INTERNET BASED DISTRIBUTED DISTANCE LEARNING MANAGEMENT SYSTEM

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ABSTRACT

The paper presents an internet based distributed distance learning management system aimed at supporting the administrative and educational activities within the EDIT Distance Learning Network run by University "Politehnica" of Bucharest, Romania.

1. INTRODUCTION

The EDIT Distance Learning Network was setup in 1998 within the project "Open and Distance Learning Network in Information Technology and Microelectronics" run by University "Politehnica" of Bucharest and IBM Global Services, Education&Training, La Hulpe, Belgium [1], [2].

The project main objectives were to assist the implementation of the distance learning methodologies and to set up an academic open and distance education network in the field of Information Technology and Microelectronics as the fist step towards building a virtual university.

2. TECHNICAL INFRASTRUCTURE

The operation of EDIT DLN is based on the use of the Internet as the delivery vehicle for all activities. The access is via a dedicated WWW server (edit.pub.ro) using common web-browsers and low cost computer equipment. The network structure integrates also a number of database servers based on IBM DB2 software and FTP-servers. The management system we are using is based on an adaptive distance learning environment developed within the project (EDIT Learning Environment - ELE) [3] and LOTUS Learning Space 4.01 (LLS).

ELE offers mainly administrative services while LLS offers educational services. Each software has his own databases and security system the synchronization being done by special modules that copies and translates user information between databases. Presently the system has one ELE server and six LLS servers located in the main EDIT DLN centers.

3. DISTANCE EDUCATION SERVICES

3.1 Administrative services

The administrative services provide tools that help to administrate the learning activities in an efficient way. The services present in our system are:

- Student and staff enrollment
- User profiles and permissions
- Authoring tools
- Course profiles and permissions
- Group/class roster
- Tracking and reporting data

3.2 Asynchronous Delivering Services

The students have access to the learning material through web [4] and collaborate in order to learn specific contents or to solve a teamwork problem by means of e-mails.

The learning process can be controlled by an instructor that coordinate the activities based on specific learning objectives. The interaction between the students and instructors is done also by e-mail.

Some courses have laboratory work that was implemented by means of web-based interfaces for all the simulation tools used within the lab [5], [6]. This interfaces allow a student to launch remotely a job with no constrains in time and space. We choose an asynchronous way of working as the jobs might run for periods of time between 30 minutes to several hours depending on the simulation type and the computer load. The results arrive as attachments to e-mail messages in the student mail box.

In Figure 1 is presented a screen snapshot of a WWW interface for a bulk Monte-Carlo simulator used in the extraction the transport parameters in compound semiconductors.

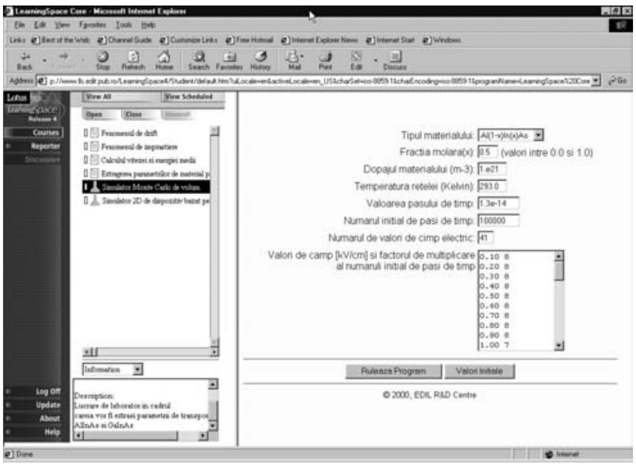

Figure 1. Screen snapshot of the WWW interface for a device simulation tool within an online laboratory

3.3 Synchronous Delivering Services

The synchronous services are: live sessions, online discussions, whiteboards and videoconferences. On line discussions supplement live sessions and other course activities. Discussions provide an interactive forum for course participants to discuss course-related content [7].

A live session is facilitated by an instructor, and requires all students to be logged on during a time period determined by the instructor. In a live session, instructors presents to students text and graphics on a Whiteboard, real-time applications that appears in a window on each student's screen and/or ad hoc classroom questions that each student can see on the screen.

In Figure 2 is presented a real-time application that show the carrier behavior in a heterostructure. This way the student is able to assess much easier the new theoretical issues helping him in obtaining higher marks and completing the course in a shorter time.

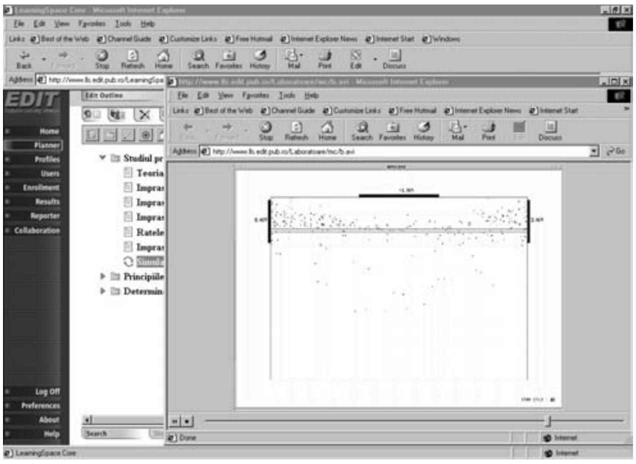

Figure 2. Screen snapshot of a live session about particle transport in semiconductor devices

