UNIVERSITI PUTRA MALAYSIA

A WEB-BASED DYNAMIC AND INTERACTIVE DISTANCE LEARNING SYSTEM

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By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

API	-	Application Programmer Interface
ATM	-	Asynchronous Transfer Mode
CBT	-	Computer-Based Training
CGI	-	Common Gateway Interface
CORBA	-	Common Object Request Broker Architecture
FTP	-	File Transfer Protocol
GUI	-	Graphic User Interface
HTML	-	Hyper Text Markup Language
HTTP	-	Hyper Text Transfer Protocol
ILS	-	Integrated Learning System
IP	-	Internet Protocol
JDBC	-	Java Database Connectivity
JVM	-	Java Virtual Machine
ODBC	-	Object Database Connectivity
ORB	-	Object Request Broker
POP	-	Post Office Protocol
RDBMS	-	Relational Database Management System
SMTP	-	Simple Mail Transfer Protocol
SQL	-	Sequence Query Language
URL	-	Uniform Resource Locator
WWW	-	World Wide Web

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

A WEB-BASED DYNAMIC AND INTERACTIVE DISTANCE LEARNING SYSTEM

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Chairman : Associate Professor Borhanuddin Mohd. Ali, Ph.D.

Faculty : Engineering

Presently, advances in Internet technology and the human-computer interface have created a wealth of new opportunities for the development of web-based interactive distance learning systems. However, most of the effort of developing the system focused on the information receiver and less on helping the information provider in delivering the information.

This thesis describes WebEd, a user-friendly system that facilitates the information provider or the instructor to carry out web-based courses. The WebEd approach is to make the instructor centrally involved and maintain the ownership of their courses. It also enables the students to access the course and interact with the instructor with the aid of the system provided services. The system supports various services for system management, communications, file management, and content management and retrieval. Some of the examples of services provided by the system are Appointment Manager, Announcement Board, Content Manager, etc.

WebEd distance learning system is dynamic and interactive, being developed using Java and CGI script. A *JavaCGI* proxy has been developed to handle the dynamically generated pages and services.

The system is built on a 3-tier architecture which splits the system processing load between the client-side workstation that runs on a browser, web server that sends HTTP commands over a network and WebEd services that handle the web-based distance learning activities. No installations are required in order to access the system as the courses are accessible via a browser.

An evaluation on the system has been conducted in getting users feedback. Analyses based on the system evaluation have been carried out to identify weaknesses of the system. Finally, the system limitations and proposed solutions are suggested for future enhancement of the system.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia untuk memenuhi keperluan ijazah Master Sains.

SISTEM PEMBELAJARAN JARAK JAUH YANG DINAMIK DAN INTERAKTIF BERASASKAN INTERNET

Oleh

LOW WAI YAN

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Pengerusi : Profesor Madya Borhanuddin Mohd. Ali, Ph.D.

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Pada masa kini kemajuan dalam teknologi Internet dan pengantara-muka manusia-komputer telah menghasilkan banyak peluang untuk membangunkan sistem pembelajaran jarak jauh berasaskan Web yang interaktif. Walau bagaimanapun, kebanyakan usaha telah ditumpukan dalam aspek penerima informasi dan tidak banyak membantu pembekal informasi dalam kerja penyaluran informasi tersebut.

Tesis ini memerihalkan WebEd iaitu satu sistem mesra pengguna yang menolong pembekal informasi atau pengajar mengendali kursus yang berasaskan Web. Pendekatan WebEd ialah dengan melibatkan pengajar secara terus dan mengendalikan kursus tersebut. Ia juga membolehkan pelajar mencapai kursus dan berinteraksi dengan pengajar dengan bantuan perkhidmatan yang disediakan oleh sistem itu. Sistem ini menyokong pelbagai perkhidmatan untuk pengurusan sistem, komunikasi, pengurusan fail and pengurusan dan pengambilan kandungan. Contoh

perkhidmatan yang disediakan oleh sistem ini adalah Pengurus Temujanji, Papan Pengumuman, Pengurus Kandungan dan sebagainya.

WebEd, iaitu satu sistem pembelajaran berasaskan Web yang dinamik dan interaktif, menggunakan Java dan CGI script. Wakil *JavaCGI* telah dicipta untuk menangani kandungan and perkhidmatan yang dinamik.

System ini dicipta di atas senibina 3-lapisan yang mengagihkan beban sistem pemprosesannya antara terminal pelanggan yang berfungsi atas broswer, pelayan web yang menghantar arahan HTTP melalui rangkaian dan perkhidmatan WebEd yang menangani aktiviti pembelajaran berasaskan Web. Tiada pemasangan diperlukan untuk menggunakannya kerana kursus boleh didapati melalui browser.

Satu penilaian telah dilakukan untuk mendapatkan tindak balas daripada pengguna. Analisis yang berdasarkan ke atas penilaian sistem itu telah dijalankan untuk mengenalpasti kelemahan sistem ini. Akhirnya, kekurangan sistem serta cadangan untuk memperbaiki sistem ini adalah dikemukakan.

