CELT Summer Instructional Development Grant

--- “NEW MECHATRONICS COURSE DEVELOPMENT”

Final Report

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Activities and Products

After the progress meeting on October 24, as suggested by Gail Rathbun, Jeannie DiClementi and Tiff Adkins, I started to concentrate on the development of the lab manual. During the last month, I completed the first draft of the lab manual for the laboratory course. The laboratory course consists of four informative experiments and one final project. The objective of the four informative experiments is to help the students get familiar with the VEX® Robotics Kit and the software environment. The four experiments are: Introduction to the VEX® Robotics Kit, Introduction to the MPLAB® IDE (integrated development environment), Programming on the motor control, and Programming on sensor interfacing.

All of the experiments and the final project will be conducted in groups. In the beginning of the semester, the whole class will be divided into groups of three, with each group having at least one mechanical engineering student and one electrical engineering or computer engineering student. This is to ensure that the students will be exposed to the multi-disciplinary working environment, which is one of the outcomes for this course.

The first experiment is about the introduction of the VEX® Robotics Kit. In this experiment, the students will first learn all of the parts provided by the VEX® Robotics Kit and build a “squarebot” following step-by-step instructions.

The second experiment is about the MPLAB® IDE. MPLAB® IDE is a software program that runs on a PC to develop applications for Microchip microcontrollers. The PIC microprocessor embedded in the VEX® controller is one type of Microchip microcontrollers. The students will program the robot under the MPLAB® IDE. In this experiment, the students will learn how to open a new project, insert the default program to the project, compile and build the project, and download the executable program to the robot. Then run the robot using the default program.

The third experiment is about programming on the motor control. In this experiment, the students will learn the motor control functions provided by the VEX® Robotics Design System. The students will then write their own program to control the regular DC motor and the servo motor, and compare the different performance between the two different types of motors.

The fourth experiment is about programming on sensor interfacing. There are three types of sensors students will learn to use: bumper switch sensor, limit switch sensor, and the light sensor. Students will write programs to utilize these three types of sensors to accomplish some line following task and obstacle avoidance task.

The final robotic competition project includes a scenario and a series of challenges. The final competition project is in the subject of homeland security operations. Each group must construct and program a robot to follow a trail of bio-chemical material (black line on a white surface), move hazardous materials to a safer location recover a victim, put a nuclear dirty bomb in a disarmament room, and retrace the route out of the hazard area.

Evaluation methods of this project

1. Students' satisfaction survey

Since the course is a multidisciplinary course, my major concern is that if all of the students from different majors learn useful knowledge. So a survey will be conducted at the end of the semester to ask the students' feedback about this. In the survey students will need to identify his/her major first for the future analysis. The feedback will be compared with the previous survey data documenting students' dissatisfaction with the contents of the course. The previous survey data are attached in the Appendix I.

The following questionnaire has been developed to check the students' satisfaction about the course contents:

- Was the content covered in this course evenly balanced among the field of Electrical Engineering, Computer Engineering and Mechanical Engineering?
- What's your plan for your future career? How will the content of this course benefit you in your future career?
- Was the content from other disciplines rather than your major taught clearly enough to learn?

Another major reason that we upgrade this course is because that the students were not happy with the LEGO Mindstorm® Kit, which is used in the current course. Therefore, I will need the feedback from the students on the new VEX® Robotics Kit that I implemented into this course and the software MPLAB® associated with the Kit. The feedback will be compared with the previous survey data documenting students' dissatisfaction with LEGO Mindstorm® Kit. The previous survey data are attached in the Appendix II.

The following questionnaire has been developed to check the students' satisfaction about the new VEX® Robotics Kit:

- Does the VEX® Robotics Kit offer enough sufficiency to build what you want to deliver? If not, are there any specific parts you would like us to add on?
- Are the sensors provided in the Kit enough for you to complete the missions? If not, what kind of sensors you would suggest us to add?
- Do you find the VEX® Robotics Kit easy to work with?
- Do you find MPLAB® powerful enough and yet manageable to work with? If not, what are the things you dislike about MPLAB®?
- Do you find MPLAB® user friendly? If not, explain your concerns in specific aspects.
- Does ENGR 221 – C language and other program languages you learned prepare you well to program in MPLAB®? If not, what kind of knowledge do you think you lack?

2. Students' feedback on the lab manual

The corresponding laboratory course is a major part of this development project. The laboratory manual I developed will play an important role in the implementation of this new development. In that regard, the feedback from the students is an important factor in evaluating this project. Hence, the following questionnaire has been developed to get the feedback from the students about the lab manual.

- Do you find the lab manual helpful and clear in preparing you for the experiments? If not, please provide what kind of other information you would like to be added.
- Do you find the competition rules clear? If not, please state which part you are unsure about.

3. Exit survey

Each April the Department of Engineering conducts an exit survey among the students who graduates in that May. Because this course will benefit the engineering students in their capstone senior design projects, two extra questions will be posed on the exit survey.

- Do you find the mechatronics course and the laboratory helpful on the senior design project? If so, which part?
- Is your job after graduation going to deal with any system related to mechatronics?

4. Peer evaluations

Another method to evaluate the outcomes of this project is to conduct peer evaluations. I plan to ask Professor Hossein Oloomi at Department of Engineering to review my course syllabus (lecture topics). Professor Oloomi developed the current course ECE/ME 387 and ECE/ME 388 and has been teaching these two courses for many years. The following questions will be posed to Professor Oloomi:

- Do you think that the listed contents are in the right sequence?
- Do you think that the listed contents are appropriate to the student level?
- Do you think that the listed contents balanced in the three different fields, Electrical Engineering, Computer Engineering and Mechanical Engineering?
- Do you see there is any potential for integration with any of your courses?

I also plan to ask Professor Oloomi to review the course materials including the laboratory manuals and invite him to observe my class in the spring of 2008.

Appendix I: previous student comments on the course contents

Comments ENGR 280 (ECE/ME 280)
Spring 2006

Outcome 1: An understanding of MC68HC11 microcontrollers

- Difficult
- Class is heavy based on prior classes in the EE[1] major that ME's[2] do not have

Course Evaluation for ECE/ME 280
Spring 2006

Question 1: What do you like least about this course?

- Being a class that is needed for MEs, I wish this class would have more ME related material. About the only ME related material in this course is gear trains.
- Book, mostly EE material.
- The mechanical stuff without taking any of it, kind of brutal.
- The ideas are basics for EE students and completely new for ME students.

Question 2: What would you suggest to improve this course?

- More ME material.
- Class is too in-depth and covers classes EEs haven't even taken.
- Electrical Engineering students should be given a chance to take ME classed rather than this course. I would suggest this class to be an elective rather than required.
- Cover less topics or not go so in-depth. Too many topics are covered. The material could be more balanced between ME topics and EE topics.

Notes
[1] "EE" means Electrical Engineering
[2] "ME" means Mechanical Engineering.

Appendix II: previous student comments on the laboratory course

Comments Lab Evaluation ECE/ME 281

Question 1: Is the lab well equipped? If not, what do you think is missing?

- Lego pieces were missing
- Better Handy Boards
- Longer phone cords would allow program changes from the play board
- We were forced to work with only one type of sensor, which was very unreliable

Question 2: Is the lab equipment functional? If not, please elaborate.

- Handy Board is inconsistent
- Handy Boards
- Handy Board is very inconsistent
- The Handy Boards could be more reliable
- Most of the sensors worked fine