

# Design and Implementation of a Software Package for Network Education

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**Abstract:** Recently, network education has emerged as an important Internet application. It not only avoids the limitation of physical learning locations but also keeps the flexibility of teaching time. By multimedia mechanisms and interactive technologies, students can enjoy a multimedia learning environment according to their needs. However, the current network education system mainly provides basic functionality and it may not meet our need for full interactivity. In this paper, a network education system, called Ceiba-3 (standing for Collaborative Enhanced Instruction By Asynchronous learning, version 3), is developed by the Computer and Network Center at National Taiwan University to improve the network education. By the integration of Web interface with internetworking and backend databases, the idea of virtual classroom is realized via Ceiba-3. Currently, the system provides a friendly environment for faculties to construct their own homepages without requiring any advanced knowledge of HTML, CGI, or Java. With a visual editor within the browser, homepages can then be generated on the fly by simple key strokes and mouse clicks. Other important functions devised include the homework assignment/grading system, the student management system, discussion boards, online chatting room, the calendar/schedule service, and list-serv mailing lists. Furthermore, the analysis report in Ceiba-3, which contains homepage access and student browsing statistics, will help teachers to follow both individual and overall learning behaviors from students. As a pioneering project toward the goal of e-school at National Taiwan University, Ceiba is generally accepted in the campus and has greatly facilitated the interaction between faculties and students.

**Keywords:** Distance learning, network education, World Wide Web

## 1. Introduction

The recent fast growth of the Web technology has greatly stimulated the next revolution in the Internet society. Web browsers are widely deployed in all computers. Among others, network education has emerged as an important Internet application since it not only avoids the limitation of physical learning locations but also keeps the flexibility of teaching time [1,2,4,5,6,7,8]. As a consequence, traditional CAI (Computer Aided Instruction) programs based on proprietary systems are gradually migrating to those with the Web-based home page style. The Ceiba (standing for Collaborative Enhanced Instruction By Asynchronous learning) project is a project being carried out by the Computer and Network Center at National Taiwan University. The primary goal of this project is to support the network education environment in the university campus. We would like to provide such a cyberspace for teachers to publish their course materials. In addition to the static materials, interactive functions for bi-directional communication between students and faculties are also provided in Ceiba-3. By the integration of Web interface with internetworking and backend databases, the idea of virtual classroom is realized via Ceiba-3. Currently, the system provides a friendly environment for faculties to construct their own homepages without requiring any advanced knowledge of HTML, CGI, or Java. With a visual editor within the browser, homepages can then be generated on the fly by simple key strokes and mouse clicks. Other important functions devised include the homework assignment/grading system, the student management system, discussion boards, online chatting room, the calendar/schedule service, and list-serv mailing lists. Furthermore, the analysis report in Ceiba-3, which contains homepage access and student browsing statistics, will help teachers to follow both individual and overall learning behaviors from students after proper data mining [3]. As a pioneering project toward the goal of e-school at National

Taiwan University, Ceiba is generally accepted in the campus and has greatly facilitated the interaction between faculties and students. The teaching quality in these Web courses can thus be improved.

This paper is organized as follows. Section 2 describes the background information of this project. Section 3 presents some design issues of the Ceiba system. Section 4 cover some aspects of the system implementation. Section 5 concludes this paper.

## **2. Background**

### *2.1 Motivation*

Distance learning via ISDN, a project supported by Ministry of Education, has been available for several years. It offers great help for students who are far away from classrooms and those who are in different universities. Under the distance learning activities, the geographical barrier does not exist anymore. However, according to the survey and the results of some on-site visits, the remote students under the distance learning activities did not feel as comfortable as local students to have the two-way communication with faculties. This is partly due to the limitation of equipment and partly due to the lack of sense of belonging of remote students. In view of this, Ceiba-3 intends to provide many interactive features, for both on-line and off-line use, to facilitate the two-way communication between students and faculties, thereby alleviating the lack of sense of belonging of remote students as far as possible.

