EXPLOITING INTERNET & MULTIMEDIA TECHNOLOGIES TO ADVANCE EDUCATIONAL PROCESS

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ABSTRACT
Internet technologies and multimedia applications are becoming the new trend in educational process. The number of schools, universities and other educational institutions that intend to adopt computer-based learning is being considerably increased. Thus there are some serious aspects to be discussed on this area. In our paper we present techniques incorporated in the organized design and the augmentative development of an adaptive web-based educational environment. We have included personalization characteristics in the educational objects and supportive communication services. This way the educational process is customized to the learning curve, the standards and the preferences of each user. Even more the opportunity to support virtual classrooms and tele-conference operations is given to the user. Due to the non-centralized character of the system such distributed actions are feasible to be done. Representative feature of our system is the application of innovative and well-known user interface and multimedia approaches where the latest and most modern technologies on the specific field are being considered and thoroughly used through the system's interaction components. In this direction we have paid a lot of effort to control and enhance performance matters. The successful use of any web environment depends on its high-quality performance and availability even under the most aggravating circumstances. A combined web engineering methodology has been adopted for the theoretical and practical model standardization. The main goal of this is to support scaling, reusability and maintenance of the web-based learning environment both in users' terms and educational material so as to cover the fields of intelligence and adaptiveness.

KEYWORDS
Computer Based, adaptive, educational software, versatile communication, virtual classroom, innovative

INTRODUCTION

Education is a crucial factor in the history of human race. Nowadays special attention is paid to the educational process and especially to the ways it is performed. The means by which training is achieved as well as important pedagogic matters are taken under great consideration in the system we describe. Considering all the above we designed an integrated environment to support the educational process in its total expanse. Our proposal can be applied either in the scope of a school classroom by providing a personal computer for each student and the tutor, or in a general learning environment, by using a personal computer connected to the Internet. The development of the system is based on the existing educational systems EURIDICES (Bovilas et al 1999, Garofalakis et al 1998, Tsakalidis et al 1999) and the multimedia application CHEMIA (Garofalakis et al 1999) for high school students.
The basic educational aspects where the design of the system is based in the specific paper are listed below:

Utilization of the educational material. Users have restricted access to this material, which is designated by the content provider or the teacher. They have the opportunity to add or update the available material.

Information presentation. The system design takes full advantage of the latest developments on the area of computer technology and especially in multimedia either in local level (CD's, LAN), or over the Internet. (Bovilas et al 1999)

Communication versatility. The system supports the basic communicative ways and protocols used in modern networks for interaction between teacher and student and for communication among students. (Chat, Email, FTP Services) (Bovilas et al 1999)

Knowledge access. The gain of knowledge is being performed by the use of different layers of access accordingly to the kind of user. Thus we have four types of users: administrator of the system, teacher, student and guest/general type.

In the following sections we will analyse the above-mentioned topics with extra care on knowledge manipulation and distribution.

EDUCATIONAL SCENARIOS

Special attention is paid on knowledge distribution methods. In order to achieve a high level in lesson authoring and manipulation, the teacher has various ways to design and modify a lesson. Depending on the educational scenarios the courses can be set as follows:
In case a student attends a class, the teacher may create lessons with less interactivity in the resulting view page, in order to encourage the in-class interactivity. Also, the teacher, having permissions of administrator, can deactivate Internet activities (mail, chat, FTP) that are beyond the classroom LAN. The ability of creating a virtual class is provided through extra handling and authoring tools for the teacher. This way the lessons become more interactive and the teacher is burdened with advanced interactions, in order to answer individual questions and give specific comments.
In case a course is designed as stand-alone over web, the teacher can make the course fully interactive, providing extra links and comments. The course this way has no teacher to supervise and answer questions. Is in the teacher's decision to provide e-mail service for questions.
Apart from the above-mentioned main scenarios, the system flexibility provides a lot of customisation options over courses so as to satisfy different kinds of course types. This adaptive system focuses on educational aspects in order to integrate the educational process with Internet technologies and multimedia.

