

E-learning system and video tutorials in the microelectronics education

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ABSTRACT

Within the framework of Microelectronics BSc. course online E-learning system was applied. Additionally all the manuals of the software tools were replaced by self-made flash based video tutorials which can be accessed online as well. Many advantages of using these curriculum developments will be described in details in this article.

1. INTRODUCTION

Since 2004 in Hungary the linear, two-tier (BSc., MSc) higher education system has been inducted instead of the undivided, one-tier 10 semesters system. In the BSc. level higher education students have to get practical, easily applicable knowledge. From 2007 September a new BSc. Microelectronics course was started. During the semester within this course there were lectures (three times per two weeks) and six laboratory practices. The students get information and knowledge about microelectronics design and simulation and they can try and practice it in the laboratories.

In the laboratories the students get applicable knowledge about

- thermal behavior of different semiconductor devices and packages,
- thermal simulation,
- simple transistor level digital block design (CMOS NAND, NOR, Register, flip-flop, etc.) and transistor level circuit simulation,
- HDL languages (mainly Verilog),
- HDL modeling of simple digital circuits (counters, ALU, etc.),
- testbench design and logical simulation,
- synthesis of complex digital circuits (traffic lamps controller) onto ASIC,
- layout generation (floorplanning, place and route, DRC),
- and complex digital system design and realization on FPGA by using development board.

In the course of the laboratories students have to use several CAD programs for design, development and simulation purpose. These tools are not easily usable and the assertive appliance of them takes weeks. The main problem is the students have only 2 hours to realize for example a digital system, so they have to prepare themselves at home from manuals or different sources and have to use the CAD tools assertively.

2. THE BENEFITS

In the microelectronics subject numerous difficult, complex CAD tools have to be used along the different design flow methodologies (top-down, bottom-up). In the beginning of every laboratory exercises a short manual or oral presentation was given to the students. Many times these

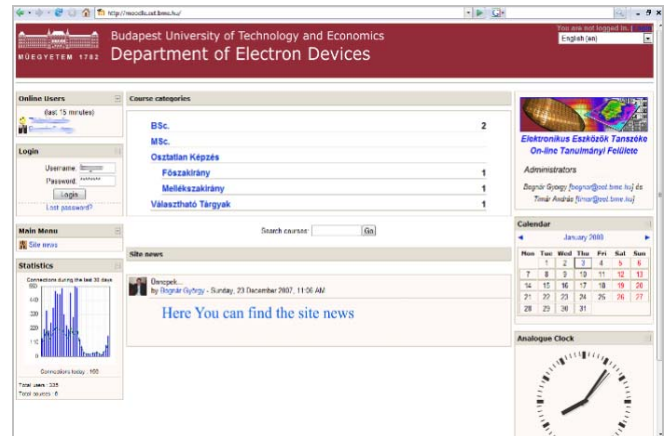


Figure 1. – Online e-learning system of DED

consumed too much time and the students were not able to finalize their work till the end of the exercise.

One of the main advantages of using e-learning system is the students of Microelectronics course can easily find instructions, different sources and materials about the microelectronics design flows, description, specifications and short manuals of software tools and development board, etc. on a well organized, simply usable online e-learning system.

The students have to make *laboratory reports* about their work during the laboratory exercise and have to finalize it at home. During a semester plenty of laboratory reports are made by the students and there was a great problem to store and categorize those, let alone the feedback possibilities from the teacher(s). Sometimes more than one thousand reports were made during one semester and within one subject. That's why it was needed to solve the online upload possibility. In the e-learning system every student can upload their reports and can find the feedback and personal hints or comments from the teachers. Afterwards they can fix the errors, reconsider their work directed by the instructions of the teacher(s) and finally upload the final version again. From the teachers' point of view, the different deadlines of the laboratory reports or home works can be easily adjusted.

In order to help the preparation process of the students, different tests can be made which can be accessed online. The test results can be stored for subsequent usage (e.g.: rating) and students get immediate feedback. This is needed and very important because of in the beginning of the laboratory practice every student gets some questions similar to the online ones and has to answer it. Thereby the preparedness of every student can be verified. This test forces the students to prepare for the laboratory.

