that is extracted from the database. XML’s Extended Style Sheets (XSL) and Cascading Style Sheet (CSS) are then applied to the layout to yield the final exhibition in HTML format. By using different information layers, reusing the layout setting, and the application of different style sheets, it is easier for authors or archivists, especially for those who are less proficient in IT, to create multiple versions of the same exhibition that vary in content, layout and presentation to meet the varying information needs of a range of different user communities.

Keywords: Virtual exhibitions, authoring tool, XML-based digital archive, reuse of artifacts, metadata, information layering, users requirements

1. Introduction

Virtual exhibitions have become common in museums or archives to provide access to
cultural heritage information resources to the public. However, using the normal Web page authoring tools, such as Macromedia’s Dreamweaver, to create online exhibitions is quite tedious and time consuming. In order to simplify the creation of virtual exhibitions and to reduce the resources spent for the development of every new virtual exhibition, some authoring tools / systems have been developed to facilitate the creation of virtual exhibitions, especially for the creation of virtual exhibitions with various versions for the same content. Some of the most notable are: ViEx System, The Norfolk System, XMP-CMS and ARCO.

ViEx System is a reusable framework supporting authoring and managing hypermedia exhibitions, funded by the Austrian Federal Ministry of Education, Science and Culture (Breiteneder and Platzer, 2001). The ViEx framework consists of three major components: a content management system, its underlying content database, and a set of layout templates. The content of a ViEx exhibition is organized in a layout-independent manner. ViEx system re-uses its “pre-built” features and content building blocks in different contexts so that it saves time and costs for developing multiple versions of the same exhibition and this its main strength.

The Norfolk system is a multi-page generator used for the multimedia educational CD-ROM project, French rural houses and farms. It was developed to reuse the XML metadata of the photographs and to generate advanced presentations using the same photographs. By generating the photographs metadata and document prescriptions once and reusing many times, the NorFolk system will save time and also less error-prone. Due to a provision for the separation between information and delivery (i.e. metadata and HTML pages), it is easier to define several presentations of the same information (Vercoustre and Paradis, 1999) in this system. This system can support the exible generation of presentations from heterogeneous sources, which is a requirement for today’s Digital libraries.

XMP-CMS (XSL-based Multi-Presentation Content Management System) is an authoring system developed by the National Chi-Nan University and the National Museum of Natural Science of Taiwan (Hong et al., 2001). The system provides a novel approach for organizing, integrating, and composing the digital museum collection into multi-style exhibition to accommodate different user’s needs using different XSL documents. XMP-CMS provides an easy way to compose artifacts extracted from the digital collection into exhibitions and also provides an easy way to create different presentations of the same exhibition content that cater to users with different needs.

ARCO (the Augmented Representations of Cultural Objects) system is a research project funded by the European Union (Patel, et al., 2005). It develops technologies for museums to create 3D Virtual Exhibitions on the Web by using an XML-driven Object Relational Database and a Content Management System together with X-VRML technology that defines the virtual exhibition layout and allows dynamic updating by simply changing the database contents. An ARCO prototype was demonstrated in COMDEX Fall 2002 conference at Las Vegas.

Obviously, all these systems have a common feature: they facilitate developing multiple versions of the same exhibition in different contexts by separating content and presentation. However, they have their own disadvantages: ViEx System does not support XML and metadata; the Norfolk system’s descriptive language is not easy to understand.
and use; XMP-CMS does not support information layering, thus it cannot provide customised content of the same artifact to different users; and the ARCO system emphasizes on creating 3D digital surrogates of artifacts on the Web, its targeted users are museums whose main collections are 3D artifacts and does not focus on archives whose main collections are 2D artifacts.

To fill up the gap between these existing systems and what the exhibition designers expected, especially the requirements of archivists who have minimum Web design knowledge, the Virtual Exhibition System (VES) project was launched by National Archive of Singapore (NAS) and Nanyang Technological University (NTU) in 2002 (Lim and Foo, 2003). The system aimed to develop a user-oriented virtual exhibition authoring tool that is intuitive, easy to use, and with facility to create various exhibition versions to adapt to different user profiles.

Based on an XML-based metadata database, VES provides functions for managing digital texts and photographs in the database, integrating the two kinds of digital artifacts into virtual exhibitions, and searching artifacts that are contained in the created virtual exhibitions. By using the “reuse and reference” model (Goh and Foo, 2002; Lim and Foo, 2003) and separating the content and the presentation, VES makes it possible to create multiple versions of the same exhibition to ease out much effort and resources.