ARCHITECTURE OVERVIEW

Fundamental Components

The system comprises of three basic components, the multimedia application, the application server and the relational database. The database, back-end of the system, receives information from many different kinds of sources, processes it and stores the results so as to pipe them to the front-end of the system when required. The application server acts as the intermediate between the multimedia application and the database and executes the interconnection between the database and the application by transporting and translating queries and results to each other. Finally the multimedia application is the component that performs the interaction of the system with the user by presenting the data to him/her and accepting the actions that he/she makes ([9], [5]).

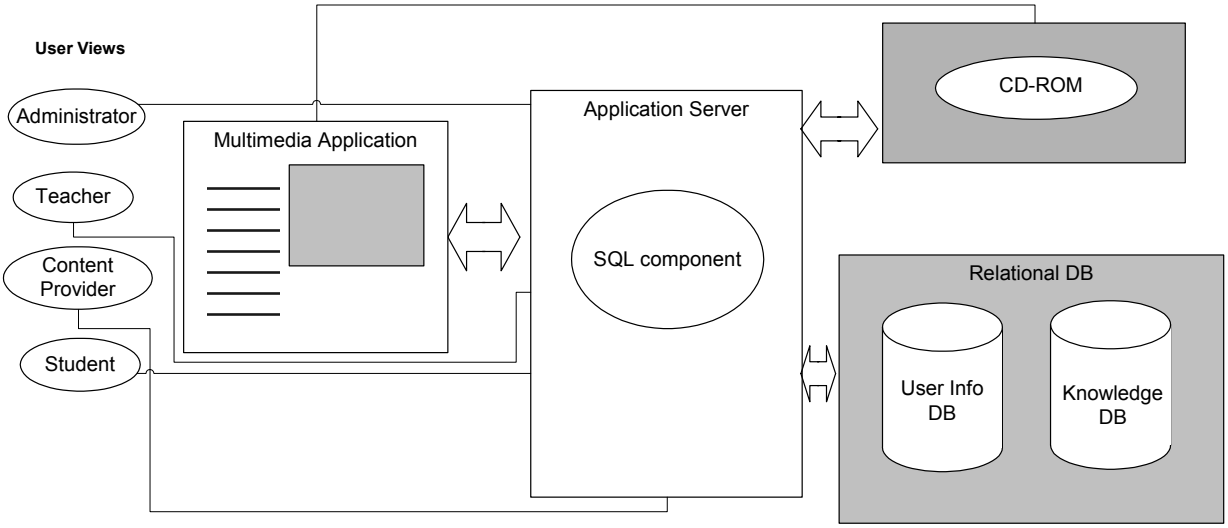

Figure 1. General architecture model

Multimedia Application
The multimedia application is the front-end of the system that interacts with the user and presents the total of the data that can be provided by the system. The educational material is supplied through many different mediums. These are the standard presentation way, text and image, while images can be either still or moving (animation). There is also extended use of video and sound in the multimedia application either as background to another medium such as text or image, or as the main presentation medium. There are also educational games (quizzes), multiple choice question tests and simulations of real educational procedures. Each screen of the application is based on a certain structure. There is a predefined area where the logos and the buttons/selections that perform the basic navigation in the system are. The centre of the screen is where the main data is presented.

For the design and implementation of the Multimedia application important pedagogical aspects were taken under consideration so as to achieve the goal of education in the most pleasant and most efficient way. The content of the application is categorized into sections, subsections and topics. The title or identification for each one of the above is displayed at the relevant screens and the user selects to navigate in a topic of his interest. The system interface allows the use of both static and dynamic information. The access to dynamic information is possible due to dynamic hyperlinking. This means that, links to objects are defined not as local references but as remote queries to the database. This means that these links are established at run-time, assuming that the information is stored appropriately in the database. This reduces the cost of static hyperlinking and results in ease of tailoring, since it permits data/schema update and evolution via the database. In addition, it makes the presentation stable, since the hyperlinked objects are subject to the integrity control of the database.

Dynamic information concerns:
- Activation of the section to be taught and deactivation of the rest
- Creation, modification and selection of multiple choice questions to form a test
- Storage of the answers of the students to the test
- Access authorization control.

