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Development of a Web-based Virtual Classroom System at the Federal University of Technology, Akure, Nigeria

B.A. Ojokoh and V.F. Balogun

Department of Computer Science, Federal University of Technology,
P.M.B. 704, Akure, Nigeria.
bolanleojokoh@yahoo.com

Abstract

The Internet is about the biggest technological advancement since the industrial revolution, and has fundamentally changed virtually every sphere of life, including educational paradigms and practice. This research work harnessed the joint and several advantages of the Web and its tools to design and write programs that run in the browser to implement a cost effective collaborative virtual classroom system. In the research, Apache served as the web server; HTML was used to edit the web pages; Javascript for data validation; MySQL for creating the database tables; and PHP for writing CGI scripts. This paper focuses on the student module of the collaborative virtual classroom system, which was designed and implemented in the Computer Science department of the Federal University of Technology, Akure (FUTA), Nigeria. The system provides such facilities as University news and calendar, results checking, course registration, online admission, and teaching support tools. The system also facilitates easy updates and maintenance.

Keywords

Collaborative learning, Virtual classroom, Nigeria, Tertiary education, online learning

Introduction

We now live in a fast changing world where improvement over existing operations appears to be the driving force for better life. This is largely due to the information revolution through which the computer and communication technologies have permeated virtually all human activities, including education. The fast changing world poses a challenge to educational and computer professionals, particularly website designers to design new technologies for delivering education at all levels.

Schools and educators have the responsibility to prepare young students to be future leaders within their environment. Schools and teachers need to know how to utilize technological advancement to promote education, and students need to be inspired to entertain new ideas, new technologies and adapt them to life. Nigerian universities need to join their counterparts in developed countries to utilize up-to-date technologies like Collaborative Virtual Classroom (CVC) to enhance the education of their students and help them overcome the time and cost constraints they face.

Collaborative learning is a process that emphasizes group or cooperative efforts among faculty and students, active participation and interaction on the part of both students and instructors, and new knowledge that emerges from an active

dialogue among those who are sharing ideas and information (Smith and MacGregor, 1992). This new conception of learning shifts away the focus from the teacher-student interaction to the role of peer relationships in educational success (Johnson, 1981). Collaborative Virtual Classroom helps to empower, enable and connect students around the world using Internet technology. It aims to provide students the opportunity of developing three skills that are essential in the 21st century - Cross-cultural communication, Collaboration and Computer skills. Collaborative virtual classroom applications give "virtual classroom" applications, with an emphasis on learner-participation. In this case, the Internet is used for communication; teacher / facilitator-to-learner communication, as well as learner-learner communication. Study materials are available on the World Wide Web (WWW), but the WWW as a medium for imparting knowledge is not the major focus. The prime emphasis is on simulating and improving on the level of class interaction and participation. Collaborative projects are carried out where learners depend on one another for input to tasks and activities, yet remain individually as well as jointly accountable (Bouton and Garth, 1983; Whipple, 1987; Gokhale, 2002; Spurlock-Johnson et al., 2004).

Collaborative Virtual Classroom also serves as Internet–managed instruction. In this case, course management, as well as the management of an entire institution, is done via the Internet. Actual teaching, instruction, lesson presentation and tutorials are done on the web, hence reducing the stress that students may face when required to take part in face-to-face learning sessions. Moreover, all course-related communication involving teachers and students can be conducted online via-e-mail and discussion forums. CVC technologies emphasize asynchronous communication, which means that there is no need to attend classes scheduled for certain days or specific hours; the study guides which include course materials, assignment and assessments are developed as Web-pages.

Considering the wave of technological advancement, it is necessary to provide a conceptual framework that will facilitate online education, which can serve as a substitute for or complement to traditional classroom education. In the traditional classroom method of learning (Chubb, 2006):

(i) the delivering of training is slow; there is no access to training for students when and where they need it;
(ii) the cost of learning (including fees, acquisition textbooks and other materials) is high;
(iii) there is specific timeframe according to instructions schedule, which make each delivery not consistent;
(iv) learners cannot learn in their preferred styles;
(v) there are less opportunities for learners to communicate; and
(vi) the physical environment in terms of lighting, comfort, group size, trainer competence and learner competence most times are not conducive for learning.

The forces that have driven a rapidly increasing number of universities worldwide to adopt and incorporate information and communications technology (ICT) in teaching and learning include (Richardson and Turner, 2001; O'Donoghue et al., 2004; Kavanagh et al., 2004):

(i) Greater information access;
(ii) Greater communication facilities;
(iii) Quality of teaching;
(iv) ICT skills acquisition;
(v) Asynchronous learning;
(vi) Pedagogical improvement and staff renewal;
(vii) Cost effectiveness.

The evolution of Collaborative Virtual Classroom technologies provides valuable opportunities for university-level education in Nigeria. The acceptance and availability of CVC in Nigerian universities will provide an integrated information infrastructure to support and enhance web-based learning and educational administration services. These services will cover such educational administration tasks as student enrolment, online access to and provision of student and subject information and provision of subject content modules or lecture notes from the most renowned expertise of professionals in the field of teaching to students.