As VES is a first prototype and largely developed to demonstrate the “proof of concept”, there was some room for improvement. The current system (VAES), attempts to enhance the functionality and user-friendliness of the VES in a number of areas:

a) To establish a central repository for various types of digital artifacts (text, photograph, audio and video) that could be used as an integrated environment for various applications.

b) To provide a metadata system with layered tags to support information layering, facilitate information retrieval and interoperability operations between systems.

c) To optimize the existing interfaces for archivists to manage the database effectively.

d) To replace the VES’s grid-based authoring tool with a powerful direct manipulation tool to support the authoring of exhibition pages in a more intuitive and flexible way.

e) To support different user group profiles (e.g. virtual exhibitions for students, teachers and researchers) by facilitating the creation of multiple versions of the same virtual exhibition to cater to diverse user groups’ requirements.

2. Design of VAES

VAES is based on a metadata database that includes all four types of artifacts metadata and exhibition metadata. According to many previous researchers, a virtual exhibition is made up of different parts, each part contains one or more pages, and each page contains different types of artifacts, navigation links to the other pages and local information like web banners and navigational buttons. Virtual exhibitions are created based on the pre-defined exhibition metadata and artifacts’ metadata that are stored in the database.

To accommodate the diversity of users, functionality of supporting customised information and adaptive presentations are expected in this system (Paterno & Mancini, 1999; Harms & Schweibenz, 2001). In light of literature, the end users of virtual exhibitions can be broadly classified into three levels based on their information needs:
casual visitors, intentional visitors and specialists (Paterno & Bucca, 1997; DiSilvestro, Garzotto and Paolini, 1999; Callery and Thibadeau, 2000; Schaller and Bunnell, 2002). To study virtual exhibition’s role in education, VAES focuses on three user groups namely, students, teachers and researchers.

VAES provides three ways to create virtual exhibitions for these three user groups: a) layered information of each artifact is produced to provide tailored information for various user groups; b) the exhibition page content can be laid out in various ways to cater to users’ appreciation taste, and c) several pre-defined format templates are provided to present the content in adaptive presentation styles. Separating the contents, layout, and templates, this system facilitates in creating multiple versions for the same content that vary in content size, layout and templates. The data flow of creating a virtual exhibition with different versions is shown in Fig. 1.

3. Data Model of VAES

The metadata database of VAES is implemented using XML and Document Type Definition (DTD). In this database, each type of artifact has its own set of metadata. Layered tags are used to describe different layers of each artifact with a unique version ID to distinguish one from the others. The 15 Dublin Core (DC) elements along with qualifies are used to describe the general features of an artifact, and non-DC elements are specifically used to further describe an artifact or the exhibition. Use of DC elements will facilitate information retrieval and information exchange between different systems, and use of non-DC elements with layered tags will provide a richer and more complete metadata description for each artifact version. An example of a photograph’s metadata is shown in Fig. 2:
Fig. 2: An example of a photograph’s metadata

The exhibition metadata describes the entire exhibition’s content. In the exhibition metadata, a user-type element is used to identify different versions for different user groups. Each version is unique with different artifacts layers and different local information. For example, the exhibition version for student includes text artifacts with the shortest length, and all the icons are colorful and in cartoon style, but the text version for researcher is the longest text, and the icon images are in black and write color. An example of the exhibition’s metadata is shown in Fig. 3.
Based on the pre-defined exhibition metadata, the individual exhibition page metadata are extracted from the database, which describes the content of each individual exhibition page. The exhibition format page metadata, slightly different from the exhibition page metadata, contain the layout information of each page. The layout information indicates the exact coordinates and size of each contained artifact in the authoring tool work area, which works as a spatial metaphor for a desktop, thus the artifact will be located accordingly in the final HTML page. The exhibition page metadata and exhibition format page metadata is generated by the system to facilitate the creation of each exhibition page. A section of an exhibition format page metadata is shown in Fig. 4.
4. Implementation of VAES

VAES is implemented by Java and XML-based technologies. A Tamino XML server is used to store, index and retrieve the metadata. Tamino APIs are used to create the gateways for communicating with the database. JSP and Servlet are used to create a few tools for user to manage the database. An Apache Tomcat Web Server (with servlet engine) is used to run these interfaces. Java Swing and XML-based APIs are used to develop the authoring tool with a direct manipulation graphic user interface. XSL and CSS are used to convert XML files to HTML files that are ready for use by end-user browsers.

To create a virtual exhibition in VAES, firstly the exhibition’s metadata is created in the metadata creation tool and then saved to the database; secondly, each exhibition page metadata is extracted from the database by using the extracting tool; thirdly, the exhibition page metadata file is imported into the authoring tool for setting the layout of the page content and then saved as a exhibition page layout XML file, finally the XSL and CSS style templates are applied to the layout XML file to make it ready for the end-user browser.