### *2.2 Technical barriers for homepage authoring*

Although most faculties have already realized the necessity of network education and are willing to do so, the barriers of computer skill are yet to overcome. Thus, the capability of simple word processing is equipped in Ceiba to facilitate the course preparation of faculties. In addition to homepage authoring, maintaining a Web server is a big challenge. In view of this, Ceiba-3 is equipped with many useful tools, including those for homework submission, on-line editing, easy management for student records with an aid by a backend database. These will certain increase the incentive for faculties and students to be involved in the distance learning activities.

## **3. Description of Selected Functions of Ceiba**

### *3.1 Easy homepage authoring and maintenance*

Ceiba provides a graphic user interface of structural file system management. Users (faculties and students) can upload and maintain their own files efficiently. To ease the task of homepage authoring, a user friendly on-line editor was devised to generate homepage on an interactive manner. Just following the instructions on the screen, with several mouse clicks and key strokes, a homepage can be produced effectively. It is very easy to construct the whole Web site by employing this mechanism. Homepages can then be authored on users' own PC locally and upload to the server when they are finished. With the above tools, faculties are then isolated from some technical details they do not have to know and are able to concentrate on their lecture preparation.

### *3.2 Course assistant utilities*

One of the very first utilities built is that for homework assignment. Using the devised mechanism in Ceiba homework can be assigned on the Web and a submission deadline can also be set and enforced. Students can then download the homework description file as well as upload their own work upon completion. Comments and grading are also performed directly on the Web. In addition, simple analysis such as average and standard deviation can be calculated automatically.

Moreover, a calendar/schedule system is developed. Teachers can always update the schedule of their classes. Also, acting as a reminder, the system will notify the students taking that class periodically before an event (quiz, homework due date, etc) is approaching. It is worth mentioning that we provide an extensible interface for other plug-in modules to be incorporated into the system. At the time of writing, a language learning system on English is also being developed in our center [9]. Another project aiming at the on-line examination mechanism is also in progress.

### *3.3 Communication tools*

A full list of students taking the course is provided for each course. Teachers can use the list to send an email to either some or all of them. Such kind of email-to-all function is of practical use and in fact needed by many faculties according to our survey. Discussion boards similar to BBS (bulletin board system) is also available in Ceiba. Whereas course announcement can only be posted by faculties, mechanisms for questions and discussions are open to the public. As requested by some teachers, a function to create multiple discussion boards is also provided, and the faculties can thus assign different groups of students to have their own boards. In contrast to the nature of being asynchronous for the discussion boards, a synchronous communication facility is devised in Ceiba. Explicitly, we develop an on-line chat room for everyone to interact in real time. As a consequence, the office hour of faculties will no longer need to be in the real office.

#### *3.4 Automation without human intervention*

As one of the major improvements of the Ceiba, a mechanism for database linking and synchronization is developed. All of the course information and student lists can be obtained from the database of Office of the Dean of Academic Affairs at the university. This means that teachers do not have to fill lots of forms when conducting their course registration in Ceiba. Further, we also establish connections to the account database in the computer center. Users only have to maintain one account from now on.

#### *3.5 User behavior tracking system*

Teachers would usually like to know the browsing status of their class Web sites. By re-designing the whole system, data mining for user behavior can now be conducted, with user's consent of course. An account is required before one can enter the system. The result is that every connection is fully recorded including "Who, When, Where, How, and What." Therefore, further analysis for the user behavior can be performed easily. Currently, a report regarding homepage hit counts, time distribution, individual browsing status, and total browsing user list is available. Advanced analysis is also being conducted.

### **4. System implementation**

The system is designed to be a three-tier client-server architecture (Figure 4.1). The server side includes an application server and backend databases. The application server acts as a Web server and also the interface to exchange data with backend databases. Data manipulation is also performed on the application server. Note that it is important to communicate among the heterogeneous databases built on different platforms. The operating system we choose is FreeBSD, one of the major systems for Internet service. Also, we use Apache as our Web server for its stability and extensibility. SSL (secure socket layer) which provides a secure connection for data transmission is also employed. For the Web page programming part, we use PHP for the whole data manipulation. PHP is an HTML-embedded scripting language that is able to generate dynamic homepages per requests. In addition, all the database queries are done by PHP codes.

