A Multilingual Scenic Learning Environment

Timothy K. Shih[1], Hun-hui Hsu[2], Che-Yu Yang[3]

[1,3]Dept. of CS&IE
[2]Dept. of French Language and Litrature

Tamkang University
Tamsui, Taipei, 251, Taiwan, ROC
Email: [3]yang@schummi.com

Jiung-yao Huang[4], Lun-Ping Hung[5]

[4]Dept. of CS&IE
National Chung Cheng University

[5]Dept. of Information Management
Kuang Wu Institute of Technology

Abstract

Nowadays the information technology is developing quickly, the Internet technology and resource change with each passing day. This project utilizes the digitalization method to simulate the traditional teaching model, and provides not only multimedia presentation, but also the related webpage resource and 3-D VR synchronous dialogue system. These technologies construct a virtual foreign language learning classroom which helps all kind of people to learn foreign language.

As a test of our system, we use French as an example, and then will extend to the other foreign languages later.

Our teaching model simulates the traditional teaching model, and consists of "classroom teaching", "off classroom practice" and "after class review" three parts, described as follows:

- Classroom teaching: simulates the traditional classroom teaching by using the technology of multimedia presentation, such as video, audio, pictures and slides presentation.
- Off classroom practice: uses the virtual reality technology to provide an interactive role-playing conversation environment just like the real world dialogue.
- After class review: cooperates with the lesson topics and web page resource recommendation to extend the learning space.

Our distance learning system of the virtual French classroom not only integrates "real-time multi-broadcasting", "lecture-on-demand" and "World Wide Web", but also includes the function of "virtual reality practice", "multimedia teaching materials" and "topic editing".

Without the limitation of time and space, our system not only fulfills the individual learner's need, but also promotes the spirits of study, and constructs a "life-time study society".

For the implementation of our Multilingual Scenic Learning Environment, you can visit the website http://i-class.fr.tku.edu.tw.

Keywords: distance learning, scenic environment, virtual reality, multimedia adaptive presentation, content recommendation.

1. Introduction

The core idea is to use information technology to simulate traditional real world learning. As shown in figure 1, we integrate several kinds of information technologies to simulate the procedure of traditional real world learning – “Classroom teaching” -> “Off classroom practice” -> “After class review”. They are implemented in three corresponding sub-projects, as described in follows.

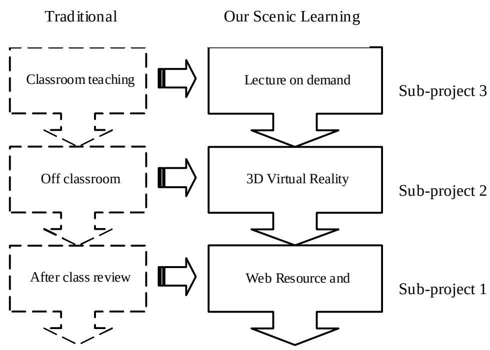

Figure 1: relations between traditional learning and our learning environment

Co-project 3 is the simulation of traditional classroom teaching - the lecture-on-demand video integrated with the interactive multimedia slides. This makes it possible for students to attend the class anywhere anytime, without the time and space limitation.

Co-project 2 is the simulation of “off classroom practice”. The instructor composes a script/scenario which is then used to construct a virtual reality scene with live audio and text chat functionalities. The students can practice language, such as conversation, dialog, with each others in the virtual world. This makes it possible for students to do after school practice without having to get together physically.

Co-project 1 is the simulation of “After class review”. It is the extension of the classroom teaching (co-project 3). The instructor prepares the course content related information as supplementary reading or knowledge into webpages. Besides, according to students’ navigation activities, our system can recommend something might interest them. This makes students widening the scope of knowledge, enlarging learning space and having widespread interests that classroom teaching hardly offers.

