A SMIL-based Real-Time Interactive Sharing System for Distance Learning

Ing-Chau Chang
Department of Information Management, Chaoyang University of Technology
168 Gifeng E. Rd., Wufeng, Taichung County, Taiwan
icchang@mail.cyut.edu.tw

ABSTRACT

In this paper, design and implementation issues of the real-time interactive multimedia distance learning system, which supports the W3C SMIL standard for presenting the real-time multimedia teaching material on the class over the Internet, are described. With content-sharing and interactive capabilities provided by this system and its tools, geographically dispersed students can devote themselves on the learning process just as they are in the traditional face-to-face classes.

Keywords

SMIL, real-time, interactive, distance learning, content sharing.

1. INTRODUCTION

The distance learning application has been predicted as one of the most important commercial applications on the multimedia information network in next decade [1]. With the unique characteristics of platform transparency and application protocol integration, the World Wide Web (WWW) technologies have been adopted for distance learning process [2]. However, in traditional WWW distance learning systems, every student individually browses web pages to access teaching courses at any time and has to learn by himself/herself. Hence, the real-time distance learning system proposed in this paper builds an environment for students to simulate the traditional face-to-face classes. Students can have the same view for teaching materials on web pages. Accompanying with simultaneous narration of the teacher to explain these materials, students can have better understandings for the ongoing course. Students can ask questions and the teacher then answers them directly. Furthermore, teachers may need more plentiful and versatile materials, such as video clips, audio segments, animations, etc., to improve students' studies. These multimedia materials are now supported independently with Netscape plug-in or Microsoft Active-X. Inter-media synchronization and real-time multiple-media presentation are beyond their capabilities. Therefore, the SMIL (Synchronized Multimedia Integration Language) [3] player is developed to resolve these problems. In this paper, an interactive sharing multimedia distance learning system to support real-time learning process is proposed in section 2 In section 3, implementation issues are described there. Finally, section 4 concludes this paper.

2. SYSTEM ARCHITECTURE

System architecture of this system is illustrated in Figure 1. The teacher and students all belong to the client side. The teaching module of each client provides functions for tools to support real-time learning process. The class server has a corresponding teaching processing module to handles actions in the class, such as the login authentication, content sharing, interaction, etc. Information is stored in the teaching database, which is managed by the class server.

Lots of tools [4] are executed at each client site in the class to help the learning process. The *shared annotation browser*, *audio narrator* and *SMIL player* are used with teacher-based floor control for content sharing and interaction. Only the teacher or one student at a time, if the teacher gives him/her the tool's floor through the class server, can control all instances of the tool in the class. This shared annotation browser integrates functions of web browser and shared whiteboard. The floor holder can use annotation functions to draw figures or type texts on the pages. All students in the class can have the same view for the HTML teaching pages after these actions. Audio narrator supports real time transmission of the floor holder's audio narration to others during the class. Beside the shared annotation browser and audio narrator, the SMIL player supports real-time multimedia presentations. The SMIL standard provides a framework for specifying when, how and where multimedia streams will play on a web-based multimedia presentation. With media streaming technology, multimedia data can be displayed at the time received by the SMIL player, without waiting for long delays before downloading the entire media file.

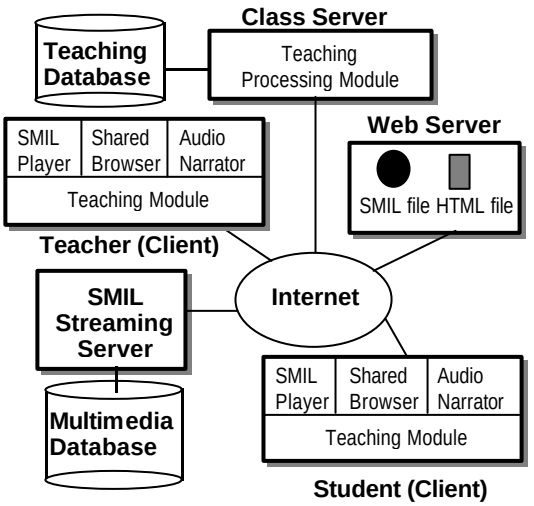

Figure 1. System Architecture.

