A Presentation Semantic Model for Asynchronous Distance Learning Paradigm

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ABSTRACT

This paper presents a presentation semantic model that is based on the augmented transition network (ATN) for asynchronous distance learning system called Java-based Integrated Asynchronous Distance Learning (JIADL) system. The JIADL system can support diverse asynchronous distance learning services. Unlike most related work in the literature, we integrate RealPlayer and Java technology so that the superiority of both models can be complemented. A course sample is illustrated to validate the effectiveness of the paradigm proposed. How to use the proposed multimedia ATN model to model the diverse requirements of a distance learning multimedia presentation is also discussed. The multimedia ATN model is powerful in modeling the asynchronization for distance learning multimedia presentations. Furthermore, in addition to supporting asynchronous distance learning, our system can be applied to a wide range of potential value-added applications.

1. INTRODUCTION

Recently, with the innovation of new network infrastructures, the development of multimedia technology and the diverse requirements asked by end-users, distance learning has become the mainstream of computer-based training (CBT). The seamless integration of the overwhelming WWW and the emerging Java technology [1] further endorses the universal accessibility to diverse distance learning services. In this paper, we present a project supported by Ministry of Education, R.O.C. and implemented at National Kaohsiung First University of Science and Technology (NKFUST). This project is aimed at digitizing and distributing video tapes recorded in a synchronous distance learning classroom to improve curriculums, to provide another channel for learning, and to complement synchronous/asynchronous learning. In order to broaden the functions and the effectiveness of such service, a number of interactive and cooperative services are integrated by mainly applying Java technology, which results in the paradigm of Java-based integrated asynchronous distance learning system (JIADL).

In this paper, a multimedia semantic model based on the augmented transition network (ATN) is proposed to model the distance learning multimedia presentations for the JIADL system. The proposed multimedia ATN model differs from the original ATN model by allowing the modeling of the multimedia presentations in addition to the sentence grammar checking. Multimedia input strings are used as the inputs for the multimedia ATN model. The multimedia input strings have the capabilities to capture the temporal relationships of the media streams, and to model the concurrent and optional displaying of the media streams in a distance learning multimedia presentation.

The proposed JIADL system integrates both the RealPlayer and Java technology. An example course is used to illustrate how a distance learning course can be modeled by the multimedia ATN model. The multimedia ATN model is powerful in modeling the asynchronization for distance learning multimedia presentations. Furthermore, in addition to supporting asynchronous distance learning, this JIADL system which is based on the multimedia ATN semantic model can be used in many potential value-added applications such as cultural heritage multimedia applications, marketing for electronic commerce, multimedia digital libraries, and lifelong learning.

The remaining of the paper is as follows. Section 2 outlines the components in the JIADL system with an example course. Section 3 introduces the multimedia ATN model and how to use the multimedia ATN model to model the example course. Section 4 concludes this paper.

2. THE JIADL PARADIGM

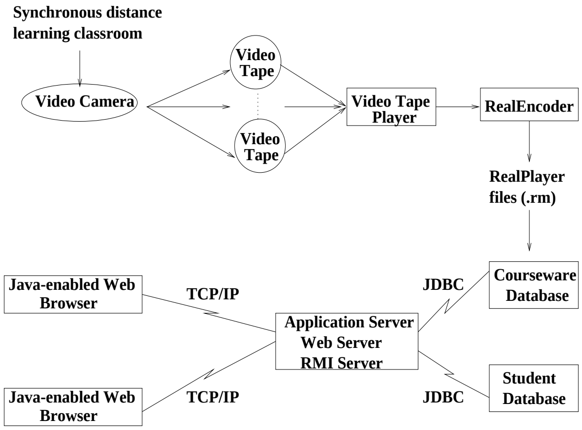

Figure 1: The JIADL paradigm.