The architecture of VAES is shown in Fig. 5. The infrastructure layer holds the repositories, Tamino XML server and repository gateway. The application layer comprises five tools: a) the metadata creation tool, b) the metadata editing tool that allow users to create, modify and maintain the metadata in the database and in the Web server’s...
local directory; c) the `extract tool` that allows users to extract each exhibition’s page content and corresponding information from the related repositories; d) the `authoring tool` that allows users to create and modify virtual exhibition’s pages ready for Web browser; and e) the `search tool` for querying and retrieving artifacts stored in the database and exhibitions. The end-user layer is for exhibition visitors to view the created virtual exhibition.

![Fig. 5: Architecture of VAES](image)

VAES has inherited all the features/provisions of VES. However, it also provides a number of improvements or new features as given below:

a) Handling audios and videos for Web presentation and information retrieval. To accommodate various Internet connections and available bandwidths, the content of each audio/video is stored in three versions with varying compression rates. The inclusion of audio-visual capability enables the virtual exhibition to render a more realistic and engaging experience to its users.

b) An optimized metadata creation tool that allows user to define and save the exhibition metadata into the database through a few entry forms. A user-type element is used to identify the unique version for different user groups. With minimized text field input, users can fill in the form in a more effective way.

c) A direct manipulation authoring tool provides several provisions in its interface as shown in direct manipulation environment in Fig. 6. The authoring tool provides a WGSIWYG approach for users to browse, display, directly manipulate and locate on exhibition page content in an intuitive way.

d) Support for different user profiles and accommodate diverse user groups, VAES facilitate the creation of multiple versions of the same exhibition with customized information and in adaptive presentation for specified user groups.
VAES was used to create a virtual exhibition known as “Colours in the Wind: Old Hill Street Police Station in Retrospect”, a historical site in Singapore. Fig. 7 shows the different versions of the same page with customized information, with different layout and style sheet for three types of users: student, teacher and researcher.

5. Evaluation and Assessment

A preliminary evaluation was conducted to evaluate and assess all the aspects of VAES such as functionality, user interfaces and potential application in January 2005. Totally 20 subjects with diversified educational or professional background from NTU are selected for this system evaluation. The evaluation procedures comprise demonstration, “hands-on” exercises followed by a questionnaire distribution to collect the feedback on various functions and features of the system. The feedbacks of the respondents about the system are positive: most of the subjects found that the system is useful. The features including visualization, artifact reference and reusing, information layering, and direct manipulation user interface are deemed as novel characteristics of VAES.

The subjects also pointed out a few problems that are related to the usability and
functionality of the system. Based on their feedback, the problems in the system’s interface were modified and improved its usability. Some of these subjects commented that VAES was not that easy to understand and operate. The comments made by them includes “How come the creation of virtual exhibition starting with creating its metadata? How come the content of a virtual exhibition is pre-defined by its metadata?” It is a common problem in any system that if the developers or users do not have minimum basic knowledge about XML, XSL and CSS, they need some orientation or short training to get to know about these technologies and architecture of the system for better understanding. It is the same in case of this system also but it does not require days or months training for Dreamweaver or any other Web designing tool.

Due to time constraint, the system evaluation has the following limitations: a) the subjects were not chosen from the targeted users of the system including archivists or museum professionals, and b) the subjects of the evaluation process are not professional evaluators who have very good experience about system design and development. To improve the validity of this evaluation, real users of the system and professional evaluators are needed for improving it quality further.

6. Conclusions and Future Work

In this paper we have described the VAES system that provides a user-friendly interface with rich features and functionalities to create multiple versions of virtual exhibitions from a digital collection to cater to different user profiles. Based on its earlier version, VAES has improved considerably in terms of it functionalities including audiovisual information support, artifact reference and reusing, user-tailored information layering, direct manipulation authoring tool with WYSIWYG user interface, separating and reusing the content, provisions of many layouts and style templates. All these new facilities have also effectively eliminated the shortcomings of the four virtual exhibition authoring tools mentioned in Section 1. VAES serves as a handy tool for archivists and exhibition designers, especially for those who are less proficient in IT, to provide cultural and heritage information online to users’ of varying information requirements or needs.

In the future, VAES can be further developed to support adaptive navigation and multilingual support to meet the demand of archivists and museum specialists. VAES can also be used in a wider context of applications such as virtual learning environments, distributed repositories of archives, and others.

Reference:


