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A SMIL-Based Catalog Presentation System in Electronic Commerce

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Abstract

Web-based catalog presentations play the key-enabling role in E-commerce in recent years. Existing catalog systems often acquire proprietary platforms, cannot deal with TV-like media objects, or consume network bandwidth inefficiently. With the emergence of advanced technologies of Web and multimedia, such hurdles can be removed. The Synchronized Multimedia Integration Language (SMIL), proposed by W3C allows Web designers to design complicated and vivid multimedia presentations in a declarative manner. These presentations are then rendered on a general-purpose browser by a SMIL player. Since the SMIL specification is quite new to the Internet and E-commerce societies, the functionality and applications of players is limited. In this paper, we propose a novel architecture based on Java JMF technology for tackling with such constraints. The effectiveness of the proposed system is validated through an experiment on product catalog presentations.

Keywords: Electronic commerce, electronic catalog, XML, SMIL, multimedia presentation, Java

1. Introduction

The advent of the Internet has given birth to Electronic Commerce (EC). In the short space of ten years, EC has shaped a new type of business world; it has greatly affected operations between business (B2B) and changed transaction channels between business and individuals (B2C). In general, effect of the Internet on commercial activity can be characterized by the three well-known facts. Firstly, it is the shifting of power from sellers to buyers through the reduction of the cost of switching and the free distribution of a huge amount of price and product information. Secondly, it is the stimulation of economic activity through the reduction of transaction costs. Lastly, it is the creation of new commercial opportunities through low cost of distributing and capturing of information, which is carried out with a speed and wide range that has never been seen before. This coincides with the study in [20], which identifies two major EC applications: product catalog which provides the information about the product and transaction

management which manages the order interactions. The first application is of particular importance since it behaves as the interface between customers and vendors. In the competitive EC environment, vendors race for consumer's "click-shopping" in one minute.

To gain the competitive edge, vendors must keep the catalog vivid, useful, informative, and interactive. In addition, the catalog contents should be designed and maintained in an efficient way. For this, multimedia, the other major enabler driving EC comes in. [1] [2] [6] [13]. In general, multimedia refers to the integration of time-based media such as audio and video and static media such as text, still images and animated images. With the convergence of the Internet and multimedia, organizations can gain a competitive edge from improving business performance [6]. Gunasekaran and Love recently proposed a framework for the design of multimedia systems in supporting numerous business applications and point out several future research directions. Puri *et. al.* investigated how multimedia integration enhance EC. Yen and Ng reviewed and discussed some web-based catalogs, categorized by five layers: application, presentation, organization, function, and physical form [20]. They also implemented a web-based catalog prototype in a 3D Virtual Reality Modeling Language (VRML) for mass customization of products in EC. Ehrke proposed a web-based catalog using Java technology to present car stereos to customers [4]. Shim *et. al.* proposed a Synchronized Multimedia Integrated Language (SMIL)-based catalog system accompanied by a presentation player written in Java [16]. For the system surveyed, the media used in presenting catalog contents ranges from text, to HTML, to 2D/3D object, and to video clips. However, there are three major shortcomings existing in these systems. Firstly, they fail to provide TV-like live catalogs. Without doubt, TV is the most efficient channel for delivering product information in spite of the Internet era. Secondly, the presentation contents are delivered mostly in a point-to-point (unicast) way so that the network bandwidth is obstructed. Finally, some of the systems violated the principal of architecture neutrality so a proprietary platform is required for running the catalog presentation.

The objective of this research is to develop a catalog presentation system for supporting EC that can effectively

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overcome these three hurdles. We rely on our previous work in multimedia streaming [10] and the SMIL standard, building on XML, proposed by W3C provides a simple way to design multimedia presentations in a similar manner to HTML documents. Section 2 presents the information technologies that are needed in the development process. Related work in designing SMIL players is discussed in Section 3. The system architecture of the proposed Web-based SMIL player is described in Section 4. Section 5 is system demonstrations. Section 6 concludes the paper and discusses some future work.

2. XML, SMIL, and JMF

A SMIL player is essentially a Web-based application, which is software-intensive system and thus needs seamless integration of the emerging Web computing technology – Java and XML. Java is well recognized for its architecture neutrality, and well accepted as a vehicle for building enterprisewide information systems. XML is designed for document neutrality that can facilitate universal message exchange. Java works well in a distributed environment, allowing users and programs to share information easily, while XML provides a tool for distributing and sorting that information. In this section, we briefly review the technologies used in the study

2.1 XML

XML (Extensible Markup Language), developed in 1997 by W3C, is an enabling technology for facilitating vendor-neutral data exchange [3]. Similar to HTML, XML is a metadata language for defining markup languages such as SMIL, MathML (Mathematical Markup Language), and CML (Chemical Markup Language). In contrast to HTML, which describes the presentation layout of a document in a Web page, XML specifies the semantics and structure of the document. XML differs from HTML in three key concepts, namely extensibility, structure, and validation [3]. In extensibility, XML allows authors to define new tags and attributes for specifying the syntax and semantics of data. In structure, XML supports nested document structures similar to regular expressions. In validation, XML allows a document to be validated via DTD (document type declaration) specification, which identifies what elements are allowed in a document, the sequence of these elements, and element attributes, etc.

XML can be seamlessly integrated with Web in a variety of ways. The most often cited one is its ability in facilitating data exchange between heterogeneous databases due to its vendor-neutrality. It can also cooperate with some kind of style sheets such as XSL (eXtensible Stylesheet Language) or CSS (Cascading Style Sheet), a language for specifying the presentation semantics of an XML document. As a result, XML allows a document to be rendered in different format to support personalized presentation. Other interesting applications include intelligent search engine, smart agents, and so on.

The elements and attributes in an XML document are extracted by a parser, which can be tree-based or event-based APIs. A tree-based parser builds an internal tree structure to be traversed by an application whereas an event-based parser uses callbacks according to parsing events such as the start and end of elements. Each has its advantages and disadvantages.

2.2 SMIL

The synchronized multimedia integration language (SMIL), developed by the Synchronized Multimedia (SYMM) Working Group of World Wide Web Consortium (W3C) in 1998, provides a simple way for designing TV-like multimedia presentations on the Web [8] [15]. The syntax of SMIL conforms to the XML standard so that one can write SMIL presentations using general text editors. There are several salient features making SMIL attractive in design Web-based multimedia presentations. Firstly, the presentation designer can indicate the spatial layout and temporal relationships of media objects of text, audio, video, image or any other media type; where and when the objects are shown. For spatiality, it differs from the text-based HTML document which follows one-dimension textual flow style on the screen, instead, SMIL uses a two-dimension layout model without scroll bars and resizing functionality [8]. For temporality, SMIL defines a set of timing constructs to synchronize a group of media objects sequentially or in parallel and to specify their begin, end, and duration times. Secondly, media objects can be distributed either from the same resource of the SMIL document or any place specified by uniform resource locator (URL) such as HTTP, FTP, or RTSP. Thirdly, a set of navigation constructs is also defined to support the functionality of HTML-style hyperlinks. Finally, media objects can be presented on client's browsers according to system and personal preferences such as network bandwidth, user language, and screen resolution.

SMIL presentations are rendered on Web browsers by a SMIL player. Existing popular players for SMIL 1.0 includes Microsoft Internet Explorer 5.0, Apple QuickTime 4.15, RealNetworks Realplayer 8, Helio SOJA [17], and CWI GriNs [5]. Most of them except SOJA can only run on proprietary platforms such as Microsoft Windows or Macintosh; this limit their usability. However, achieving smooth SMIL video presentation over the Internet is a non-trivial work which involves prefetching and buffering media objects [7].

2.3 Java Media Framework (JMF)

The JMF API provides three packages: Player, Capture and Conference for manipulating time-based media including playback, capture and conferencing [9]. It supports most standard media content types such as AU, WAV, MIDI, MPEG-1, and QuickTime, and AVI. There

are two JMF versions available currently: JMF1.1FCS, designed for playback and JMF2.0ea (early access), in which the functionality of media capture is added. With Java Media Player, developers can design media players receiving and presenting either from reliable sources such as a local (via FILE) or network (via HTTP) file or streaming sources including broadcast media, multicast media, and VOD. JMF1.1FCS supports RTP for playing broadcast and multicast media for limited media types including DVI, GSM, G723, and G711 except MPEG-1. Although JMF2.0ea improves MPEG-1 in which Layer 1&2&3 (MP3) is also supported, MPEG-1 video is still not provided. Therefore, it is a great challenge for playing RTP multicast MPEG-1 using JMF.

The JMF mechanism is a layered architecture. The data source layer is in charge of data acquisition whereas the processor layer takes care of data un-compression and passing data to renders such as monitor or sound card for presentation. There are two classes in the data source layer, namely PullDataSource and PushDataSource, in which the former is designed for local-file (including MPEG) streaming play and the latter is for networked non-MPEG streaming play via RTP. These two classes are totally different and may not be cast to each other straightly.

3. Related Work in SMIL Players

SMIL players available on the Internet can be generally grouped as two categories based on the environment they run: proprietary and Java-based. An up-to-date list can be found in [19]. We briefly review several major players in this section.

The first category includes Microsoft IE, RealPlayer, and GRiNS. To improve multimedia and interactivity in Web pages, Microsoft IE5.5 offers a set of attributes in the so-called HTML+TIME construct for specifying the timing behavior of media objects such as start, end, duration and repeat times [18]. HTML+TIME is implementation of the HTML+SMIL profile in SMIL 2.0, which is currently in the stage of working draft. RealPlayer from RealNetworks supports playing SMIL presentations since its G2 version in 1998 [14]. RealPlayer G2 was the first SMIL player implementation in the key vendors of networked multimedia. GRiNs (GRaphical iNterface for Smil) is another presentation system for SMIL documents along with a powerful authoring environment [5].

The second category which adopts the Java approach includes S2M2 (Streaming Synchronized MultiMedia) [11], SOJA (Smil Output in Java Applet) [17], and the JavaBeans approach [16] . Both rely on old version of JMF technology however SOJA fails to play mpeg items and S2M2 did not support streaming media objects using Realtime Transport Protocol (RTP).

4. The Proposed System

We utilize the Java computing and JMF technologies to develop the SMIL presentation system to meet two goals, namely RTP streaming and navigation of HTML-style hyperlinks. This section discusses our system development approach. The high-level system architecture is illustrated in Figure 1.
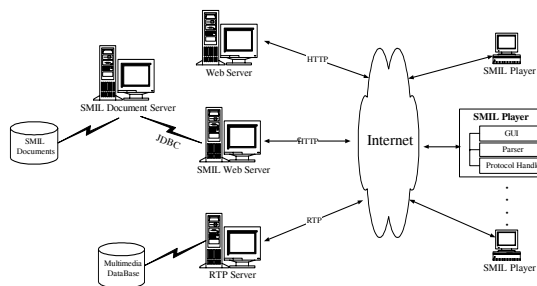

Figure 1. The system architecture

It contains Web Server, SMIL Web Server, SMIL Document Server, RTP Server, Multimedia Database containing MPEG and MP3 items, and SMIL Player on the client side. The platform where each component runs can be different. The Web Server acts as an object repository for downloading the SMIL Player applet to eliminate the need for installing the component. Thus, the Web Server shows emergent Object Web of the evolving client/server model [12]. The player contains three major components. The GUI component allows customers to retrieve catalog presentations in SMIL documents, managed by the SMIL Document Server. The Parser component, which is a SAX (Simple Api for XML)-compliant parser, a event-based parser, validates the specified SMIL document and retrieves the embedded elements and attributes. The Protocol Handler invokes the procedures for handling specific protocols such as RTP MPEG or HTTP/HTML. For the request of RTP MPEG streams, the client sends a subscription request to a mutlicast group for receiving contiguously transmitted demultiplexing RTP video/audio streams from RTP Server (see Figure 2).

Raw video/audio data are then fed into buffers for efficiency consideration when playing. Depacketization and Video/Audio Buffer constitutes Video/Audio Data Source which inherits from the class PullDataSource defined in JMF so JMF Player can treat video/audio raw data as coming from reliable data sources such as FILE or HTTP. Finally, the depacketized raw data in the buffer must be converted into bit streams for playing using JMF Player.

Figure 3 illustrates the sequence diagram in UML (Unified Modeling Language) for rendering RTP MPEG streams.
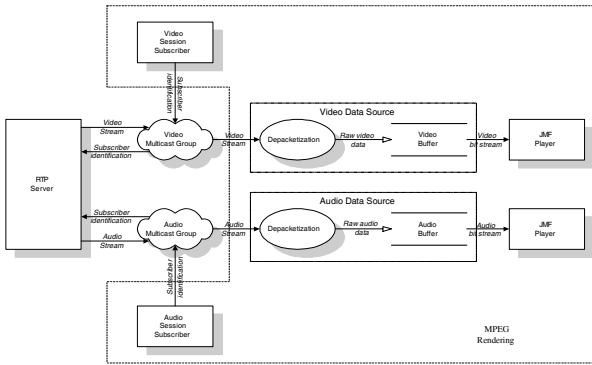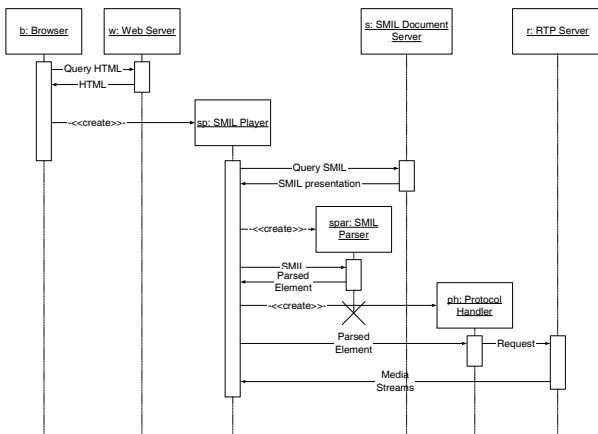
Figure 2. Rendering RTP-MPEG presentations

Figure 3. The sequence diagram of the SMIL player

Customers log into the catalog system via a Java-enabled browser to download the SMIL player in the applet form and create it as a player object in Java Virtual Machine (JVM) in the browser. After the customer chooses the product of interest, the player in turn contacts the SMIL document server to obtain the SMIL presentation for the product. This document is parsed and the embedded media objects are retrieved from remote multimedia databases. Finally, the protocol handler invokes the RTP render to communicate with the RTP server and renders the video and audio streams received.

5. System Experiments

The proposed system has been experimented on the NKFUST campus network environment for supporting a virtual EC portal site. We discuss the cases of navigation and RTP-MPEG streams in this section. Figure 4 shows the SMIL presentation document for Cisco's IP/TV product. It indicates the layout about the three synchronous media objects (one RTP-MPEG, one local HTML and one remote HTML items). It is worth noting that a subtle syntax provided by SMIL when designing a catalog presentation.

Figure 5 is the snapshot during the presentation is rendering. On the right-hand side of the panel, one can navigate the Web page as in a HTML browser when watching RTP-MPEG streams as shown in left-top screen.

The text window on the bottom provides the functionality of text caption. This greatly improves the interactivity of the presentation. Thus, the proposed system meets the requirements of spatiality, temporality, and interactivity for multimedia presentations.

```
<smil>
 <head>
  <layout>
   <root-layout width="640" height="420" background-color="white" />
    <region id="video_panel" left="10" top="20" width="370" height="263" />
    <region id="html_panel1" left="390" top="20" width="240" height="390" />
    <region id="html_panel2" left="10" top="300" width="370" height="180" />
  </layout>
 </head>
 <body>
  <par>
   <rtp video="rtp://224.123.111.101:22224"
        audio="rtp://224.123.111.101:22225" region="video_panel" />
   <html src="http://www.cisco.com" region="html_panel1" />
   <html src="file:d:/project/cisco.htm" region="html_panel2" />
  </par>
 </body>
</smil>
```
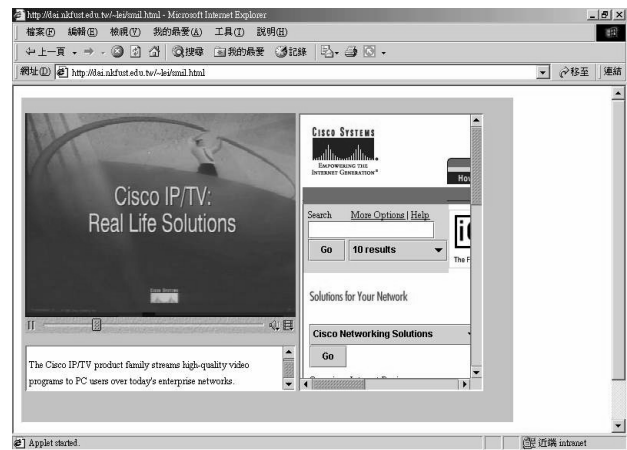
Figure 4. The experimental SMIL presentation

Figure 5. The rendering result of the SMIL presentation in Figure 4.

6. Conclusions and Future Work

The work presented in this paper was motivated by the need for the development of Web-based catalog presentation system in EC. We surveyed existing systems and identified three pitfalls in existing systems, namely violating platform neutrality, inefficiency in network bandwidth, and the lack of live TV-like presentation quality. In this paper, we followed the SMIL standard in multimedia presentation and applied the emerging Java distributed multimedia computing technology to alleviate such weaknesses. The system proposed in this paper is a novel architecture for playing live TV-like SMIL. In addition, the navigation of HTML-style hyperlinks is offered by appealing to the Java Swing facility. To meet the reusability of software development, we integrate the component of RTP player developed in our previous work and SAX for parsing SMIL documents. The resulting system is at its initial stage but demonstrate an encouraging direction towards EC applications. As far as

the references surveyed, our work presented is the very pioneering study in the literature towards integrating playing RTP media and Java JMF in Web-based catalog presentations. The future work includes the performance evaluation on the network bandwidth and enhancing the system to offer VCR-like functionality for more vivid catalog presentations.

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