We have carried out an example course of French teaching. One lesson is about French food. In the system of lecture on demand (sub-project 3), instructor introduces some background knowledge about French food, such as dining manners, famous food, famous restaurants, French wine, local delicious ..., etc. In the system of virtual 3D environment (sub-project 2), students practice how to read and order from food menu in French through being in a “virtual” French restaurant. In the system of web-content recommendation (sub-project 1), students can browse webpages about various foods, such as chocolate, cheese, wine, coffee; or other additional detailed information, and they will get feedback with recommendation with something they might be interested in but have not read yet.

In the following sections, we will illustrate each of the three subsystems in detail respectively.

2. Lecture on Demand Virtual Classroom

Lecture-on-Demand (LOD) multimedia presentation technologies among the network are most often used in many communication services. The main goal of our system is to provide a feasible method to record and represent a lecture/presentation in the air. In this sub-system, we research how to present different multimedia objects on a web-based presentation system. The distributed approach is based on an extended timed Petri net model [1, 2, 3]. Using characterization of extended media streaming technologies, we developed a Web-based

Multimedia Presentation System (WMPS). Using the browser with the windows media services allows students to view live video of the teacher giving his speech, along with synchronized images of his presentation slides and all the annotations/comments.

2.1 WMPS System Architecture

The architecture of WMPS consists of several major components, namely *user interface, encoder engine, media synchronization manager and web publisher manager*. The system block diagram of the architecture is shown in figure 2.

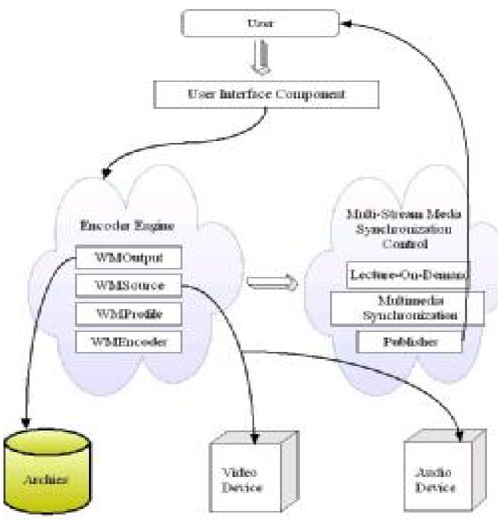

Figure 2: Component grouped for the purpose of WMPS.

2.2 WMPS System Operations

This section shows several examples of WMPS operations. The examples illustrate the user setup phase, record and integrated media synchronization control phase operations. The serving components in these examples interwork the transferring transactions/messages. Due to the space limitation, the detail explanation can be found in [13].

<u>User setup phase</u>

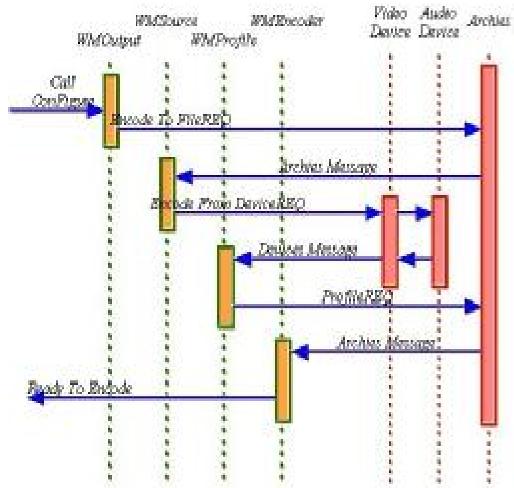

Figure 3: The user setup phase

Figure 3 shows the user setup phase operation. The major operations in this phase are provided by user interface component.

<u>Record and integrated medias synchronization control phase</u>

The record and integrated media synchronization control [5,6] phase is illustrated in figure 4.