The significance of Collaborative Virtual Classroom technologies to Nigerian university communities and their students, teachers and administrators, as well as the society at large cannot be over emphasized. They will increase the efficiency and productivity of the academic staff and

adult learners with shared base of knowledge, skills and values, improve the universities, image and enhance the whole learning environment.

This preceding discussion highlights the urgent need for Nigerian universities to develop and use Collaborative Virtual Classroom technologies that take into account both the universal good practices in such technologies, as well as local conditions.

This paper discusses the learning aspect of a research work carried out to design a Collaborative Virtual Classroom. A prototype of the system was implemented in the Department of Computer Science of Federal University of Technology, Akure, Nigeria.

Related Work

Fundamental to computer-mediated communication systems is the concept of being able to utilize the capabilities of a computer to tailor human communication process to the nature of the application and the group undertaking this application (Hiltz and Turoff, 1993; Turoff, 1991).

A number of researches have been conducted so far on Virtual and particularly Collaborative Classrooms. Hiltz (1998) confirmed that Collaborative learning designs are more effective for online learning than pedagogical approaches that emphasize individuals working alone with materials posted online. He stated that software structures can be constructed which will support group collaboration, although they can only facilitate the desired behaviour, not produce it. From his study, he discovered that for the group to adapt a structure of interaction that is collaborative in nature, the instructor must mould, model, and encourage the desired behaviour, and the students must be able and willing to participate regularly. He further recommended that the question of how to build and sustain online learning communities is a prime area where researchers on Asynchronous Learning Networks ought to be focusing their efforts.

Turoff (1995) reviewed the software functionality that has evolved over the past two decades of research in Computer Mediated Communications at New Jersey Institute of Technology, Newark NJ, USA to create a Virtual Classroom to support distance education. The multimedia Virtual Classroom courseware allowed the author who publishes the on-line classroom courseware and the user who browses the available information and contributes to the authoring as a participant. Based upon many years of evaluating the effectiveness of this approach to remote education, he summarized his views about the software functionality needed for further improvement of the approach to distance education. He emphasized the need for integration into a single interface that is easy to learn for the sake of usability and user acceptance of the software. In addition, he recommended the use of the technology to facilitate multiple instructors, multiple courses, material used across different course sequences, training on the job, and numerous other requirements that in themselves can add to the requirements for software functionality.

Gibson and Rutherford (1998) developed a method implemented in the "OTEN Information Technology Virtual Classrooms". This method, incorporating a listserv, newsgroup and Web pages, allows questions, answers and additional comments to be embedded in all the learning materials in the most relevant places, hence allowing some interactions to take place. It allows the usual class exchanges to occur and also saves them in context for the next student to use. They reported that "Apart from helping to create a feeling of belonging to a class, this also improves the quality of the teaching resources because after a time the teacher can review and edit these annotations and make use of them to improve the content of the next edition."

System Design and Implementation

Design Objectives

The system aims at giving an effective, interactive and cost-effective channel for promoting online learning, for teaching and instruction, and for delivering and taking tutorial practices, on the web. It emulates and improves upon the nature of class interaction and participation, while providing a means of disseminating information to students both on and off campus.

Since the system involves online client-server activities, it is built on the WWW framework. This provides a cost effective way of publishing information, supporting collaboration and workflow and delivering scientific application to connected users all over the world.

Access to the Internet is essential for the design of the new system. Since all learning activities are done online, access to secured information is controlled through a registration process and user passwords.

Data Collection and Analysis

The research was conducted, firstly, by means of an extensive review of current related literature. A thorough study of the current methods of teaching and learning was also carried out, thereby understanding the teaching and learning requirements, constraints and inadequacies. Afterwards, relevant data collection was done through study of the departmental handbook, collection of sample lecture notes from the lecturers, and personal interview with some members of the school.

Design and Programming Tools

The design of the system was done using Hypertext Markup Language (HTML) to create plain text and image files; JavaScript, for client – side validation; PHP, which is a server side application program, to write CGI scripts; and MySQL for database management. Apache was used as the Web Server, and File Transfer Protocol was used for the file upload. The following languages were used for the reasons outlined:

1. ***HTML*** was used because it is the standard for authoring web pages and supported by a wide variety of browsers (both graphical and non-graphical).
2. ***Javascript*** was used for validating the entries made on the client side because it is supported by the two most popular browsers – Internet Explorer and Netscape Navigator.
3. ***MySQL*** is the database construct that enables PHP and APACHE to work together to access and display data in readable format to browser. It is a Structured Query Language designed for heavy loads and processing of complex queries. As a relational database system, MySQL allows many different tables to be joined together for maximum efficiency and speed.
4. ***PHP,*** abbreviation for Hypertext Preprocessor, was used to write CGI (Common Gateway Interface) scripts to support the database because it has tightly integrated database capabilities, and it is extensive in that it offers compatibility with several database servers.