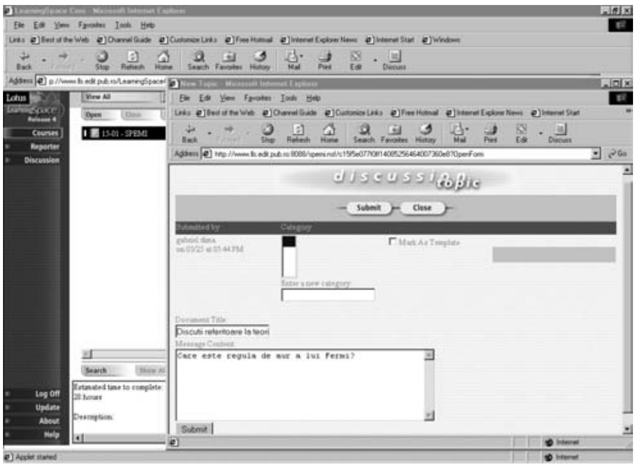

Figure 3. Screen snapshot of a discussion session

Online discussions allow real-time interaction between course participants. This way design projects and theoretical problems can be discussed without any delays. At the beginning of the course these facility is frequently used by students for getting known each other. Online discussions do not require all course participants to be logged on the same time.

3.4 Intelligent Tutoring Services

In addition to the LLS facilities the system offers intelligent tutoring services that were build in ELE software [8]. The ELE design follows the traditional design of an Intelligent Tutoring System that entails several modules: the Domain Model (DM), the Expert Model (EM), the Instructional Model (IM) and the Student Model (SM).

The *Domain Model* in this implementation contains a list of domain concepts and an order relation that establishes the sequence in which concepts should be mastered. The DM is not distributed, but it is stored on a server (and possibly mirrored) from which it is made available to all users.

The *Expert Model* consists of a list of tasks and/or questions and possible answers along with the domain concepts needed for solving them. In this case the EM is distributed as each exercise or simulation comes with its own part of the EM designed by the author. This is made possible by an easy and powerful scripting language and a well-defined interface between the EM and the SM. This allow the author to establish the way the SM will be updated as a result of the student's actions.

The *Instructional Model* tries to diagnose the student's level of knowledge and uses this information to determine what teaching materials should be presented to the student. The diagnosis is done using the data stored in the SM and the feedback from the EM. The IM is also server-based and not distributed.

The *Student Model* is the key to adaptability as it stores up-to-date information about the student's goals, knowledge etc, which allows the IM to make its decisions. This implementation is a differential one, which focuses on the differences between the student and the EM, and resides on the main server, due to the need to keep an accurate and accessible track of student data. There are several sub-models that are being used for organizing this data:

- The *Domain Knowledge Model* (DKM) is a fuzzy subset of DM representing domain concepts mastered by the student.
- The *Knowledge Delivery Model* (KDM) is a fuzzy relation between domain concepts and teaching materials. This relations override those set in the IM and may be modified only by the direct tutor of the student.
- The *Knowledge Genesis Model* (KGM) is a fuzzy relation between domain concepts, which shows the necessity of other concepts before another. Like KDM this overrides the implicit settings in DM.

The results of tests and simulations within a course are checked by server side programs that simultaneously update the DKM and allow IM to choose the best training material.

The secure access to SM database allows tutors to remotely supervise their students (Figure 4). This way a particular student model may be tailored to fit exceptional needs that the implemented Fuzzy Logic Control System does not meet yet. Future development may bring a Learning Fuzzy Logic Control System, powered by an artificial intelligence engine, which infers future correction rules from tutor's tailoring actions.

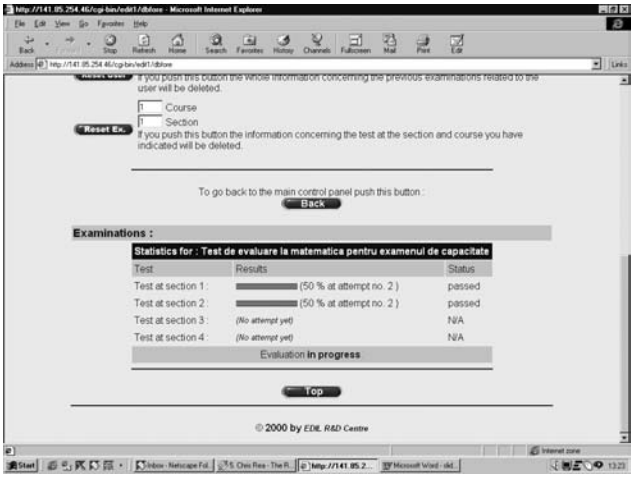

Figure 4. Screen snapshot of student tracking database

The system granularity with respect to the interaction control is extremely fine as it uses the accepted human-computer interaction principle of providing immediate feedback following every response from the user.

When a student joins an ITS system he is subjected to a pre-test that tries to asses the domain concepts and areas that need working on. After this the computer generates an optimum path for the education experience, that the student is about to undergo. Each section on the path consists of a loop:

```
Section{
        Pre- test ;
        Learning;
        Post-test;
       }
until  (Post-test > threshold);
```

where all the elements are dynamically generated, according to the student's profile.

The course is considered completed when the final post-test mark is greater than a given threshold. When a student uses the Help/Assistance/Modeling options for exercise solving, the SM is updated such that the better the student model fits the student the less assistance is needed during exercise solving.

4. SUMMARY

The Internet based distributed distance learning management system of EDIT DLN has been presented.

The main features of the EDIT DLN management system are: internet dedicated architectures, distributed way of working both in the design and exploitation, intelligent tutoring methodologies, high degree of reusability, integrated communication system, web-based publishing system and secure web access to the databases.

Depending on the topic and/or target group the system uses for the implementation of the course materials either ELE and/or LLS.

5. ACKNOWLEDGEMENTS

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