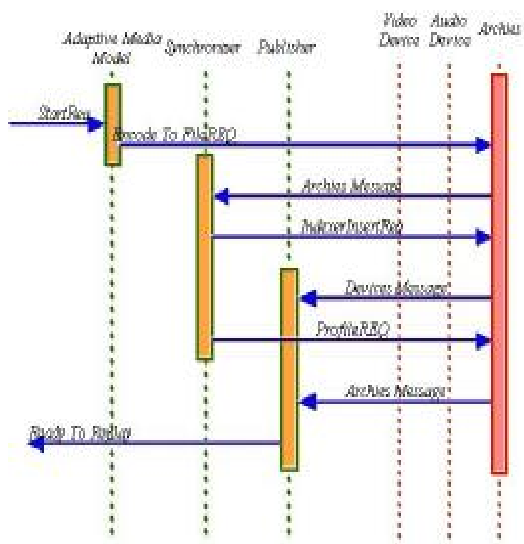

Figure 4: The record and integrated medias synchronization control phase

2.3 A Multiple Level Content Tree for Abstraction

Given a web-based multimedia presentation, the corresponding multiple level content tree can be constructed, as shown in Figure 5. A teaching material can be taken as a multimedia presentation with some kinds of sequence fashion. The multiple level content tree approach may be used to arrive at an efficient summarizing and combination method.

The *level* of a node is defined by initially letting the root be at level 0. If a node is at level q, then its children are at level q+1. Since a node is composed of a presentation *segment*, the *siblings* with the order from left to right represent a presentation with some sequence fashion. The higher level gives the longer presentation. Consequently, this approach gives flexible teaching material; accordingly, it is very fit for the web-based multimedia presentation.

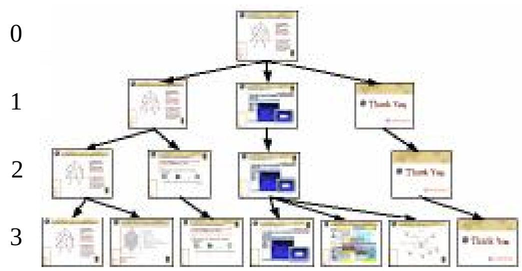

Figure 5: An example of multiple level content tree.

2.4 Implementation

The following are some interfaces and demostration of the implementation.

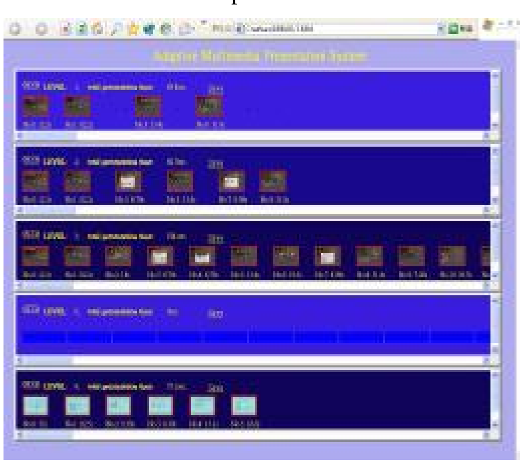

Figure 9: A Multi-level content tree

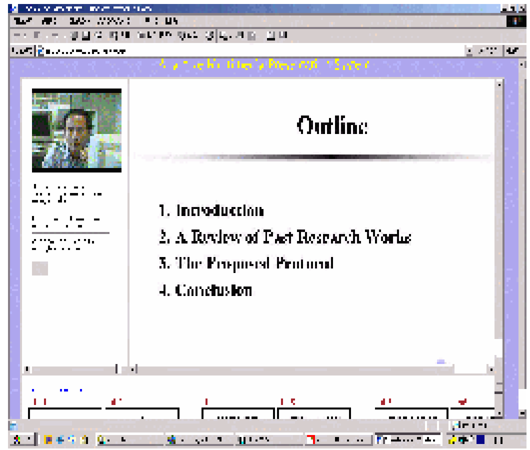

Figure 10: A example of Presentations presentation multimedia of the web-based

3. Collaborative Virtual Environment for Multilingual Learning

The main objective of the research is to construct a distributed multi-server interactive framework suitable for multilingual learning, which can not only simulate the real world learning environment by using virtual reality technique, but further provide network services that the real world learning environment does not have.

We try to utilize the framework of distributed server [9] to get efficient management of lingual learning in virtual environment, using the optimized landscape specifications to overcome the difficulty of server-side bottleneck of network flow in the interactive virtual environment, lifting up the capability of meantime online-users, and realize the goal of virtual reality lingual learning environment.