Scenario of using this SMIL-based real-time interactive system is as follows. Before the class, the teacher can use the SMIL

authoring tool to prepare SMIL multimedia presentations and add hyperlinks for them on the teaching web pages. These HTML and SMIL files are stored on the web server. When the class starts, the teacher and all students will execute the shared annotation browser and audio narrator on their own sites. Then the teacher opens web pages with the shared browser. URLs of the pages are first sent to the teaching processing module of the class server, then to the teaching modules and shared browsers of all students. Each shared browser then individually sends HTTP requests to the destination web server specified in the URL to retrieve the page. Other browser actions, such as window scrolling and annotations, are handled in the same way. Hence, all the teacher and students have the same view for the page. Whenever the teacher wants to show a SMIL presentation, he/she just clicks on the hyperlink and then its URL is sent to the shared browsers of all students, as described above. Each shared browser sends a HTTP request to get the SMIL file on the web server. As the shared browser receives the SMIL file, it executes the SMIL player to parse the SMIL file for its temporal and spatial relationships. The SMIL player then sends requests to the SMIL streaming server to access media data. Through the streaming server, these media data is streamed to the SMIL player and played back synchronously. Audio narration of the audio narrator and playback actions, such as pause, fast-forward, position tracking, stop, etc., of the SMIL player are handled similarly. Consequently, this distance learning system provides the teacher and all students a real-time, interactive and content-sharing environment.

3. IMPLEMENTATION ISSUES

This system is implemented on Microsoft NT 4.0 and Windows 95/98. Underlying network is the 10Mbps Ethernet LAN. System modules and tools are implemented by Borland C++ Builder 3.0. Current supported media types of the SMIL player are static text, dynamic text, wave audio (.wav), and AVI/MPEG-1 video (.avi /.mpg). The streaming server is multi-threaded to support several concurrent SMIL players of the teacher and students.

A HTML teaching page on the shared annotation browser is shown in Figure 2. The teacher uses annotation functions to point out location of the Canadian Tundra on the map with a line and write down a blue and underlined sentence, *Tundra is here!* After the teacher clicks on the hyperlink below the map, all clients in the class will see the SMIL presentation for the tundra on their own SMIL players, which is shown in Figure 3. There are three images on the upper left part of the window, one is the text image, and the other two are images for yaks. A MPEG-1 video clip where a man is talking is shown at the upper right corner of the window. Further, a paragraph of dynamic text is scrolling up on the lower right part of the window. All the media data is displayed synchronously.

In current implementation, the shared browser and SMIL player of each client individually connect to the web server and streaming server to access data. Multiple copies of HTML web pages and SMIL media data are sent, which consume network bandwidth quickly. Integration of the class server and multimedia proxy server to cache these data is necessary to improve performance and scalability.

4. CONCLUSIONS

In this paper, the SMIL-based multimedia distance learning system, which supports content-sharing, interactive and real-time presentation capabilities, is proposed and implemented. Geographically dispersed students can devote themselves on the learning process over the network just as they are in the traditional face-to-face classes.

5. REFERENCES

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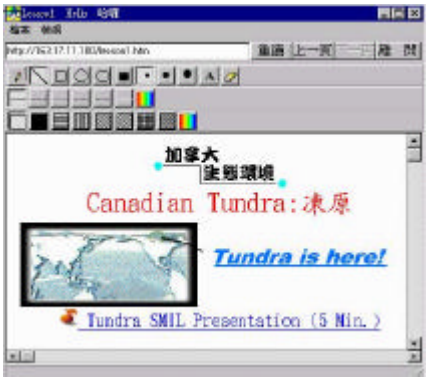

Figure 2. A teaching page on the shared browser

Figure 3. A SMIL multimedia presentation on the SMIL player.