Developing of Internet-based Virtual Collaboration and Multimedia Content Authoring System to Compose Virtual Conference

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Abstract

The development of Internet technologies and computer devices make it possible to move communication space from the real world to virtual worlds. Thus, there is an increasing need for virtual communication or virtual collaboration tools which enable users to communicate or work with others in virtual space wherever and whenever. In this paper, we propose an Internet-based virtual collaboration system supporting multimedia presentation. The proposed system provides two main functions. One is a content authoring function for creating multimedia presentation and the other is a virtual collaboration function for offering conferences that helps users exchange their opinions. The authoring function uses Synchronous Multimedia Integration Language (SMIL) that integrates and synchronizes media objects such as text, images, and video. While making a multimedia content, text or drawing can be used as annotations over images in layered architecture. In virtual collaboration, users can use digital images and spatial data elements which are used to represent users’ opinions and areas of interest in images. From conferences, users’ opinions along with coordinate information can be stored into XML database using Unstructured Information Management Architecture (UIMA).

Keywords: Virtual Collaboration, XML, Multimedia Content, Digital Image Annotation, Distance Conference, SMIL, UIMA

1. Introduction

Due to advances in Internet and multimedia technologies, the Internet usage has continued to increase rapidly and it became possible to move communication space from the real world to virtual worlds. Therefore, Internet based communication using computers or mobile devices has emerged as an important method of communication and there is an increasing need for virtual communication or virtual collaboration tools which enable users to communicate or work with others in virtual space through the Internet wherever and whenever. Especially, for education or research area, Internet based virtual learning or virtual collaboration may be expected as an effective method.

Wu et al., [1] proposed a conference control framework to integrate and control heterogeneous collaboration solutions and implemented a collaboration system based on the framework. Fox et al., [2] proposed a global multimedia collaboration system that support various collaboration services such as video conferencing and implemented it based on XGSP

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Web-Services framework in USA and China. Bouras et al., [3] proposed a web-based virtual collaboration space called Educational Virtual Environment (EVE) which provides e-learning services such as forums, chat, and e-mail in synchronous and asynchronous modes. Pooshfam et al., [4] proposed a system for annotating images and videos in a collaborative way. Bouyakoub et al., [5, 6] proposed a temporal authoring environment for building SMIL document with incremental method based on H-SMIL-Net model. Ha et al., [7] have proposed a system that enables to create SMIL document from temporal scripts and UML sequence diagram to improve reusability.

In this paper, we propose a new way that enables users to learn or collaborate with others in virtual space through the Internet. The proposed system provides virtual collaboration space called a conference which is held by user’s request with administrator’s approval and supports users to exchange or leave their opinions using annotations over digital images in layered architecture. The proposed system also provides multimedia content authoring function that enables users to produce their own contents from media objects using SMIL. From conferences, users’ opinions along with coordinate information can be recorded into XML database in real time and unstructured data may be converted into structured data using UIMA.

2. UIMA

The Unstructured Information Management Architecture (UIMA) [8-11] is a software framework developed by IBM, and currently the Apache foundation is supporting UIMA as an open source project. UIMA makes it possible to change unstructured information to structured information by adding structure (annotation) to original data. Figure 1 shows the basic concept of UIMA framework.

![Figure 1. Basic Concept of UIMA Framework](image)

UIMA consists of several components which communicate each other in order to exchange data. In general collection analysis processing, UIMA is composed of the following primary components: Collection Readers, Analysis Engines, and Common Analysis Structure (CAS) Consumers [12, 13]. A collection reader reads unstructured data such as text, audio, and video and sends the data gathered to an analysis engine in CAS. CAS defines a data structure that is exchanged between components. The analysis engine which contains an annotator analyzes the data received from the collection reader to search specific data as instances, and produces an analysis result including metadata. Data analysis is processed by performing a series of analysis engines. At each level of analysis, an analysis engine adds annotations into CAS and sends its analysis result to next sequenced analysis engine. Annotations are accumulated in
CAS until the analysis processing is completed. Finally, CAS consumers generate structured data that may be stored into files or a database. XML descriptors are used to configure UIMA components. In the proposed system, unstructured data along with associated elements recorded from synchronous and asynchronous collaboration can be changed into structured data and can be stored into XML database by using UIMA.

