Beyond the Initial NSF-ILI Grant - Planning for the Subsequent Development

Ece Yaprak
Wayne State University
yaprak@eng.wayne.edu

Lisa Anneberg
Lawrence Technological University
Anneberg@ltu.edu

Nizar Al-Holou
University of Detroit-Mercy
Alholoun@udmercy.edu

Abstract

In 1996, Wayne State University's Division of Engineering Technology was awarded NSF ILI grant for improving the digital design laboratory environment [1,2]. The objective of this laboratory development was to incorporate the computer-aided digital design methodology along with sophisticated PLDs [programmable logic devices] into a seamless design environment that will keep pace with the rapid technological advances. Presently, we are expanding the initial funded grant to encompass additional institutions and technologies. This paper explains the planning steps, the initial contacts, and the future enhancements that are underway. The paper will explain the laboratory enhancements and map out the plans for the expansion to other institutions including community colleges.

Introduction

NSF ILI grant provided a wonderful opportunity for the WSU engineering technology students to study and work with advanced state of the art programmable chip simulation and chip programming using Altera software and hardware development packages. Additionally, the grant was a unique collaboration between academia (Wayne State University), government (the National Science Foundation), and industry (Altera Corporation). The engineering technology students presently utilize two types of PLDS in the 7000 series in conjunction with Altera Corporation's MAX + PLUS II design software package. This package combines text, graphics, and waveform entry methods for digital design. In addition, the WSU laboratory has a web-site for this funded project: http://ozric.eng.wayne.edu/~altera.

Students access this web-site for software and hardware development information, and an initial lab example, the full adder, is included. A summer class for middle school students and middle school teachers also utilized the laboratory environment, and introduced the students with their teachers to digital design [6].

Other institutions will benefit from the prior experience and already developed digital design environment at WSU. The next plan includes more involvement with other colleges, middle school teachers, and middle school students.

Project Overview

Rapidly increasing device densities, design complexities, and time-to-market pressures are constantly challenging digital logic design engineers and technicians. In order to prepare students for these challenges, students must be taught using the latest technology embedded into advanced hardware and software tools. The purpose of our project is to enhance student learning in digital logic design, using state-of-the-art software and hardware development tools. This purpose will be realized through a partnership among three universities in Southeastern Michigan and through collaboration with the Altera Corporation [which will provide the necessary software and hardware.

The project has four teaching objectives. These are:
1) to enhance engineering education in the digital design area, particularly at the three partner universities [Wayne State University (WSU), University of Detroit Mercy (UDM), and Lawrence Technological University (LTU)], to better prepare students for the high-tech, global environment in which they will be working in the next millenium.
2) to share what was learned from an NSF-ILI grant awarded to WSU with the two partner universities through (a) the set-up of the WSU's digital laboratory and (b) making the laboratory materials and the Altera User Manual developed by the WSU available at these schools.
3) to diffuse what was learned in the WSU setting into K-12 educational settings, in an effort to infuse "the joys of technical education" into youngsters, particularly young women.
4) to facilitate the exchange of ideas, practices, and application about digital design courses through service as a national clearinghouse via the development and posting of a laboratory manual and other educational materials on the project's web-site.

The project is composed of the following activities:
1) Adaptation and implementation of exemplary materials originally developed by the PI of this project through an NSF-ILI grant for use at UDM and LTU.
2) Development of a *Digital Laboratory Handbook* which will be composed of 21 laboratories developed by the PI and the faculty at the partner universities. This handbook will include laboratories for lower as well as upper-level digital sequences, will implement Altera's Design Laboratory Package, and will be placed on the project's web-site. Institutions throughout the country will be able to select laboratories from this Handbook and use, or adapt them to their particular setup. The Solutions Manual which will accompany this Handbook will be made nationally available to faculty.

3) *Professional Development Workshops* for faculty members, who teach digital courses at the three partner institutions to help train them in teaching digital logic design in a state-of-the-art setting.
4) Professional Development Workshops for K-12 teachers and students who will attend the workshops and/or attend each of the three university's ongoing innovative K-12 Education outreach programs.
5) Evaluation of the effectiveness of this adaptation and implementation effort by the WSU, UDM and LTU Industrial Advisory Boards.

Goals and Objectives of the Project

The WSU, UDM, and LTU partnership is an effective mechanism with which to achieve our project's goals, because these schools are similar, yet different, from one another. All three schools are teaching-oriented, but UDM and LTU cater to a slightly different set of students than does WSU. WSU, a Carnegie I research university with an urban focus, draws heavily from the many ethnic communities in and around Detroit, such as Arabic, Polish, and Ukranian populations. The UDM student population is proportionately heavier in African-American students, and LTU draws heavily from the ethnic nationalities sprinkled into the Southeastern Michigan area.

Each of these partner universities has its unique network of outreach programs targeted at a different segment of the Detroit area population. For instance, WSU's Southeastern Michigan Alliance for Reinvestment in Technological Education (SMARTE) program is dedicated to serve K-12 teachers. UDM's Detroit Area Precollege Engineering Program (DAPCEP) is dedicated to serving precollege students, and LTU's 2+2+2 High School Engineering Preparation program is dedicated to inspiring technical education in high school students. By essentially interweaving these three networks, our project will effectively carry the following objectives to the different populations in Southaeastern Michigan.