Sometimes the written software manuals could be so long and the tools could be so difficult, so the manuals in text format (completed by screenshots, figures and pictures) are not usable. It is a great problem when in every semester the version of the applied CAD tools change, so some

buttons, menu items, or mostly the overall look of the programs change. We had to find a simple, well ordered and easily upgradable way to introduce different tools. For this reason a video tutorial compositor tool was used [1]. The output of this tool is a flash animation, which can be easily inserted as an embedded movie object into an HTML web page. These movie files consist of a number of screenshots (25 or 15 frame per a second) so every movement of the mouse pointer, all the typed characters and the changes in the screen can be followed and visualized. The creator can easily add some hints or text to the video stream. Accordingly the students are able to see the appearance and the usage of the software tools before the laboratory exercise. It is a great benefit, because of they can work faster and more precisely.

Another benefit is that these contents (manuals, videos, etc.) can be accessed from anywhere through the Internet. Every student can access only to the allowed subjects or courses and find everything in one place (e.g. the teachers' name, photos, email addresses, rates, points, assignments, etc.). The online materials (flash videos, user guides, homeworks) can be accessed by the students from home or a remote location with a constant speed. A medium speed (512Kb/s) ADSL internet connection is more than sufficient to watch the flash videos continuously. The videos are buffered so they can be viewed with a slow internet connection also (eg. Modem). These videos can be downloaded and saved to a local computer in order to view them later, without an internet connection.

In order to train the students for cooperation and teamwork, on-line chat possibility and internal e-mail delivery were established. Students can collaborate to solve different problems or homeworks. According to our experiences, students often used the e-mail messaging platform among each other, especially before laboratory sessions and exams. The on-line chat possibility which was offered by the e-learning system was seldom used. Approximately 25-30 e-mail messages per day were sent before exams. To show significant statistics, e-learning materials were accessed before an exam more than 550 times per day by more than 100 students. The on-line materials are also available during a laboratory session thus the tutorial videos can be played concurrently with the CAD applications. This was a necessary feature of the e-learning system.

3. IMPLEMENTATION

In the Department of Electron Devices, the Moodle course management system is used [2]. Moodle is a free, Open Source software package designed using sound pedagogical principles, to help educators create effective online learning communities. It can be freely downloaded [3] and installed on every system that has PHP, SQL and HTTP server capability. Moodle requires a MySQL Open Source database server [4], which is available on many platforms like Linux, Windows, *NIX, etc.

The latest version of Moodle requires a PHP5 interpreter to be installed on the target system.

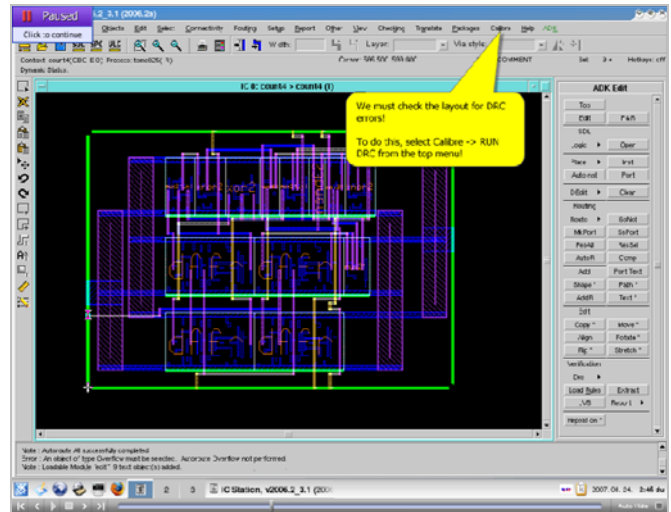


Figure 2. – Video tutorial about P&R
(A hint can be seen in the yellow box)

The installation and configuration of the Moodle system took about one month but uploading the on-line contents and keeping them up-to-date takes much time and continuous availability.

The Moodle server can be accessed from anywhere on the Internet by using any ordinary web browser. Every data is stored in an SQL database (managed by the MySQL server) hence data backup and restore for example can be very easy in case of a system failure. This functionality can be directly accessed from the web interface of Moodle amongst many other useful features. The greatest advantage of Moodle over other course management softwares is that it is free and can be customized in order to accomplish special organization purposes. Another advantage is that Moodle is developed by the Moodle Community and thousands of 3rd party addons are available freely as well. Because of the many addons and mods, a great augmentation of the Moodle system can be achieved this way providing every feature we needed.

CONCLUSION

The E-learning online system of the Department of Electron Devices was tested successfully during the last semester (2007 autumn) on approximately 300 students within the framework of Microelectronics BSc. course. From the next semester we will continue using and testing this system on 500 active students.

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