Application Server
The three components of the database Server that are related to the user views are listed below. In the two last the dynamic hyperlinking is being used mostly:

Component for the administrator
This component is responsible for the system security, since it enables the administrator to establish passwords for the rest of the user types. The passwords are stored in the database. This component also deals with database updates.

Component for the teacher-content provider
This component allows the teacher to perform specific operations over the lessons such as activate and deactivate certain sections of the application that have or don't have to do with the lesson of the day. The teacher also has the capability to create the tests and exams for the students and also can handle in a degree the database where the results given by the students are stored.

Component for the student
This component is used for the identification of the student to the system by checking the login name and the password given by each user. It also is responsible for the online delivering of the tests and questions from the teacher's computer to the students ones and storing the answers to the database.

User views
We can distinguish the ways in which the users are connected to the system and thus the information is viewed by each one of them.

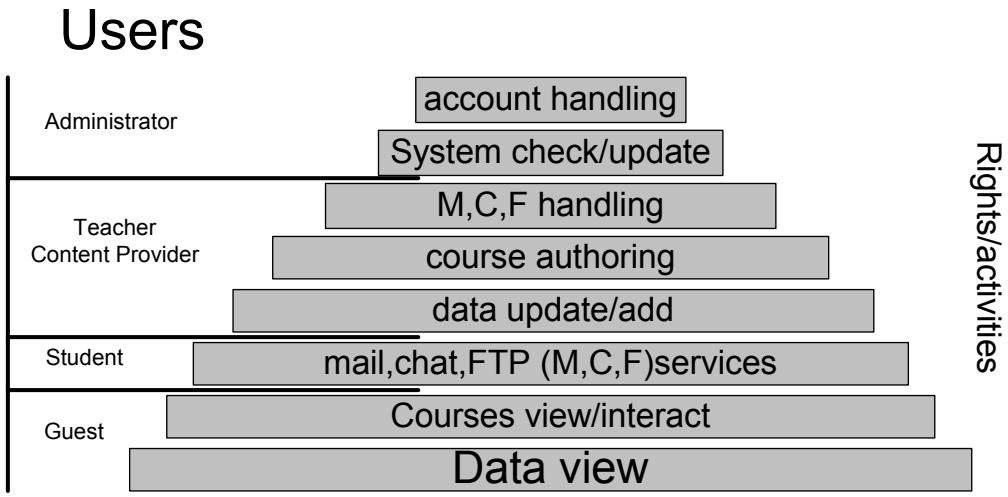

Figure 2. Pyramid of user rights and activities. Each line indicates the limit of rights and activities for every type of user

Administrator
The administrator is responsible for managing the system, creating or cancelling accounts for the rest of the users. The administrator is also the user that can update the system and the database and add new data. He is also responsible to correct any unexpected malfunctions either locally on the computer database or on the system server over the network.

Teacher
The teacher can customize each lesson, put additional material and also some extra questions. He can receive the answers of the students either directly or accessing the database and return them the results. He can also use the utility operations provided by the system such as exchange electronic mail, instant messages or files with the students. In the scope of a classroom the teacher can perform only educational procedures and separate his role from providing content to the application, an act which can be performed by a distinct person.

Content Provider
The role of the content provider has a meaning in a classroom where the responsibility of the teacher is mostly instructive and advisory as well as interactive with the students. In that case the existence of another person with content management duties is necessary. The tasks this person undertakes have to do with educational material supply according to the class's needs and the teachers decisions and the modification of the contents of the system in order to properly correspond with the requirements of the students.

Student
The student can use all the system services that are defined for the students such as navigation through the application, study the educational material, solve the existent exercises or any exercises assigned by the teacher either in the schema of the classroom or on his personal computer with or without the use of the internet. He can also use the services that have to do with email and instant messages exchange with his tutor or other students and also download and upload files from and to the system server relevant to the lesson.

General/Guest
The user that can access the environment and gain some information relevant to the lesson and be clued-up in general about the educational material is the guest or general user who can access almost all the general services of the system.