1) To enhance technical education in order to prepare students for better job opportunities in the next few decades.
2) To diffuse what has been learned in one university setting into other university and college settings.
3) To diffuse this experience to K-12 teachers and students, in an effort to motivate youngsters, particularly young women, into technical careers.

Detailed Project Plan

Most modern industrial digital circuit designs require the use of computer-aided design methods and tools. One such tool is the Programmable Logic Device (PLD). PLDs are digital logic chips containing circuitry that can be *programmed* by an individual to realize logic functions that might ordinarily take tens of SSI circuit packages to implement. In using these devices, the probability of error shifts from wiring to programming. Many PLD packages today come with a simulation option where the simulation package tests the logical operation and internal timing. This allows the students to model their circuit

design before programming them into a target device (ie. an IC chip). PLDs are one of the most significant new advances in digital electronics, as they allow the student to overwrite his/her design onto the same chip.

One of the pioneers in the introduction of PLD packages has been the ALTERA Corporation. ALTERA's MAX+PLUS II Development software is a fully integrated programmable logic design environment, which allows seamless integration with industry-standard design entry, synthesis, and verification tools. This implementation will give the WSU, UDM, and LTU students an edge in the job market. With the Altera Corporations funding, these schools will also be able to implement the same type of laboratory instruction in their own programs.

The following describes the role of each partner university in the project for implementing the project activities. WSU's role in this project is to transfer to UDM and LTU the laboratory teaching experience and lab materials in the digital design area using programmable logic devices. To implement this transfer, the WSU will:

- Assist the partner universities in implementing the transfer to their institutions, and share the already developed laboratory materials with them,
- Through workshops, train faculty members who typically teach courses in the digital area at the partner universities,
- Train through workshops K-12 educators in the Detroit metropolitan area about digital design, and motivate youngsters in technical education and technical careers,
- Update the WSU laboratories already developed and compile these with the other labs that will be developed into a Digital Laboratory Handbook and make this available on the project's web-site.

In addition, the WSU will coordinate and manage the project, and will assure that the project will progress toward reaching its objectives. Each institution should have the proper computer facilities necessary to run the Altera system.

"Adaptation Phase"	• Workshops will be conducted to faculty members responsible for teaching digital sequences at WSU, UDM and LTU • Additional laboratories will be developed
"Implementation Phase"	• "Digital Laboratory Handbook" will be developed • Workshops will be conducted to K-12 teachers and students under WSU's ongoing programs such as SMARTE, TECH PREP, SUMMER ACADEMY • Additional workshops will be conducted for faculty at other colleges to share and learn from our experiences

Evaluation Plan of the Project

To facilitate continuous improvement, we plan to use the following methods to evaluate our progress:

- A questionnaire for laboratory evaluation will be completed by students at each participating school at the end of the semester which will solicit their responses about the utility, applicability and reliability of the Altera development package.
- Contact with students and their employers will be maintained after students' graduation to assess the impact that the laboratory may have had on the students, both in terms of the students' job performance as well as sustained learning.
- Information will be garnered from industries to gauge their reaction to selected experiments, to solicit their contributions for further enhancement of these experiments through a survey as well and through discussions with each partner university's Industrial Advisory Board.

Conclusion

In this paper, the plans for adaptation and implementation of a digital laboratory using Altera Development Package at WSU were explained. The plans for the expansion to other universities and K-12 institutions were explained. The impact of our project is wide. Its impact on engineering technology education at WSU is realized through the addition of new laboratory designs using state-of-the-art CPLDs in all required digital design and computer architecture courses. Our students in Digital Design and Microcomputer Hardware Design courses have informed us that they have benefited from this laboratory enhancement. Other institutions will also benefit from this project. Its impact on K-12 education will be even deeper with the planned teacher training workshops on digital design technology.

Acknowledgement

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ECE YAPRAK

Ece Yaprak received the B.S. degree in Electrical Engineering from the University of Michigan-Dearborn in 1980, the M.S. and Ph.D. degrees in Computer Engineering from Wayne State University in 1984 and 1989, respectively. She is an associate professor in the Division of Engineering Technology, Wayne State University. Prior to joining WSU, she worked for Western Michigan University, General Electric, and Ford Motor Company. She is a member of ASEE and IEEE, and is IEEE/SEM's Director of Educational Activities.

LISA ANNEBERG

Lisa Anneberg received the B.S. degree in Industrial and Operations Engineering from University of Michigan at Ann Arbor in 1979, the M.S. and Ph.D degrees in Computer Engineering from Wayne State University in 1983 and 1991, respectively. She has been affiliated with Lawrence Technological University in Southfield, MI since 1990 and is an associate professor in electrical and computer engineering. She received SAE's [Society of Automotive Engineering] Ralph Teetor Educational Excellence in 1996. She is on ASEE's Women in Engineering Directorate, a local NSPE chapter [National Society of Professional Engineers] president-elect, a SME certification committee member.

NIZAR AL-HOLOU

Nizar Al-Holou received MSEE from Ohio State University in 1983, and Ph.D. in Electrical Engineering from University of Dayton in 1987. He is an associate professor in the Electrical Engineering Department at University of Detroit-Mercy. He has published many articles has funded research.