3.1 Architecture of cluster server

One goal of the system is to construct a server cluster environment. As the framework is a 3D multi-user interactive environment, every user (client) plays a role in the virtual environment - users do interactive activities with each other in this 3D space. Here a virtual role controlled by a user (client) is called an "Avatar".

In the research of cluster server, we use the position of Avatars in the virtual world to divide users into groups, and each group is managed by a server in the server cluster. This increases the capability of the meantime online users. As the figure 11 shows, we divide the whole virtual world into several areas, the Avatars active within an area are managed by a server. An Avatar is controlled by a single client, and a client can control only one Avatar. So the client controlling an Avatar only needs to communicate with the server which manages the Avatar.

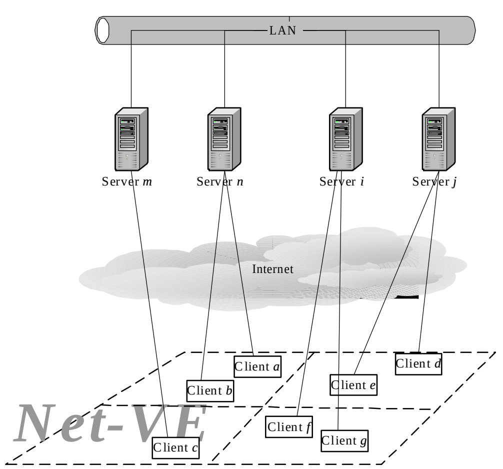

Figure 11: architecture of cluster server

As an Avatar travels in the virtual environment, whenever the Avatar walks through two different areas, the control right will be transferred from the original server in charge of the original area to the server in charge of the later area. This makes the server management more efficient. The principle of the management is as following.

First, we let two servers in charge of two neighbor areas overlap some sub-area with each other, here the servers in charge of two neighbor areas are called "Chained Servers", and the overlapped area is called a "Border". When an Avatar moves into a Border, it intends to travel across two areas, and we treat it as to transfer from one server to another server. As we can see in figure 12, when an Avatar walks into a Border (here the border is B) from area A to area C, the server in charge of area A (here it is Server m) will setup a connection to the server in charge of area C (here it is Server n). And the Border is the overlapped area (B) of two Chain Servers, the neighbor server (here it is server n) will construct a "Shadow Object" in it's Border area (here it is B). The Avatar in the original server is name "Proxy Object".

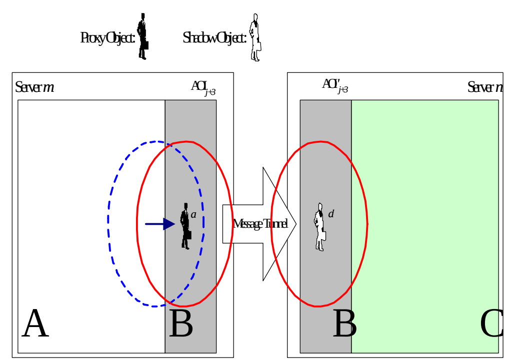

Figure 12: the migration of an Avatar

3.2 Avatar Migration

Figure 13 is an example of the status update actions when an Avatar is doing an "Avatar Migration". Due to the space limitation, the detail explanation can be found in [7, 11].

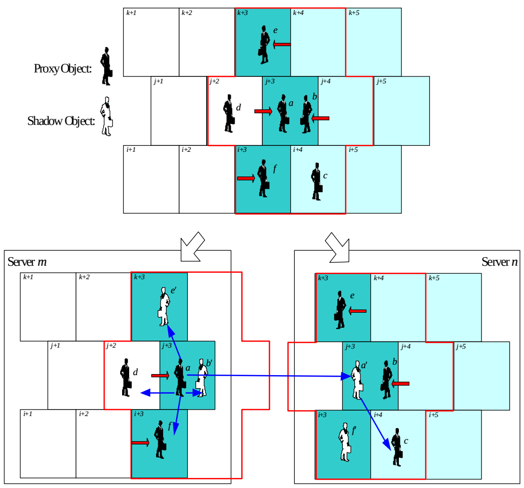

Figure 13: status update during an "Avatar Migration".