System Architecture

The design of the system was decomposed into modules to provide a software structure that implements the functions elaborated in the system detailed design. The modular design of the system shown in Figure 1 focuses on the internal processing function, decomposing high level functions into sub functions, defining internal data stream and data stores and establishing relationships among functions, data stream, and data store. The activities of collaborative learning, which include course registration, posting of questions, posting of assignment, download of lecture note and video, were noted. Top-down, modular approach was employed for the decomposition of the proposed system, which tends to reduce complexities inherent in higher level modules. Figure 1 and 2 illustrates the system's modular structure, and the flow chart of activities and processes in the student's module of the system.

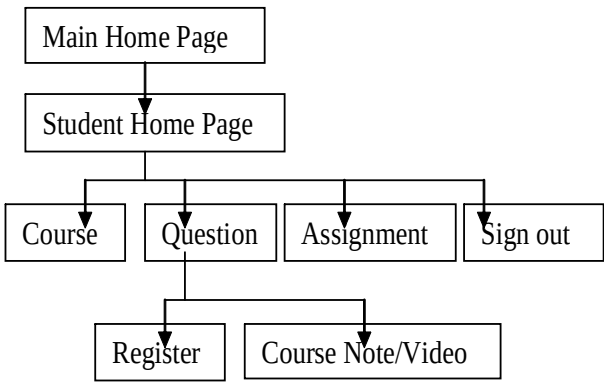

Fig. 1: System's Modular Structure

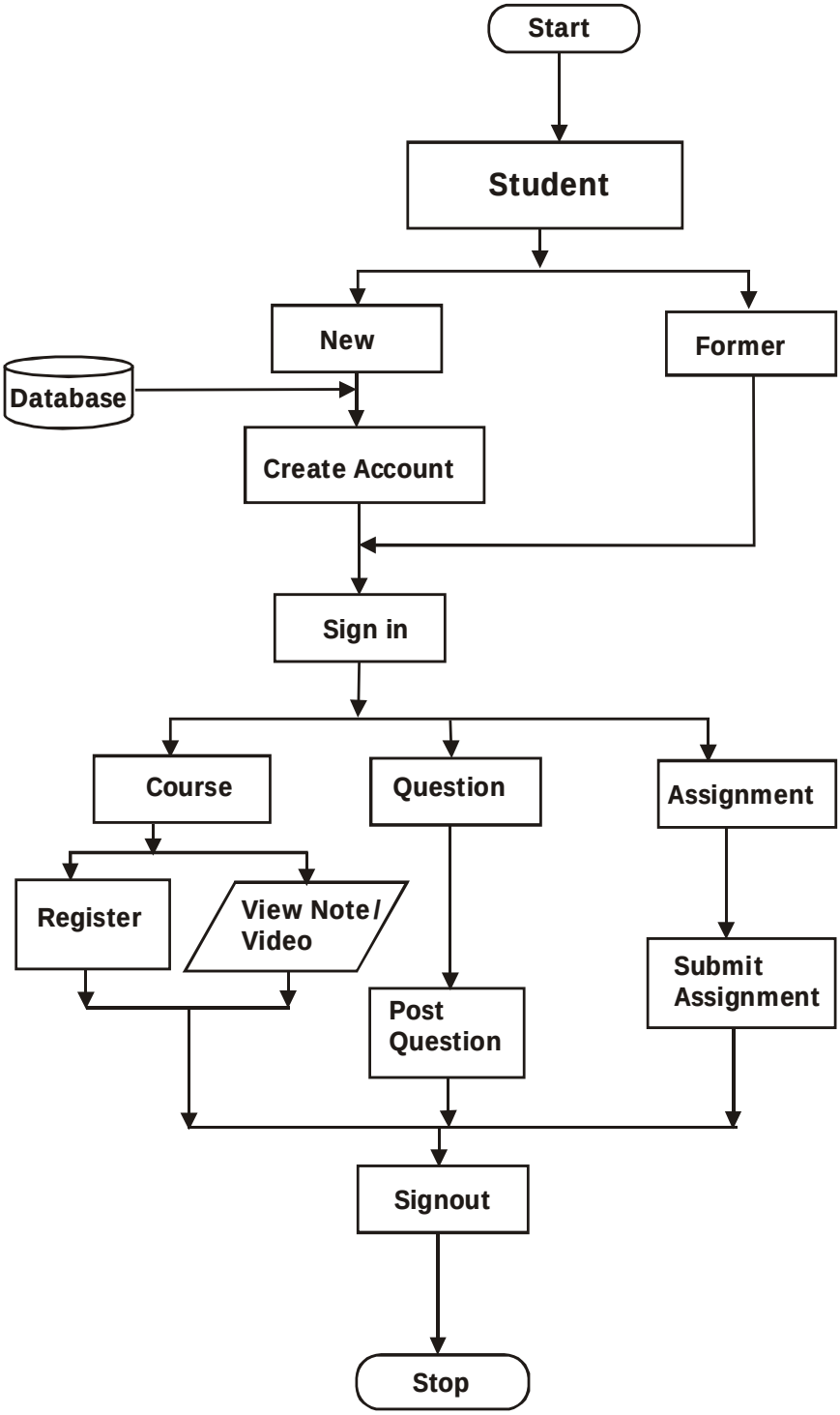

Fig. 2: Flow chart of activities and processes in the student module of the system.

