Web-based Multimedia Content Management System for Effective News Personalization on Interactive Broadcasting

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Abstract: - This paper describes the design and implementation of an effective web-based multimedia content management system (MCMS) for organizing, integrating and composing personalized digital news for interactive broadcasting. A 5-layered architecture is proposed for the MCMS and is implemented using the Java 2 Enterprise Edition (J2EE). A prototype based on our framework has been implemented in the News On Demand KIOSK Network (NODKN). This system enables news publisher to manage personalized news that is structured, profiled and streamed to end-users. It examines the user's profile to identify what kind of news to include in the news program and what kind of styles to provide to the users. The MCMS generates SMIL documents, which are the backbone for digital news broadcasting, using XML and XSLT techniques. The MCMS has three essential features. (1) It allows an effective collaboration among contributors to the content production process. (2) It provides an easy way to produce personalized digital news, and (3) it provides an easy method to create different presentations of the digital news that is catered to users with different needs.

Key-Words: - MCMS, J2EE, personalized news, Interactive broadcasting, NODKN, XML, XSLT, SMIL

1 Introduction

In recent years, digital TV is experiencing a gradual growth as a leading medium for distribution of information and news [1]. The Internet bodies, such as W3C [2] and IETF [3] have put in a lot of effort in defining standards that merge World-Wide-Web technology with traditional TV to enhance the services for the interactive TV. The idea of user interaction with the TV is not new. There are many systems available in the market that claim to provide interactive features and access to the Internet through TV [4, 5, 6,7].

Digital news broadcasting in the interactive TV environment has many outstanding features as compared to normal television [8]. Nevertheless, there are many design issues that a digital news designer needs to consider. First of all, workflow in digital news production is much more complicated. Unlike a person working in a television news publication dealing with only video element in a television news publication, a digital news producer produces news program by using images, webpages, animation, video clips and other multimedia gadgets. Since digital news is broadcasted through the Internet, bandwidth becomes an important factor as its availability to different users can vary tremendously. Thus, it is impractical to design one-size-fit-all digital news.

User attention span is another main issue. While an investor may be willing to go through long explanation of market analysis in different forms like text, graph, hyperlinks, a layman may only be interested in a summary of local stock market in text form. Furthermore, the sophistication of users should also be considered. An expert and a novice apparently will expect different experiences when browsing through interactive TV for digital news. With the flexibility allowed to the digital form of media presentation, an interactive television should try to accommodate as many different user needs as possible. Most people would agree that such a multi-style personalization of digital news program for different users is desirable.

Using current techniques, each layout of the same news program needs to be designed separately. For online digital news involving combination of multimedia elements such as video, audio, image, text and animation, the realization process usually requires a tedious multimedia composing, and is therefore very time-consuming. Moreover, it is also quite cumbersome to modify the information contents afterwards. As the information is growing in an exponential manner, soon it would assume

enormous proportions. If online news uses HTML-based webpages, then the "hyperlinks" between associated news webpages will be difficult to trace and maintain.

In view of the above problems, we will present an effective multimedia content management system (MCMS) that provides a novel approach for organizing, integrating and composing personalized digital news for interactive broadcasting.

2 Design Issues of MCMS

Online digital news, from the user's viewpoint, can be treated as a sequence of webpages. A webpage, of course, contains multimedia elements, hyperlinks and animation. We refer to each of these webpages as a news item. In our methodology, we address three issues that we consider central to producing a flexible and easy to use multimedia content management system:

1. *Remote Access*- It should allow an effective collaboration among all contributors to the content production process.
2. *Easy to Use*- It should produce personalized news item from the digital archive of the news.
3. *Support for Multi*-Style- Once the news item is produced, it should create different presentation styles that suit different users.

We tackle the first issue by building a web-based content management system to increase the efficiency of the production process, allowing reporters, journalists, editors, designers and managers or approvers to work together more effectively, despite the time and location constraints.

Regarding the second issue, digital news elements are stored in a multimedia database. Our approach treats each of these elements as a building block (XML) and uses XSLT techniques to provide a mechanism for generating Synchronized Multimedia Integration Language (SMIL) document. SMIL is a language for describing interactive synchronized multimedia distributed on the Web [9,10]. Each SMIL document is then treated as a news item.

Concerning the third issue, we note that digital news should accommodate users of different interests, background, bandwidth and sophistication. In our approach, we provide an easy way to generate multi-style digital news with the same news elements. This means that different users may experience the same digital news with different multimedia style and level of details. The deciding factors are the user network bandwidth and the user profile. For instance, when interacting with corporate executives equipped with multimedia-enable computers and high bandwidth network, the system can provide high-resolution video or graphics in a SMIL document. On the other hand, a system with a low bandwidth Internet connection but intent on information content, the system will provide the user with more of textual information but less of visual display to reduce the data transmission in a SMIL document. This is achieved by designing different style sheets (XSL) for different targeted users.