3.3 Implementation

Here we define some important functions that virtual distance education environment should have nowadays:

Traditional dynamic web-pages: the interactive web-pages.

Interactive capability in 3D space: interaction of movement and interaction of space.

Interactive between 3D space and 2D space: as they are complementary in some area.

Text chat capability: provide interaction with keyboard or other similar equipments.

Voice chat capability: voice interaction between users.

URL sending and linking: provide extra information to each other.

According to the above functions, we designed a user interface, as shown in figure 14.

Figure 14: An instance of user interface of the virtual environment.

In lingual learning domain, both text and voice are very important. Our system provides both text chat and voice chat to users for online real-time communication. We integrate Microsoft's NetMeeting to implement the voice chat. Both the content of text chat and voice chat can be recorded to files, and instructors can supervise the students according to their record files.

4. Culture Study and Sociology Analysis for web-based Content

This subsystem mainly simulates the "after class review" of the traditional education in the real world. After class review: cooperates with the lesson topics and web page resource to extend the learning space.

Instructor publishes supplementary reading or course relative extracurricular information to our system website, these webpages is composed in the foreign language. Students can browse the webpages according to their interests. Through the utilization of information technology, and the cooperation of the webpage resource in foreign language, we can not only provide lingual learning source systematically, but also support what may be insufficient in the classroom teaching.

Besides, through the recommendation procedure [12], we can extend students' interests and enrich their knowledge.

4.1 Recommendation system architecture

The recommendation system we proposed consists of 6 components — User Assistant Agents, User Behavior Generation Component, Recommendation Generation Component, Recommendation Delivery Component and Information Center. Figure 15 is the system architecture overview.

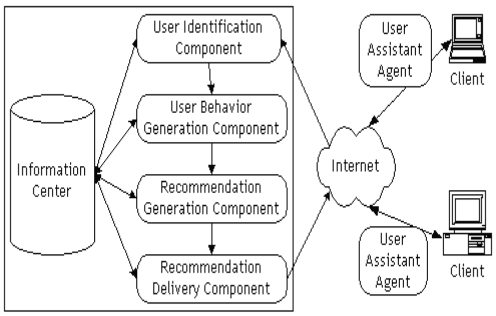

Figure 15: Recommendation system architecture.

4.2 The Webpage-Keyword-User Model

According to the users' browsing records, we further build a three-view analysis model — the WKU Model. Each view expresses an analysis matrix. Figure 16 shows the WKU model.

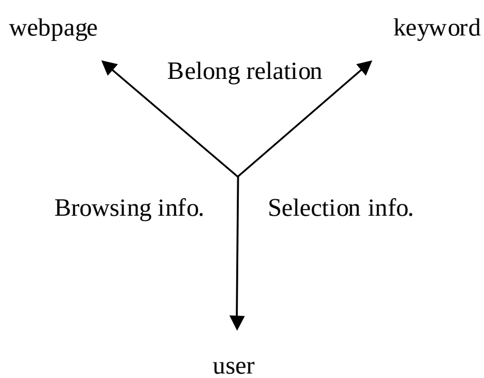

Figure 16: Webpage-Keyword-User Model

We explain each "view" of the model as below.

User-Webpage Matrix

Table 1 is the logical view of the User-Webpage matrix. If a user i used a webpage j, then the UiWj will be filled with '1', otherwise, it would be filled with '0'.

Table 1: User-Webpage matrix

Webpage Identification

User Identification

	W_1	W_2	W_3				W_n	
U_1								UCI_1
U_2								UCI_2
					U_iW_j			
U_m							U_mW_n	UCI_m
	WCI_1	WCI_2	WCI_3				WCI_n	

For users, we can use the *UCI* to find which users have widespread interests; for webpages, we can use the *WCI* to find which webpages are potentially popular webpages. The *UCI* and *WCI* are calculated as follows:

- User Caution Index (UCI)

$$UCIi = \frac{\sum_{j=1}^{n} UiWj}{n},$$

where U_iW_j is the matrix's content and n is the total number of the webpages.