Input Design

This consists of the forms that were used to enter data into the system. The input design forms include: student personal registration form, question form and students' assignment posting form. Samples of the student personal registration form and question form are displayed in Figures 3 and 4.

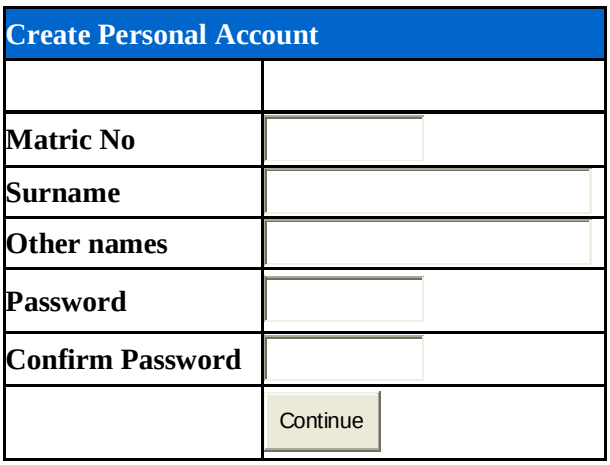

Fig. 3: Student's Personal Registration Form

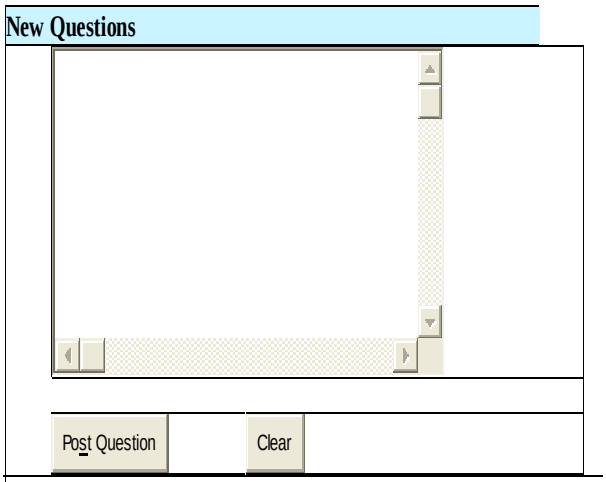

Fig. 4: Question Form

Output Design

The proposed system has the facilities to generate output in formats that can be printed. The output include: list of courses and lecturers assigned and list of submitted assignment.

Database Design

The system uses MySQL to build the database which consists of several tables for data storage. Tables I to VII are the database tables used by the system.

Table 1: Assignment

Field	Type	Description
Id	varchar(15)	Primary key
code	varchar(8)	Course code e.g. CSC203
question	text	Questions asked
datesubmit	date	Date of Submission

Field	Type	Description
code	varchar(8)	Primary key
title	varchar(70)	Course title
unit	char(3)	No of units

Table 3: Course

Field	Type	Description
Id	Int(11)	Primary key
code	varchar(8)	Course code
title	varchar(70)	Course title
unit	char(3)	No of units
lecturers	varchar(50)	Name of lecturer
coursenote	text	Course material
video	varchar(120)	Lecture clips

Table 4: Question

Field	Type	Description
Id	varchar(15)	Primary key
question	Text	Questions
matno	varchar(11)	Matric number
datequest	Date	Date questions were asked
datereply	Date	Submission date
teacher	varchar(30)	Name of lecturer
reply	Text	Submitted solution

Table 5: Register

Field	Type	Description
Id	Varchar(15)	Primary key
matno	Varchar(11)	Matric number
code	Varchar(8)	Course code

Table 6: Studaccount

Field	Type	Description
Id	Int(11)	Primary key
matno	varchar(11)	Matric number
surname	varchar(30)	Student's surname
othername	varchar(30)	Student's firstname
password	varchar(20)	Password

Table 7: Submit_Assignment

Field	Type	Description
Id	varchar(15)	Primary key
code	varchar(8)	Course code
matno	varchar(11)	Matric number
assignment	text	Question
datesubmit	date	Submission date
attach	text	Submitted solution

Web Interface

General Home Page

This is the general login page. It gives the description of how the student can log in through the student login box where user name and password can be entered. It also creates a current account where student can register newly (Figure 5).

Student Home Page

This page contains Home, Courses, Question, Assessment, and Log out menu. This page has links to all the other modules on the site (Figure 6).