3 System Architecture

The framework for multimedia content management system presented in this paper is built on top of the J2EE platform [11] that provides a robust scalable system to employees, managers and partners. When deployed, it helps organize content from inception to eventually archiving and deletion of news content. It is built using a 5 layered web-based architecture shown in Fig.1. This architecture consists of a presentation layer, an application logic layer, a persistence layer, a database layer and a streaming platform.

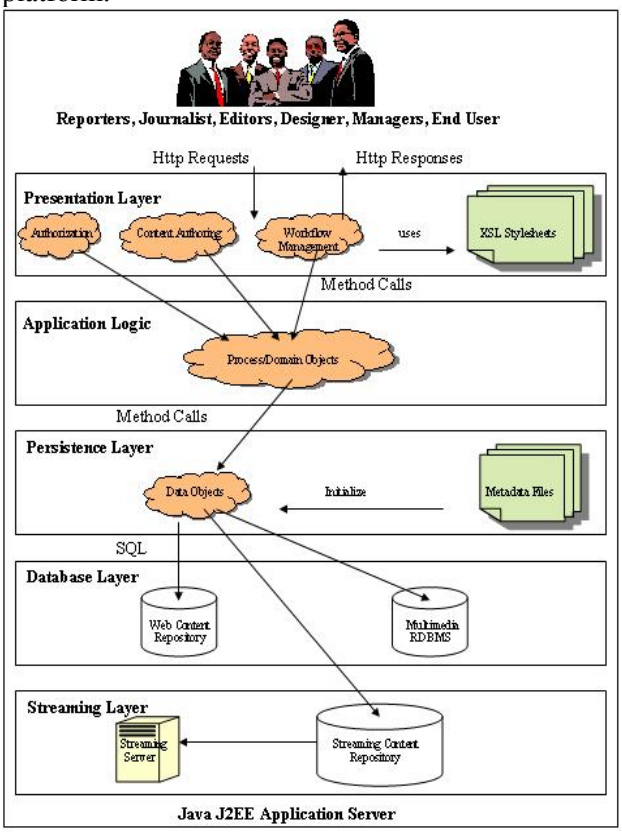

Fig. 1: System Architecture for SMIL-based Multimedia Content Management System

The presentation layer consists of dynamic HTML which is formed from XML and XSL stylesheets and java servlets for content management tools. Application logic layer contains domain-objects and process-objects which together perform operations on data-objects and provide data for presentation to management and authoring tools on the presentation layer. Digital news is constructed in our system based on XML, XSL and XSLT techniques [12, 13, 14], which are more suitable for description and presentation of hierarchical media structures. The persistence layer possesses the characteristics needed to read, write and delete objects to or from the database. Database layer provides the mechanism for storing news content and user's profiles persistently by using a relational database model. Finally, a streaming server is used to deliver the personalized video content to the user. RealSystem Server Basic from Real Networks is used as a streaming server in our system because it supports SMIL streaming [15].

4 News On Demand Kiosk Network (NODKN)

We have implemented the MCMS framework on NODKN, a collaborative project between Multimedia University and Matshusita. The implementation aspects are discussed in the following sub-sections.

4.1 Management and authoring tools in a collaborative environment

As mentioned earlier in connection with the design issues, the key issues are: (i) to provide a collaborative environment for workers, and (ii) to allow producers to easily create digital news from multimedia database. Thus, the proposed MCMS contains a set of management tools that enables managers, technical users and non-technical users to create news content, categorization, versioning, searching, deployment, archiving, comments and so on (See Fig.2) in an easy manner through a common storage (Oracle database).