- Webpage Caution Index (WCI)

$$TCIj = \frac{\sum_{i=1}^{m} UiWj}{m},$$

where U_iW_j is the matrix's content and m is the total number of the users.

Keyword-Webpage Matrix

The logical view of the Keyword-Webpage matrix is similar to the logical view of the User-Webpage matrix.

The Keyword-Webpage matrix shows that some webpages have some keywords that express the content of the webpages. If webpage *i* has keyword *j*, then the K_iW_j will be filled with '1', otherwise, it would be filled with '0'. This table/matrix is established by information retrieval technique.

User-Keyword Matrix

This matrix represents that someone is interested in a webpage and focuses on the webpage's keyword. In the previous section we built browsing records for the users; now, we extract the information into the *navigation vector*. Each user has a navigation vector respect to a webpage. According to the navigation vector, we compare users with each others to find their co-relation and then classify the users into heterogeneous groups. A navigation vector of a webpage for the user *i* looks like: $NVi = (k_1 , k_2 ,k_3 ,\ldots, k_n)$, where the webpage has *n* keywords. We compute the elements of the navigation vector by the following equation:

$$navigation\_vector\_element\_m = \frac{\sum k_m}{K} \times avg(k_m),$$

where

$$avg(k_m) = \frac{time\_of(K_m)}{total\_time(W_j)}$$

, m is the number of keywords which the user navigated, time_of(Km) is the total times the user navigated the keyword Km, total_time(Wj) is the total time the user navigated the webpage j.

And we use Final Navigation Vector to update the user's latest preference:

$FNVi = old(FNVi) \times W_1 + (k1, k2, k3, \ldots kn) \times W_2$,

where $W_1 + W2 = 1$, $(k_1, k_2, k_3, \ldots k_n)$ is the new FNV value of the user *i*. W_1, W_2 is a set of factors which is adjusted according to the user's response to the recommendation. If the user accepts our recommendation, we will enhance the factor W_2; if the user doesn't accept our recommendation, we will enhance the factor W_1. The approach is the basic evaluation of our system and the fundamental method to update the user profile. The logical view of the User-Keyword matrix is similar.

4.3 Recommendation events and process

We have 3 major recommendation events, as the following:

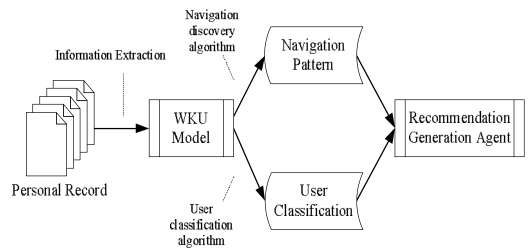

Figure 17: Recommendation process of the existing users

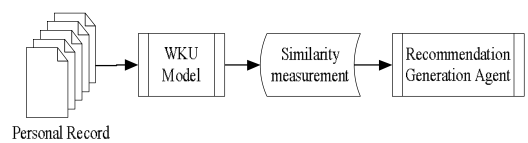

Figure 18: Recommendation process to the new users

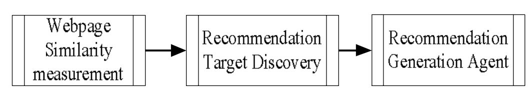

Figure 19: Recommendation new webpages to the users

5. Conclusion

In this research, we have utilized the information technologies to simulate the traditional teaching model, where the idea of such a simulation of more completed learning flow is not often seen nowadays. Our system provides not only multimedia presentation, but also the related webpage resource and 3-D VR synchronous dialogue system. These technologies construct a virtual foreign language learning classroom which helps all kind of people to learn foreign language.

As a test of our system, we use French as an example, and hope to extend to the other foreign languages in the future.

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