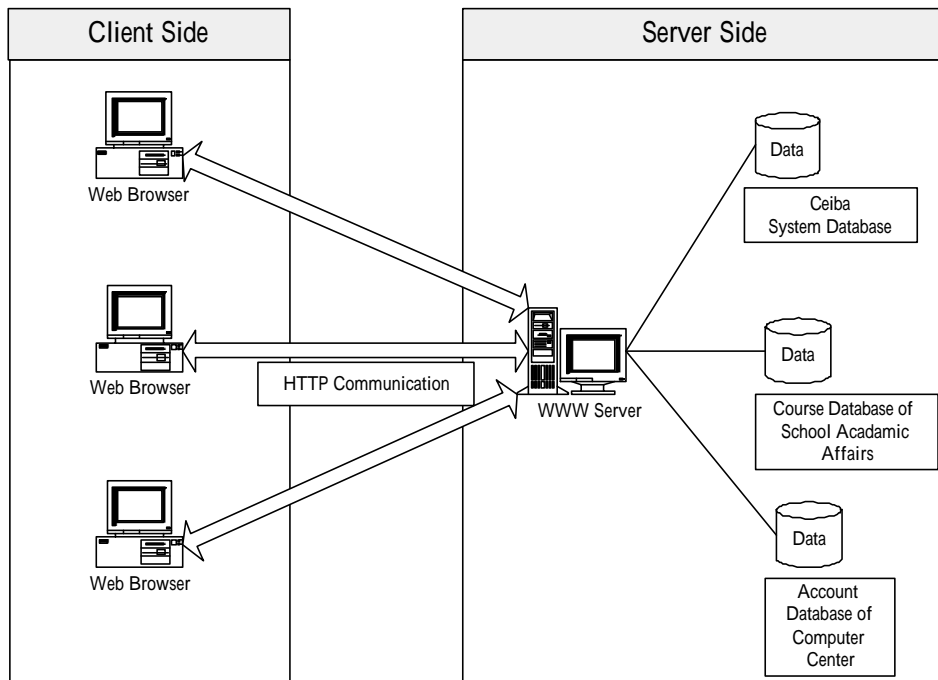


Figure 4.1 The architecture of Ceiba system

The client side is mainly a Web browser which has in fact become an essential part of a computer. The communication protocol employed is the standard HTTP (HyperText Transfer Protocol). For security concern, we use the enhanced HTTPS with data encryption. Since the system requires access control, we have to ensure the account and password information not to be eavesdropped while it is transferred over the Internet.

Two Web pages in Ceiba-3 are shown here for illustrative purposes. Figure 4.2 is the interface for new course registering. Teachers are able to add whatever courses they wish to offer. Figure 4.3 shows the personalized homepage of a student. The course enrollment list is the first page after a successful login of a student, thus providing a customized homepage for every user.

Figure 4.2 Course registering homepage

班次	學號	課程名稱
526 U0990		視窗程式設計製作
741 N0210		多變量分析
523 N0040	08	專題討論
523 N1910	45	專題研究
523 U02100		人工智慧
921 U1000		多媒體網路
503 10210	02	計算機程式

by 非同學工作小組 [\(c\) 國立台灣大學計算機及通訊網路中心](#)

Figure 4.3 Personalized homepage for students

## 5. Conclusion

In this paper, Ceiba-3, developed by the Computer and Network Center at National Taiwan University to improve the network education, is described. By the integration of Web interface with internetworking and backend databases, the idea of virtual classroom is realized via Ceiba-3. Currently, the system provides a friendly environment for faculties to construct their own homepages without requiring any advanced knowledge of HTML, CGI, or Java. With a visual editor within the browser, homepages can then be generated on the fly by simple key strokes and mouse clicks. Other important functions devised include the homework assignment/grading system, the student management system, discussion boards, online chatting room, the calendar/schedule service, and list-serv mailing lists. Data mining for students' behavior can also be conducted in Ceiba-3. As a pioneering project toward the goal of e-school at National Taiwan University, Ceiba is generally accepted in the campus and has greatly facilitated the interaction between faculties and students. The teaching quality in these Web courses can thus be improved.

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