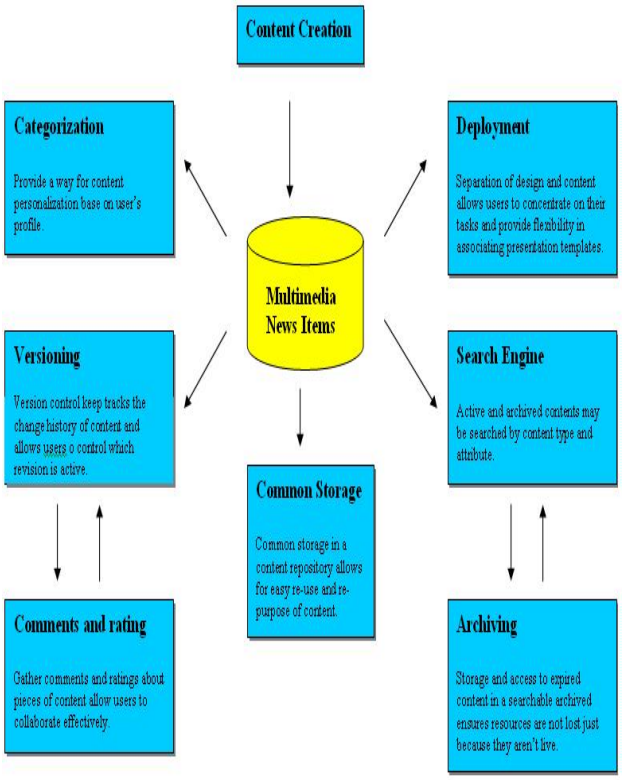

Fig. 2: Collaborative managing tools for authoring digital news

News publication manager interacts with the MCMS management tools to define news event and assigns specific tasks to the selected reporters, journalists and other relevant parties. Upon receiving tasks from the manager, say a journalist then uses MCMS to interface with the central database and retrieves news item sent by the reporters around the world to create or edit digital news by filling up the pre-designed templates. The pre-designed templates are created by the layout designers. The separation of design and content allows users to concentrate on their tasks by providing the flexibility in selecting the presentation templates. During the content creation processes, digital news is segmented by journalists according to some categories to provide a mechanism for content personalization for different users (See Fig. 3). Meanwhile, authorized news editor can use the management tools to review, revise and approve submitted content to ensure correct grammar and consistency of style. In the MCMS environment, editors can work together to ensure the quality of news content by gathering comments and rating the pieces of content created. News content versioning keeps tack of changed history of content and allows editors to control, which revision is active. Search engine is provided to minimize the time wasted on finding news item by allowing the content creator to

search for either active or archived news in a central database according to the type and attributes. By having the common storage platform, journalist can easily re-use and re-purpose the news content to meet certain tasks assigned by managers in a more effective manner.

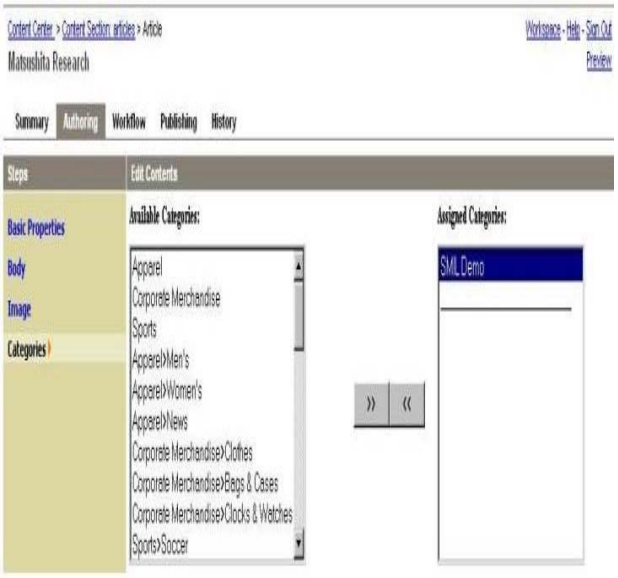

Fig. 3: A snapshot of MCMS where categorization of digital news is done by journalist.

4.2 Personalization of digital news

The MCMS framework is based on a personalization model in which a sequence of multimedia elements, hyperlinks and presentation styles is profiled. The personalization process consists of the following steps (See Fig. 4):

1. The end-user is registered with the server by selecting the news categories of interest, bandwidth availability and level of sophistication.
2. MCMS gets access to the database to retrieve all the news items and presentation styles that match the user's profile.
3. MCMS personalized module generates necessary JSP codes to allow user to retrieve personalized Electronic News Guide that contains article's name, abstract and URL.