FUNCTIONAL SPECIFICATIONS

It is already mentioned that our solution aims is to satisfy the needs of a wide range of users under different circumstances and with multiple requirements. In order to achieve this we have designed different operational modes. There is potentiality to install and execute the system either locally CDROM-based or having the software installed on the central system server (network-based). Thus the provided services of the system could be divided into supplied through the Internet (Online Services) and not supplied through the Internet (Offline Services).

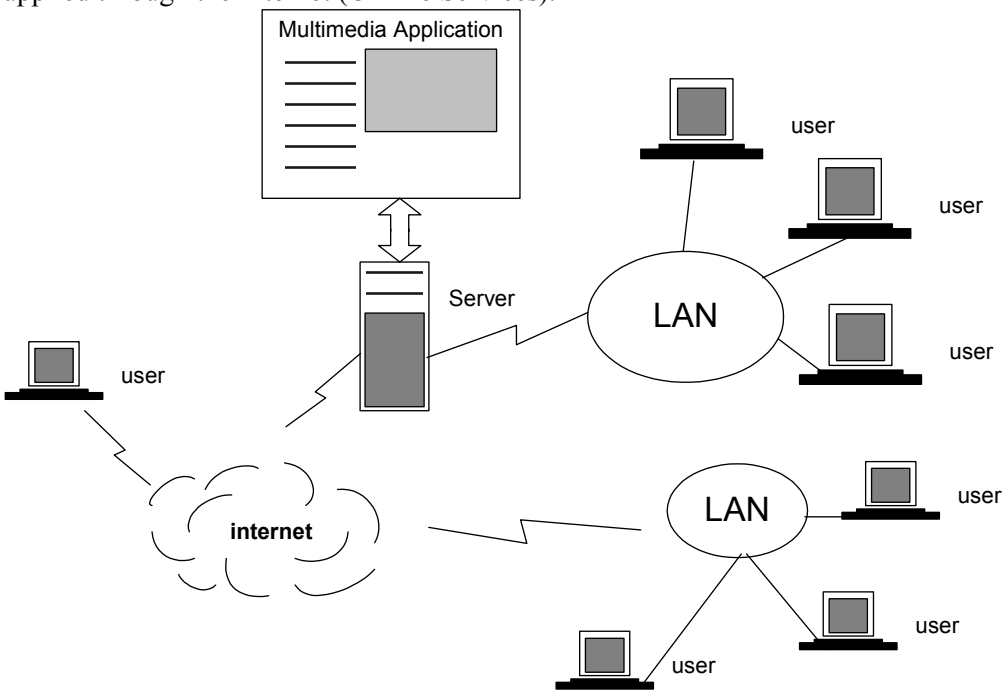

Figure 3. General services over network

Offline Services
The environment provides the option to select among different procedures given. Particularly the instruction takes place without the use of Internet in the following ways:

Using CDROM over a local network (LAN)
This particular mode may be used in a school class and provides synchronous educational process; the students have contact with their tutor in real time. Suppose there is a LAN installed in school, the students' and the teachers' computers are connected and each user student or teacher accesses the system with a personal account. Our solution in CDROM medium is installed locally, on every personal computer. The teacher has the opportunity to interfere in the educational process by adapting the content and the view of the day's lesson from his own personal computer directing in this way the students to a specific topic and discouraging them to waste time by viewing irrelevant to the particular lesson subjects. In this case apart from the basic educational functions that are supplied to the users the option to use some extra features is given. These features are the exchange of instant messages (Chat) among the students as much as file transferring services (FTP).

CDROM – Based Only
Using the CDROM exclusively is easy and simple for a single student who chooses to be educated in his own place over his personal computer without the use or supervision of a tutor. The only guidance he could need is the one that could be offered by the system support by means of a Help Wizard. This particular mode provides asynchronous education, the student can use the system any time he likes and do his exercises when he feels like.

Online Services
The system is potential to provide some extra, very useful services, which are based on the use of the Internet. In this case the system provides the following modes:

Local Network (LAN) Connected to the Internet
In this mode a local network is established, the way we described above, with the extra feature that this LAN is connected to the Internet. This extra feature offers some more services. These are the opportunity to use email among the students and the teacher and even communication among all the school classes that use the system. This communication can be extended beyond the exchange of instant messages and electronic mail to sharing knowledge, exercises, and news among teachers and students from different schools and locations. Another useful opportunity given by the system is accessing material from shared directories that are hosted to the central server of the system, which has been placed by other schools and users or by the administrator of the system. This mode provides synchronous education.