CHAPTER I

INTRODUCTION

Definition of Distance Learning

A classic short definition of distance learning or distance education is referenced in a paper by Grimes (1993) as "Any formal approach to learning in which the majority of the instruction occurs while the educator and learner are at a distance from each other."

The United States Distance Learning Association defines distance learning as "The acquisition of knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance."

In general, distance learning is the exchange of curricular materials between an instructor and students located at distant sites, for example through the correspondence programs, TV and radio broadcast. Typical methods of distance learning with some form of two-way communications between them include:

- Multiple user audio-only conferencing
- One-way video/two-way audio via satellite
- Two way video and audio conferencing
- World Wide Web-based access to educational programs

There are some significant motivations and benefits of distance learning over traditional learning, such as:

- **Flexible access by the student**. Through distance learning, students can access the courses from more than one location, rather than only at the institute or instructor's location. This makes the course more easily accessed by the students everywhere.
- **Improved access to instructors and courses**. Distance learning makes it possible to provide students at a given location with access to instructors and course offerings from several different institutes. This gives students chances to access more instructors and courses.
- **Cost Effective**. The cost of conducting the distance learning is comparatively lower than traditional learning programs as there are less faculty members involved and less facilities required in distance learning. As for the student, there is no extra transportation or accommodation fee needed for distance learning. This is definitely an advantage to those who enroll in the distance learning program.
- **Sharing of resources**. Distance learning makes it possible for course materials at one institute to be used at other institutes. Thus, different distance learning providers can collaborate in producing higher quantity and quality of course materials. Consequently, more students can be benefit from the vast amount of resources through the distance learning delivery mechanism. At the same time, it resolves the problems of lack of experts and teaching manpower.

Since the 1980s (Maddux, 1997), distance learning programs have integrated many of the new technologies, including satellite, voice response systems, interactive compressed video, computer software, and, most recently, the World Wide Web (WWW). Distance learning program that utilizes WWW as the curricular medium is called as web-based distance learning.

Web-based distance learning is a process that enables students to pursue their study at the time and place of their choosing by using Internet, electronic devices, multimedia tools and the WWW. Web-based distance learning systems are asynchronous, and the prepared lectures are available via the Internet through web browsers. The front-ends are most often designed in HTML, enriched by Java, JavaScript, or Dynamic HTML.

Advantages of Using WWW in Distance Learning

Internet, specifically, the WWW has been chosen for the course delivery tool in the proposed distance learning system for the following advantages:

1. Networking allows communities of distributed students to be able to access the course material. The course can be delivered remotely via modem and network without any geographically restrictions. It also enables sharing of resources, where instructional resources at one institute can be shared with others.
2. The course material is located centrally in one or more web servers; no diskette is needed to distribute. The material is only needed to be published once in the web servers, and enabling them to be accessed by unlimited numbers of users from distant sites.

3. The WWW enables seamless integration of materials from many sites. For example, Lesson One can be in Malaysia, and Lesson Two in Singapore. This creates the opportunity to enlist participation by multiple faculty members at multiple sites and establish consortia to develop rich, cross-specialty distance learning program.
4. Web-based course delivery provides ease of updating and expansion of the course material. New information can be uploaded as quickly as transferring hypertext document to the web server, producing course materials that may be years ahead of textbooks.
5. No special software is needed; the students need only a web browser to access the course material. The graphical browsers provide a user-friendly interface that learners only have to learn once. A web browser is a free, familiar, and easy tool for students to set up. And the course provider does not require any expensive software and extensive amount of time for authoring hypertext documents for content materials, as there are many free HTML editors available over the Internet.
6. Another advantage of using WWW as hypertext delivery medium in distance learning is the platform independent feature of WWW. Platform independence means that the course material provider no longer has to worry about producing separate versions of course materials for Macintosh, DOS and Windows.

Therefore, a personal computer, nearly any operation system, a web browser, a modem, a land-line telephone connection enable entrance to the web and thus web-based distance learning system independent of time and location.

Limitations in Web-based Distance Learning

However, there are also some limitations in web-based distance learning, as follows:

1. Networked access to the server may be slow, especially if operating over a modem. This might discourage the student to log in and access the course material regularly.
2. The web-based distance learning is not able to keep track of the student's participation and progress through a course like the traditional lecture-based learning. The reason is lack of face-to-face meeting between the instructor and the students. Additional efforts must be carried out in order to monitor the student's participation through a web-based distance learning course.
3. HTML as an authoring tool is not as sophisticated as other commercial tools. Thus the completed presentation of the course content may not be as fantastic. It is, by nature, static and pages are simply read from the web server and transmitted to the browser for display. However, JavaScript and Java applet and other Internet technologies can be embedded into the web in order to enhance the functionality and interactivity of the course content. One may also make use of CGI to add additional functionality in the form of CGI scripts.
4. The cross-platform, browser-driven nature of HTML document may display complexity. Different browsers and platforms display the screen differently, sometimes leading to dismaying results. The page may nicely fit the screen on the development computer, but may be oversized on a user's computer, requiring the user to scroll to see the whole screen. Older versions and less sophisticated

browsers may also do unpredictable things to the user's computer display, particularly in the display of tables and frames.