The high-level architecture of the JIADL paradigm is outlined in Figure 1. The archived lecture contents are converted into RealVideo files by RealEncoder in advance and are stored in the Courseware database. Mobile learners may download the system applets from Web Server and retrieve the courseware of interest via the JDBC mechanism. The student database keeps records of students' learning progresses and personal registration information. RMI Server supports the collaborative learning in chat rooms. Currently, the platform for Application Server, Web Server, and RMI Server is on NT4.0. An example course offered by the Center of General Education at NKFUST had been experimented on the JIADL Paradigm. The lecture was broadcast in live video from NKFUST to four neighboring universities via three ISDN dedicated lines at 384K.

There are three subsystems in the JIADL system.

- **StudDBMS.** Any students including ones in the classes can log into the JIADL system by registering it in advance. The StudDBMS subsystem allows learners to query and modify personal information besides registration.
- **CourseDBMS.** The CourseDBMS subsystem endows the lecturers or administrators to manage the digitized courseware.
- **CyberLearn.** The CyberLearn subsystem is the kernel part of the JIADL paradigm. It allows the student to browse the static lecture notes and/or the corresponding video lecture. After students specify their student ID, Password, and the course information, they click on the OK button to activate the window as shown in Figure 2.

Empowered by Real Player G2 [2], the student is granted to the capability in controlling voice and lecture progress. Other further functionality like lecture clips can also be easily implemented. One important supplementary function for mobile learners is the Notes Area (the bottom area in Figure 2), in which the learners may write down the notes and send them via the SMTP protocol. One notes that the

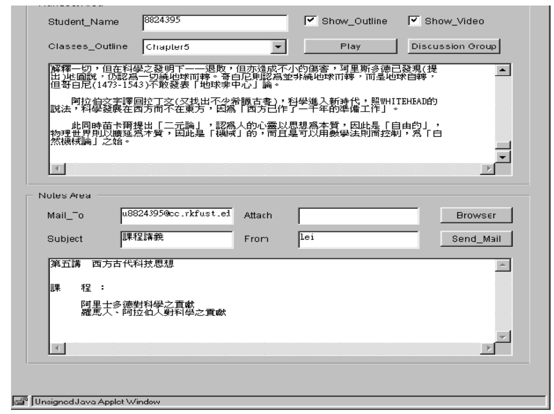

Figure 2: The CyberLearn subsystem.

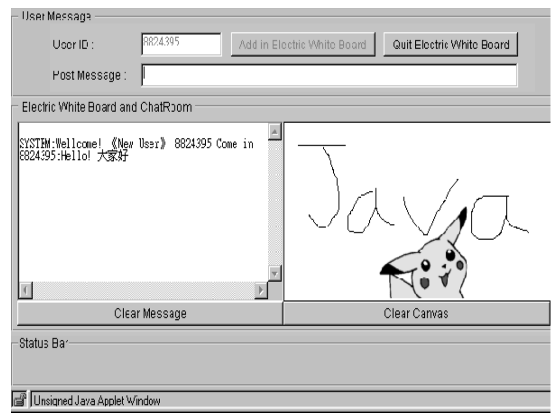

Figure 3: The whiteboard subsystem.

capability of attaching MIME objects from the local learning environment is incorporated. From the learning theory, learners of distance learning are not expected to sit still and stare at the lectures consistently. To improve the learning interaction, an interactive multi-user chat room and a collaborative real-time whiteboard are offered, which are based on Java RMI distributed computing model. Figure 3 depicts the layout of such services, where a number of vivid images can be added into the whiteboard.

3. USING MULTIMEDIA ATNS TO MODEL PRESENTATIONS IN JIADL

The augmented transition network (ATN), developed by Woods [5], has been used in natural language understanding systems and question answering systems for both text and speech. The proposed multimedia ATN that is based on the ATN with modifications can model multimedia presentations, multimedia database searching, the temporal, spatial, or spatio-temporal relations of various media streams and semantic objects, and multimedia browsing [3].