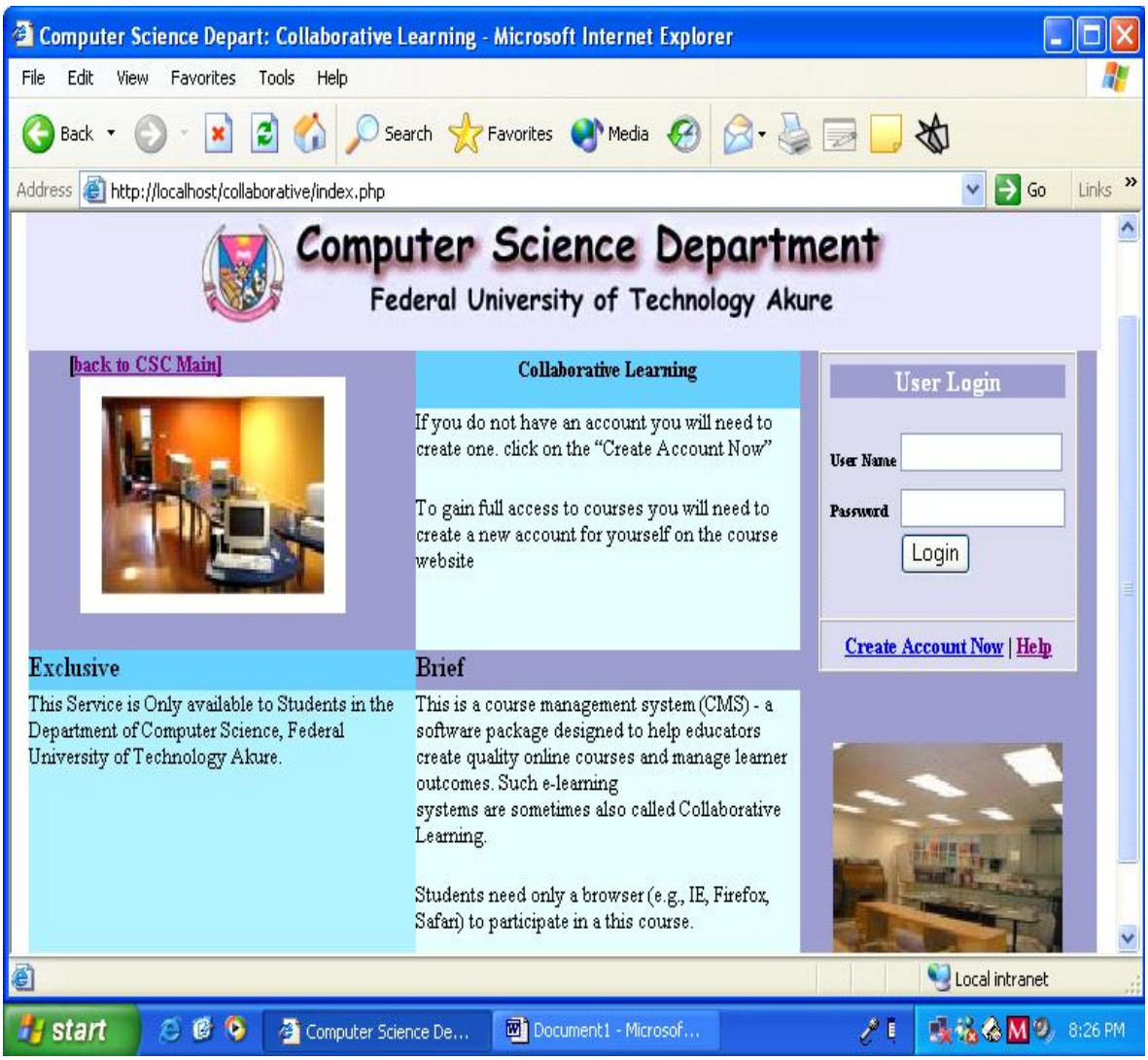

Fig. 5: General Home Page

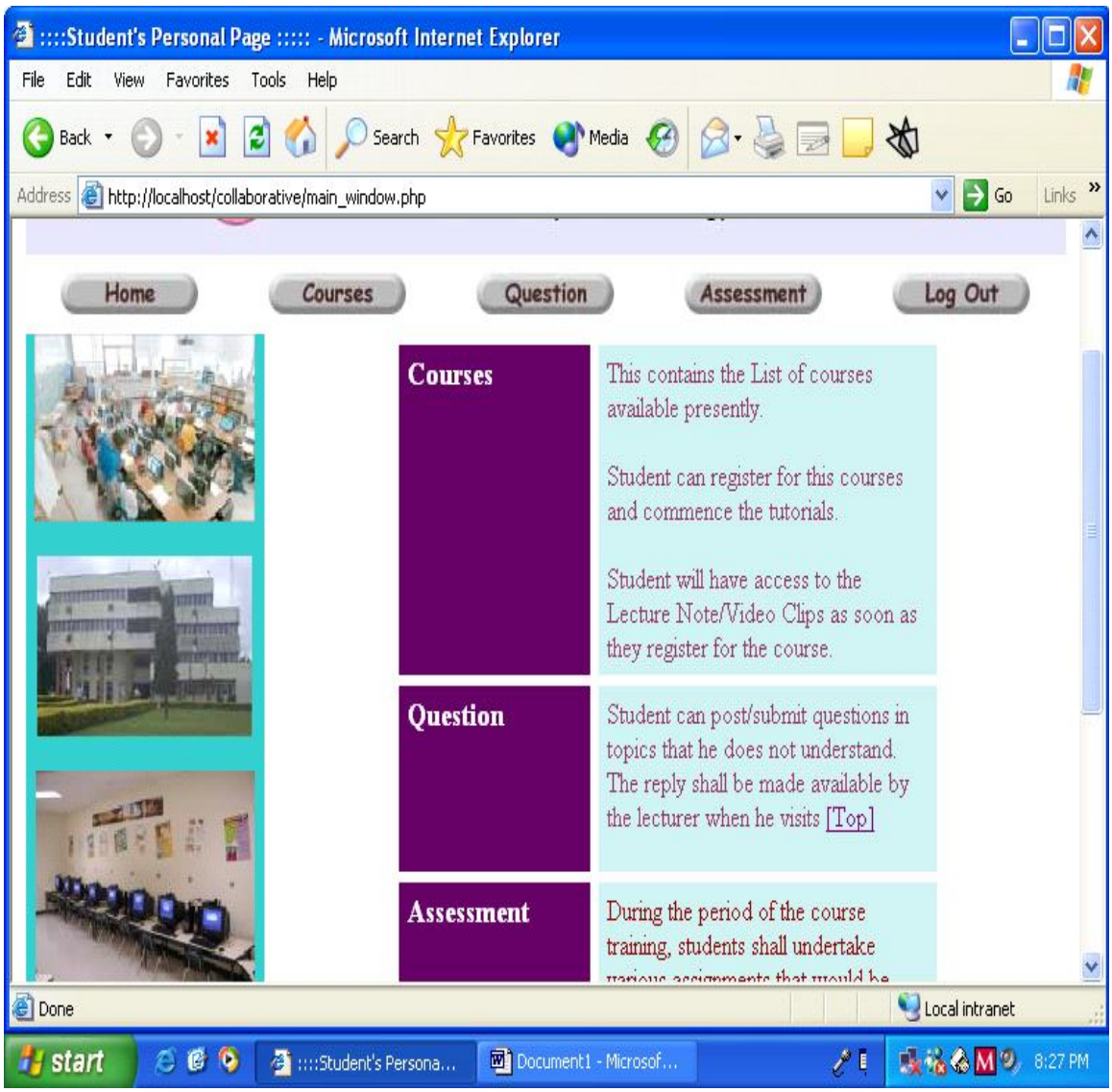

Fig. 6: Student Home Page

Course Registration Page

On clicking "Course Registration" under "Courses", figure 7 is displayed. This page shows the number of courses that have been registered for, the course code, course title, and number of units. It also displays an additional registration form where students can register newly.