5. Publishing the course material on the web server is a tedious task that should be carried out by the course instructor. The published course material should be updated from time to time to make sure that the students always access the latest information. Most of these tasks are assigned to the teaching assistance or system administrator. This might be considered as a waste of resources. However, the system can be designed in such a way that it provides the instructor a mechanism in updating the course material easily.

El-Tigi and Branch (1997) reported that most of the web sites that are dedicated to distance learning lack interaction, learner control, and feedback. These sites are not being designed to support active learning but merely to present the course material in a passive-learning format. It is essential that Internet be used as an interactive educational technology in which active usage and learning are the primary objectives.

Research Direction in Distance Learning System

Applying the WWW to distance learning is a major field of research nowadays. Through the Internet and its communication technologies, researches and studies become focus on the possibilities offered by this new technology for distance learning (Ausserhofer, 1999). Creating web-based course contents is easy; however, delivering the contents, managing the class and motivating the students are difficult

especially with the rapidly increasing number of documents for the course content (Azuma, 1999) and students involvement in the class.

In fact, a system should be designed to be used as an accompanying tool to increase the students' interest in the course and encourage them to participate in the class. An efficient distance learning system must also help the students to understand better the ideas and concepts taught in the course by allowing them to interact productively with course materials.

Besides, a good web-based distance learning system should facilitate the instructor in delivering the course without any assistance from the system administrator. The instructors should be able to deliver and update the course contents in a timely fashion, manage the link structure of the course contents and interact with the students more frequently with the aids of the tools provided by the system.

As distance learning system is being used by students and instructors for different purposes, a layered design should be used to handle the system access right, where different groups of the users are restricted to perform certain tasks. Besides, different groups of students are restricted to take part of certain course materials or perform certain network-intensive features. This also prevents slowing down Internet performance but enable access to the allowed services.

In fact, a lot of effort is being spent in research for a good system architecture design, useful system functionality and accompanying tools for efficient distance learning.

Objectives

This project is part of a TEMAN (Testbed Environment For Malaysian Multimedia Applications and Networking) project sponsored by IRPA (Intensification of Research in Priority Areas). One of the aims of this project is to create an interactive and intelligent distance learning environment to run over the national ATM network. Currently the research has been refocused to Ethernet running IP since the complete testbed ATM network is not yet set up.

The objectives of this project are to investigate the distance learning options that uses the current communication technologies to:

- Create a distance learning system that facilitates ease of management and maintenance.
- Develop a flexible content delivery system that enable instructor to publish their lecture on-line without any assistance from the system administrator.
- Create an interactive environment for effective learning by utilizing various technologies such as Java, JavaScript and CGI script.
- Provide an effective two-way communication between the instructor and the students for distance learning purposes.

Organization

This thesis is divided into six chapters. Chapter I is an introductory chapter, it provides a brief introduction to distance learning and lists out the objectives of this project. Chapter II is a literature review on distance learning issues. The relevant technologies and their prospects in web-based distance learning are covered here.

Chapter II also discusses the desirable features and supporting tools that should exist in an effective distance learning system. Some of these discussed features are included in the present thesis project.

WebEd is a web-based distance learning system that was developed in Department of Computer and Communication Systems in Faculty of Engineering, UPM. The WebEd distance learning system requirements are presented in Chapter III. Chapter IV describes the system architecture and implementation. The system evaluation analysis, findings and the lessons learned are presented in Chapter V. Finally, Chapter VI draws the conclusion of this project and discusses future works for the system enhancement.

CHAPTER II

LITERATURE REVIEW

Introduction

The concept of computer-based training (CBT) dated back to the late 1960s and early 1970s (Vetter, 1997). But the desktop PC revolution of the early 1980s quickly led to a proliferation of CBT, delivered first on floppy disk, then CD-ROM, and now the web. It is now clear that web-based distance learning is becoming an important part of the learning environment, especially in North America, Europe and some Asian countries.

There are at least three approaches to web-based distance learning: real-time web-based learning, non-real-time learning, and a combination of these two. Real-time web-based learning attempts to create virtual classrooms in that they preserve the traditional roles of a teacher and a group of students meeting at the same time over the Internet. In non-real-time web-based learning, the student downloads the course from the web and takes the instruction at his or her convenience.

From the majority of distance learning systems studied, one can be summed up that there are three most important elements, which should be available in a complete distance learning environment. These three basic elements are course material, student assessment and communications. Typical student assessments are