CDROM connected to the Internet
This mode is similar to the one while only CDROM is used, with the extra feature that users are connected to the internet and can access some more services such as email exchanging, instant messaging (Chat), file transferring (FTP). Furthermore the chance to make questions to other users through discussion forum is given and the assignment of exercises to students is also available in real time. This way of education could be either synchronous or asynchronous.
All the above scenarios have a very important characteristic; adaptation. The system is adaptive. For a user to access the system the existence of a personal account is required. The environment has the ability to observe the user every time he connects to it. This means that it can track the actions he makes, the response time he has in some situations and even ask from the user to make specific choices. This rationale's goal is the creation of a profile for each user. For example the system can distinguish if the student, who has just connected is expert, advanced, novice and according to his skills and abilities it can provide him the appropriate services or even some extra helping material.

NON FUNCTIONAL SPECIFICATIONS

Performance Specifications

The system availability is at least 10 hours a day for teaching during the time defined for this purpose and at least 6 hours for writing (authoring).
The demands on online transfer for video and voice for the synchronous tele-education require at least 64 Kbps bandwidth for each user (student or teacher). For asynchronous tele-education while the students access html pages as well as any other kind of information with a Web browser but is also possible to receive even the lesson in a compressed form and store it locally for future use the usual bandwidth used for WWW navigation is enough.

Safety Specifications

The system must have the ability of recovering and fully start to work properly again in a little time after a system failure so as valuable time of the educational procces will not be wasted.
In case the lesson flow has problems for a student, this shouldn't affect the flow of the lesson towards the rest of the attending students.
Regular copies and back up archives for the already stored data are created so as important information about the system and the class will not be lost, even if there's an important failure in the system.

Security Specifications

As far as asynchronous tele-education is concerned, it's guaranteed that the creation and modification of the lessons is being performed by authorized users. This way the problem of copyrights is solved so as the material is not stolen and used by any other user that is not authorized. For example in case the classes are being held on students' charge.
As far as synchronous tele-education is concerned it should be guaranteed that the modification and presentation of the lesson is exclusively done on the teacher's computer towards the computers of the interested students avoiding the option of being intercepted and directed towards other computers.
As a result all the databases containing educational material and ready educational scenarios must provide authentication control for the user and check the kind of access he has (ability to modify, read only e.t.c). Furthermore the authentication and connection control of the user is being hold during the navigation of the user in the system and the update of the data stored in the database.
There should be an option to do with the encryption of the transferred data from and to the students.(i.e. email, files, html pages, e.t.c.)
All the user actions will be recorded in order to recognize and prevent potential system failures or violation attempts.

Maintenance Specifications

There's the opportunity to add new users, teachers and much more students, without reducing the system and network performance. Even more the system can be updated and extended without pausing its function for a long or a short time.
The system will be open to incorporation of new software and hardware products. (New software versions or update of networks).

Interface/Background Specifications

The student will be able to use the program in a sort time (for example with a day training).
The teachers will be able to utilize the system to author educational scenarios with a sort time training (a week of training).
Administrator users will be able to support main system functions (database maintenance, web page developing, security level handling etc.) after sort training (a month of training)

CONCLUSION AND FUTURE WORK

Our proposed solution mainly focuses on the educational process. Key feature is the centralization of the authoring services provided to teachers and tutors to organize material from a database in courses.

Also extra care is given in user views and admission permissions of courses. The system performs the development and main functions of a database, a multimedia application CD with material, a server to handle network traffic and a web page that host internet traffic and interface.
From design to implementation several additions should be made. The system will be expanded to include several different lessons in order to create an information node over all school facility. Also, extra options that will allow teachers from different school to exchange rapidly and gainfully developed courses and material from one school's database to the other will be developed.
Designing and implementing such a system that will encourage and advance educational process will boost education to another level of completeness, allowing all persons involved (teachers and student) to use information technologies to gain more effective knowledge.

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