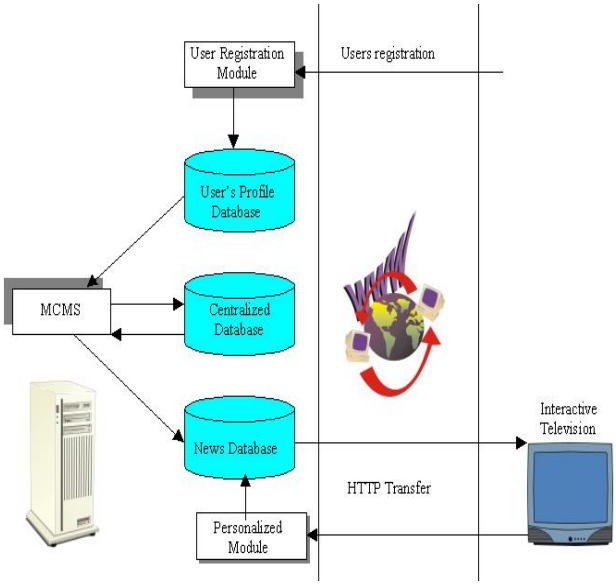

Fig. 4: Digital news personalization process

4.3 Multi-styles content authoring system

In our design, individual news element in multimedia database is represented in XML-based conceptual model in a unique manner. The model contains the information such as title, object ID, metadata, date, hyperlinks, versioned and so on. The personalized digital news (SMIL files) in an interactive television is logically divided into mainly two sections the layout section and the body section and is composed from several digital objects stored inside the multimedia database. Template designers and developers will concentrate on the layout section for the presentation of content dealing with its type and location. The following sample code represents a typical template created by designer using our MCMS.

```
<layout>
<root-layout id="main.smil" width="600"
height="400" background-color="black"
title="News On Demand KIOSK Network" />

<region id="bgimage_region" left="0" top="0"
width=" 600" height=" 400" z-order="0" fit="fill" />

<region id="Video" left="155" top="40"
width="440" height="300" z-index="1"
background-color="black" fit="fill" />

<region id="slides" left="5" top="100" width="140"
height="200" z-index="1" background-
color="black" fit="fill" />
</layout>
```

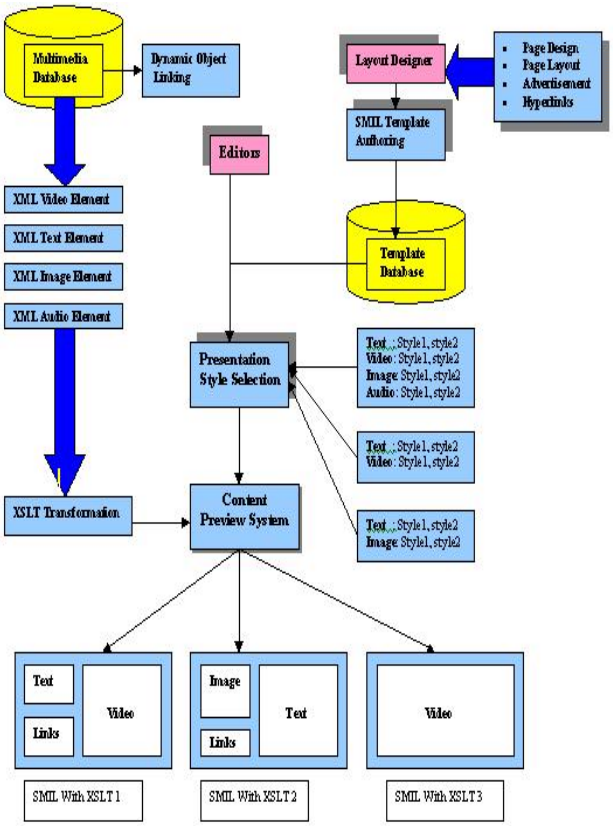

Fig. 5: Designed of multi-styles digital news authoring system

The content authors, will focus on producing content in the body section without bothering about the presentation. Personalized news is composed from a sequence of multimedia elements that matches with the user's profile and groups into sections defined in a selected template. Body elements are added into the SMIL files as illustrated in the following SMIL code.

```
<par>
        <img src="ferrari2.jpg?duration=0:00.5"
        region="bgimage_region" fill="freeze" />
        <par>

        <seq>
        <video id="clip 2" src="F1.rm"
        region="Video" />
        </seq>

        <seq>
        <textstream src="news.rt"
        region="slides" />
        </seq>

        <seq>
        <textstream src="summary.rt"
        region="summary" />
        </seq>

        </par>
</par>
```

The personalized styles for digital news is achieved by using XSLT stylesheets that convert multiple XML documents into SMIL files by selecting in a more or less automatic way from the set of suitable presentations according to the user needs as shown in Fig. 5. Figure 6 shows a sample of digital news composed by content creator with a pre-defined layout using our MCMS.

Fig. 6: A snapshot of composed digital news using XSLT and XML techniques.

5 Conclusion

In this paper, we have presented the design of a 5-layered web-based multimedia content management system (MCMS) using J2EE. The effectiveness of the MCMS is amply demonstrated in News On Demand Kiosk Network (NODKN). The framework has several novel features as compared to conventional approaches. These include a collaborative environment among news producers, a set of management tools for easy content authoring and profiling and a mechanism for quickly producing multi-style digital news to achieve news personalization. The major contributions with regard to digital multimedia news, personalization and management can be summarized as: (1) Support for effective personalization of multimedia news content and presentation styles through the utilization of XML and XSLT techniques. (2)

Separation of design and content which allows journalist, editors to focus on content preparation rather than advanced HTML and SMIL programming. (3) Support for the re-use and re-purpose operations of the same multimedia elements to be part of the other news program. (4) Web implementable MCMS. So, content author can remotely use the application without any need of additional hardware or software. All that is required is a web-browser that supports SMIL streaming.

As the current system is only tested on computers, we would like to extend the system to cater to other devices such as digital TV, hand phone and PDA in the future.

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