3. SMIL

The Synchronized Multimedia Integration Language (SMIL) [14, 15] is a XML based markup language by W3C recommendation which enables users to create multimedia presentation files. SMIL integrates diverse media elements such as text, images, video and audio by synchronizing them in temporal and spatial terms. The proposed system provides multimedia content authoring function using SMIL for presentation.

4. Content Authoring

The proposed system provides an integrated graphical authoring environment for users who want to produce multimedia contents from media objects. Media objects are integrated and synchronized with the temporal and spatial information into a single multimedia content using SMIL. The system architecture of the content authoring function is shown in Figure 2.

![Figure 2. System Architecture of Content Authoring](image)

It has been designed and implemented using Java with JMF and JDOM. We have used NetBeans IDE 7.2.1 development environment. The content authoring function is composed of the following modules.

- Initialization module: This module facilitates creating a new presentation by initializing other modules. It creates a presentation folder, and road slide images and video or ready to record video. It specifies the layout that defines the regions of media objects.
- Recording module: It records video and audio during a presentation and enables the author to view the video screen being currently recorded during the recording progress by using JMF. Existing video and audio can be played and showed by this module.
- Encoding module: This module converts a recorded video into streaming format and compresses the size of video.

- Timing module: It specifies the time duration of a presentation with time stamp by author's command. It records the beginning and end time with time stamp for the video and audio and calculates the total time duration for the presentation. When author's command is occurred for images, this module specifies the beginning time and time duration of each image, and uses that information to synchronize media objects.

- Compiling module: This module corrects the temporal and spatial information about media objects from other modules and compiles it. It provides the functionality enabling to generate a SMIL for synchronizing media objects.

- Editing Module: It allows an author to change the slide images in existing presentations to different slides. When this module is activated, it reads a SMIL document. Each editing operation by author’s command is reflected immediately to SMIL document.

While producing a multimedia content, annotations can be added by drawing or writing on images in layered architecture that separate images from annotations. Annotations are stored as images and synchronized with the slides.

5. Virtual Collaboration

The proposed collaboration system offers multiple virtual conferences which enable users to communicate or collaborate with others in virtual space. A conference must be created by the system administrator upon the user’s request. Once a conference is created, detail topics can be created and be associated with the conference. Users can join multiple topics or can be assigned to multiple conferences at the same time. The proposed system provides an independent (or not tied with the main window) private window. The discussion and any shared data in a private session are hidden from the other members. In a shared window, the viewpoints of all users are synchronized. If any user expresses opinion using a symbol and comment, the content of every participating client object is updated simultaneously.

Figure 3. Communication Architecture between Server and Client

Figure 3 shows the communication architecture between a server and a client. First, a session manager in a client side tries to establish a socket communication with a connection manager in a server side. After socket connection, each working applet in a client side
communicates with a topic manager independently using multi-thread operations. When the client objects and topic manager communicate, parameters can be passed as objects that contain participants’ opinion or request by way of serialization. On the server side, topic manager invokes XML converter and have the objects saved into a database so that they can be available for the client objects in searching and fast loading.

In the proposed system, users can collaborate in synchronous and asynchronous modes. In a synchronous mode, the state changes are multicast and updated to other users’ views synchronously so that all users can see the same view. However, asynchronous collaboration is also possible by allowing users to log on the topic at their convenient time and leave new marks and comments at any time because other’s opinions and their related information are saved in a database. All the relevant image files should be available to the entire user throughout the collaboration. Each user’s opinion will be recorded into XML database using UIMA and be available for the future reference.

In virtual collaboration, users can use images and annotations which are used to represent users’ opinions and areas of interest in images in layered architecture that separate images from annotation. In the annotation layer, various symbols such as arrows and/or polygons that is associated with x-y coordinates that represent the location on the image.

6. Conclusions

In this paper, we have proposed a new virtual collaboration and multimedia content authoring system that enables users to learn or collaborate with others through the Internet. The proposed system provides a virtual space called a conference where users can exchange or leave their opinions over digital images and can do presentation. The proposed system also offers multimedia content authoring function that enables users to produce their own contents from media objects using SMIL. From conferences, users’ opinions along with coordinate information can be recorded into XML files in real time and may be stored as structured data into a database using UIMA for future context based intelligent search. Our system may be expected as an effective tool in education or research.

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References


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