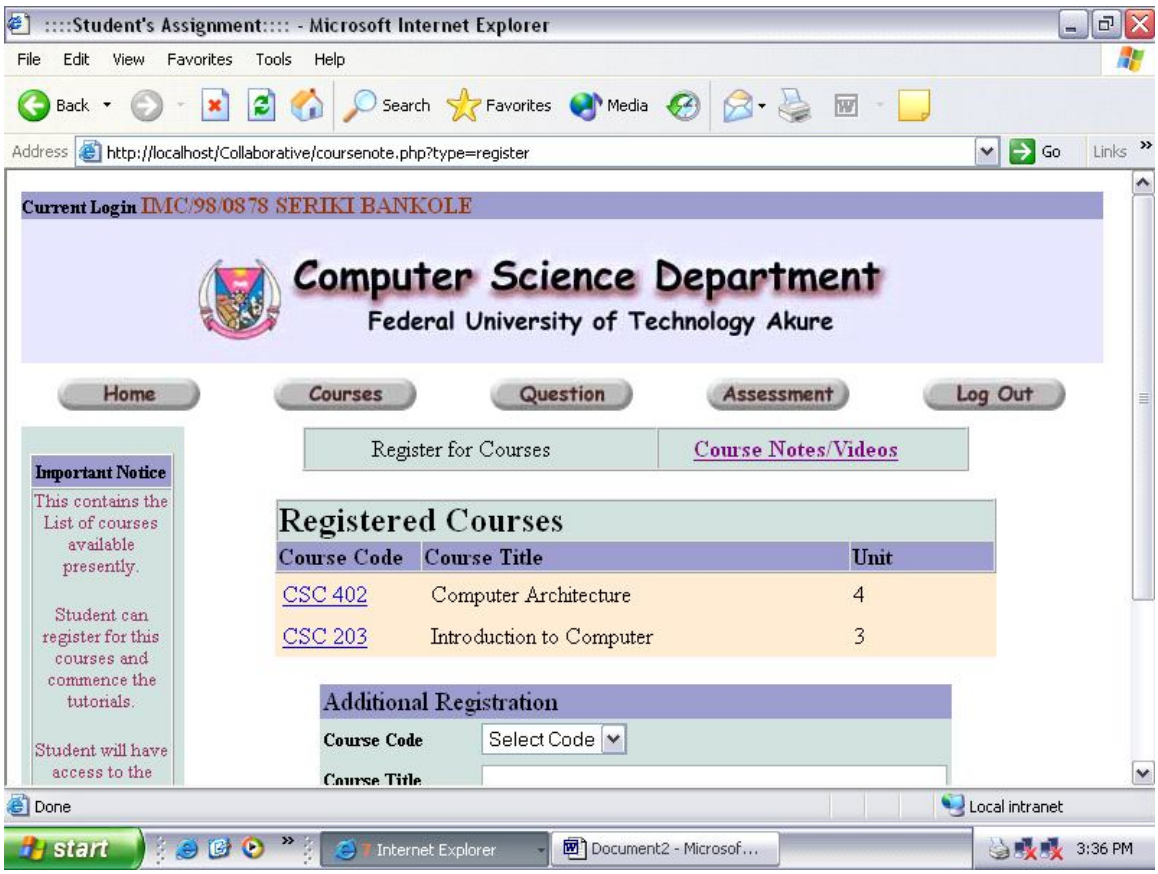

Fig. 7: Course Registration Page

Question Page

On clicking "Question", figure 8 is displayed. This page shows the previous questions that have been asked by the student and the reply to the question by the teacher or lecturer. Also a folder where new questions can be asked is displayed. There is another page that lists courses, their titles, units, the names of the lecturers teaching each of them, and the course note/video. On clicking on note, the notes for the course will be displayed, while clicking on video displays the clip of the lectures.

Assignment Posting Page

On clicking "Assignment", figure 9 is displayed. This displays a folder where new assignment questions are posted. It also shows the list of submitted assignments.