A multimedia ATN consists of nodes (states) and arcs. Each state has a state name and each arc has an arc label. Each arc label represents the media streams to be displayed in a time duration. Therefore, time intervals can be represented by a multimedia ATN. In the multimedia ATN, a new state

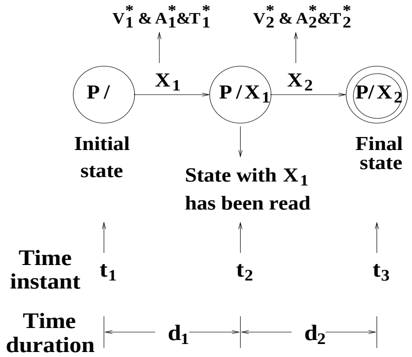

Figure 4: A multimedia ATN for an example multimedia presentation.

is created whenever there is any change of media streams in the presentation. The two situations for the change of media streams are shown as follows.

(1) Any media stream finishes to display;
(2) Any new media stream joins to display.

Figure 4 is a multimedia ATN for an example multimedia presentation in the JIADL system. There are three time instants (t_1 to t_3) and two time durations (d_1 and d_2). There are two occurrences of media stream combinations at each time duration and they are:

(1) Duration d_1: V_1, A_1, and T_1.
(2) Duration d_2: V_2, A_2, and T_2.

As shown in Figure 4, there are three states and two arcs which represent three time instants and two time durations, respectively. State names are in the circles to indicate the presentation status. State name $P/$ means the beginning of the multimedia ATN (presentation) and state P/X_i represents that presentation P just finishes to display X_i and the presentation can proceed without knowing the complete history of the past. For example, state name P/X_1 denotes the state after X_1 has been read. The reason to use X_i is for convenience purposes. In fact X_1 can be replaced by $V_1^* \& A_1^* \& T_1^*$. State name P/X_2 is the final state of the multimedia ATN to indicate the end of the presentation. Each arc label X_i in Figure 4 is created to represent the media stream combination for each duration. For example, arc label X_1 represents media streams V_1, A_1, and T_1 display together at duration d_1. A new arc is created when new media streams V_2, A_2, and T_2 start to display.

When an ATN is used for language understanding, the input for the ATN is a sentence which consists of a sequence of words with linear order. In a multimedia presentation, when user interactions such as user selections and loops are allowed, then we cannot use sentences as the inputs for a multimedia ATN. In our design, each arc in a multimedia ATN is a string containing one or more media streams displayed at the same time. A media stream is represented by a letter subscripted by some digits. This single letter represents the media stream type and digits are used to denote various media streams of the same media stream type. For example, T_1 means a text media stream with identification number one. A multimedia input string consists of one or more media streams and is used as an input for a multimedia ATN. Multimedia input strings adopt the notations from regular expressions. Regular expressions [4] are useful descriptors of patterns such as tokens used in a programming language. Regular expressions provide convenient ways of specifying a certain set of strings. A multimedia input string may consist of several input symbols and each of them represents the media streams to be displayed at a time interval. In our framework, multimedia input strings are used to represent the presentation sequences of the temporal media streams. A multimedia input string goes from the left to right, which can represent the time sequence of a multimedia presentation as shown in string (1).

$$\text{Multimedia input string: } (V_1^* \& A_1^* \& T_1^*)(V_2^* \& A_2^* \& T_2^*) \quad (1)$$

In string (1), the "&" between two media streams indicates these two media streams are displayed concurrently. The "*" symbol is used to indicate the media stream which can be dropped in the on-line presentation. For example, $V_1^* \& A_1^* \& T_1^*$ represents media streams V_1, A_1, and T_1 being displayed concurrently but each of them can be dropped if Show_Outline and/or Show_Video buttons are not highlighted.

4. CONCLUSION

In this paper, we presented the JIADL system which is based on the proposed multimedia ATN model for supporting asynchronous distance learning. The inputs for a multimedia ATN are modeled by the multimedia input strings. The multimedia input strings have the capabilities to capture the temporal relationships of the media streams, and to model the concurrent and optional displaying of the media streams in a distance learning multimedia presentation.

As far as the references surveyed, our work presented is the pioneering study in the literature towards integrating RealPlay G2 and Java JMF in the distance learning application. In addition to supporting asynchronous distance learning, the paradigm has a variety of potential value-added applications. For example, The National Palace Museum of R.O.C. had published a series of video tapes, a preview function can be simply provided in the JIADL paradigm.

5. REFERENCES

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