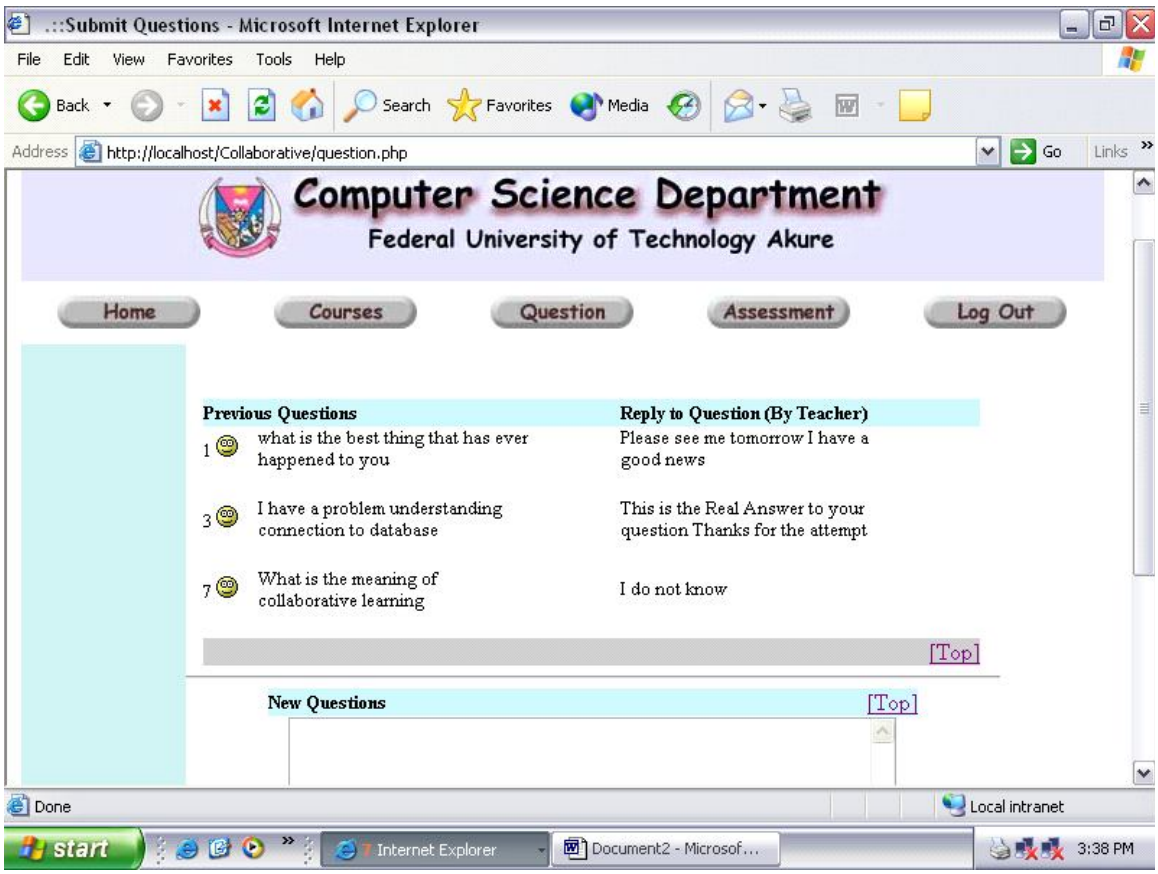

Fig. 8: Question Page

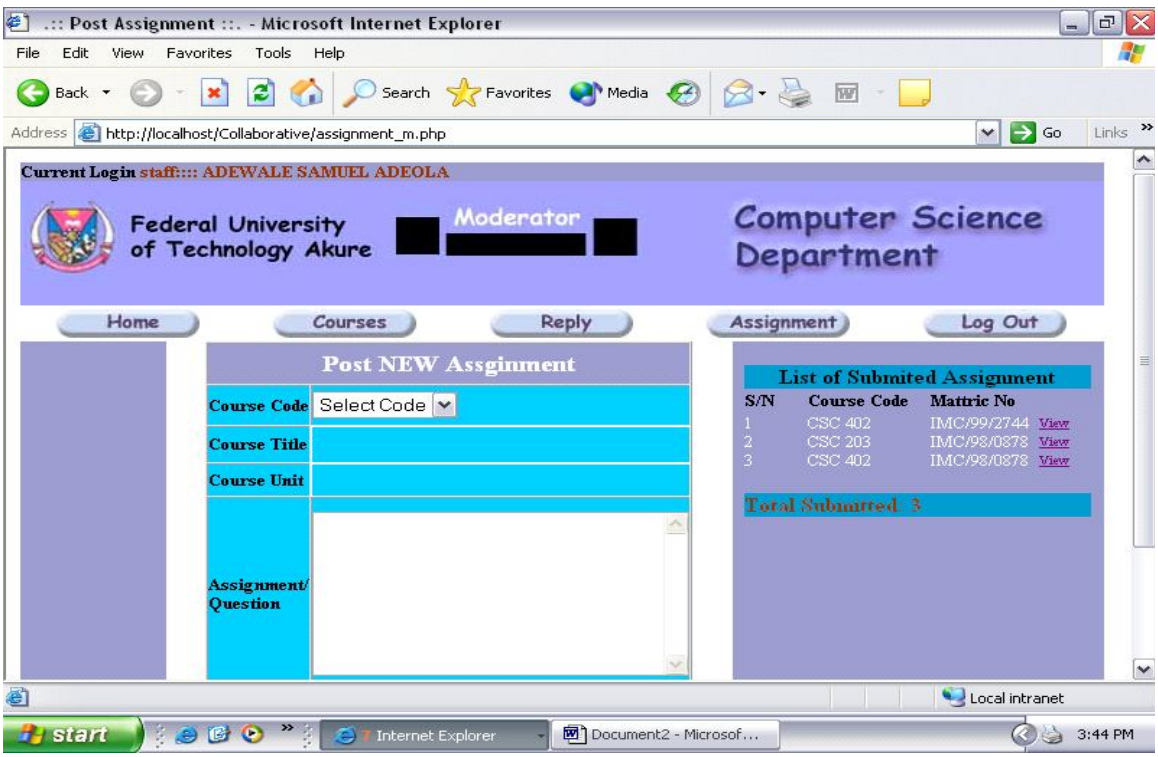

Fig. 9: Assignment Posting Page

Hardware and Software Requirements

Hardware Requirements

For the system to be fully operational, a full multimedia and Internet-connected computer system with a minimum of the following requirements are needed at the server end: P-III processor; 10.2 GB hard disk space; 64 MB RAM; Super VGA colour monitor; peripheral auxiliary hardware, such as, stabilizer and UPS. Low cost complete computer systems are sufficient to operate at the client side.

Software Requirements

The software requirements of the system include:

- A Network Operating System (Linux or Windows NT) at the server end.
- Windows Operating system (Windows '95, Windows '98, Windows 2000, Windows ME or XP) at the client sides.
- Web Server (Apache)
- MySQL Server
- Web Browser (Internet explorer or Netscape Navigator) and Firewall software for security enhancement.

Conclusion and Future Work

The prototype of a Collaborative Virtual Classroom System was designed, implemented and tested at the Federal University of Technology, Akure (FUTA), Nigeria. The design of the system took into consideration the characteristics of a traditional Nigerian university classroom and how these could be implemented in a virtual learning environment, incorporating students' collaboration. With the system, teaching, learning, posting of assignment, tests and tutorial and others could be done without students having to use a physical classroom.

The prototype was tested with some students of the Computer Science Department of the university, in order to validate its functionality and usability. Lecture notes and assignments were posted to students through the system, and the students submitted their assignment reports and interactive questions also through the system. The students noted the relative efficiency of the system, compared with performing the same activities in the traditional classroom and emphasized the system's advantages of convenience, effective utilization of time and accessibility to students.

However, they also noted that the system would require some more enhancements for it to fully replace the traditional means of learning. The students also recommended that further tests with more students in different departments of the university be carried out to ascertain the acceptability of such a system by students.

Finally, the students observed that uninterrupted power supply and full Internet facilities are required for using the systems, and that students would need some training, in order to be able to use the system effectively.

Issues of security and adequate monitoring of students' activities during sessions on the system were some challenges faced in the course of the system design. Some of the problems were solved to some extent, but for maximum security, there is the need to put in place good firewall software when the system is fully implemented for operational use in the future.

In line with the above considerations, future research direction on the work will include a more elaborate implementation and evaluation of the system in a more formal way, hence helping to improve on its applicability, especially to the entire University and any Nigerian university.

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***Mrs. Bolanle Adefowoke Ojokoh** is a Lecturer II in the Department of Computer Science, Federal University of Technology, Akure, Nigeria. She holds B.Sc (Hons) and M.Tech. degrees in Computer Science.

***Mr. Victor F. Balogun** is a Lecturer I in the Department of Computer Science, Federal University of Technology, Akure, Nigeria. He holds B.Tech. (Hons) and M.Sc. degrees in Computer Science.

Mrs. Bolanle Ojokoh