Teach Computer Techniques through Multimedia

Suxia Cui\textsuperscript{1}, Younhui Wang\textsuperscript{2}, Felecia M. Nave\textsuperscript{3}, and Kendall T. Harris\textsuperscript{4}
\textsuperscript{1}Electrical and Computer Engineering Department
\textsuperscript{2}Engineering Technology Department
\textsuperscript{3}Chemical Engineering Department
\textsuperscript{4}Mechanical Engineering Department
Prairie View A&M University

Session: Tools, techniques, and best practices of engineering education for the digital generation

Abstract

Prairie View A&M University (PVAMU) College of Engineering (COE) launched its ten-week summer program entitled “College of Engineering Enhancement Institute (CEEI)” in 2009 aiming at lifting incoming freshmen to a higher math and science level before their first semester. Each program in the COE participated to introduce their individual curriculum through hands-on projects designed by faculty members. Computer Engineering and Computer Engineering Technology programs collaborated and designed two multimedia projects. This paper summarizes the successful experience to share with peer educators.

The fast growth in computer technology has changed our daily lives dramatically during the past decade. The new generation of students is developing with the fascinating multimedia environment such as video games, imaging, and digital music. Educators also teach high school and college students with multimedia tools in order to maintain students’ interest in the subject matter being taught. A survey of the literature suggests that multimedia teaching tools can increase the recruitment and performance of students. A group of faculty members from PVAMU utilized such techniques in recruiting and retention and proved to be effective [1]. Here we present two example projects of introducing computer engineering to freshmen through multimedia technology. Both projects have been tested to be effective through PVAMU COE CEEI 2009 summer program. One project is microcontroller-based music beat generation and the other is to create 3D anaglyph images through digital image processing techniques. Microcontroller is perfect for students to understand the procedure of downloading programs to drive the hardware, and with such understanding, students were able to design their own system to perform music beat of their favorite songs. The 3D anaglyph images unveil the mystery of making 3D images out of 2D pictures. The visual effect built on engineering solution increased students’ enthusiasm for engineering especially Computer Engineering as their majors.

Background

Prairie View A&M University is the second oldest institution of higher education in the state of Texas. The College of Engineering has seven programs accredited by ABET (Accreditation Board for Engineering and Technology): Computer Science, Computer Engineering Technology,
Chemical Engineering, Civil Engineering, Electrical Engineering, Electrical Engineering Technology, and Mechanical Engineering. In the summer of 2009, College of Engineering Enhancement Institution (CEEI) program provides incoming freshmen from different major an opportunity to know the college and prepare them ready for the transition from high school to college lives. Besides the math, physics, and chemistry courses which enhance them for science foundation, each program presented a hands-on project to let students have a preliminary knowledge of what they can do while completing their majors. Based on the similarity of application, Computer Engineering (CPEG) and Computer Engineering Technology (CPET) programs collaborate to group both majors in one session and introduce two projects to the freshmen. There were total of 17 freshmen from CPEG and CPET programs in summer camp 2009.

Projects developed for Computer Engineering Related Majors

Computer engineering is a discipline that embodies the science and technology of design, construction, implementation, and maintenance of software and hardware components of modern computing systems and computer-controlled equipment. Computer engineering has traditionally been viewed as a combination of both computer science (CS) and electrical engineering (EE) [2]. Computer Engineering has both software and hardware parts which is challenging among all engineering discipline.

In this session of introduction to Computer Engineering program, projects are designed to facilitate incoming freshmen with a preliminary understanding of how computer contributes to our everyday life style. The following two projects are selected:

I. Microcontroller based project

Microcontrollers are small, self-contained computers, and are brains of dozens of devices and appliances in our everyday lives. It is a very good example to introduce how computer engineering links both hardware and software together. The project teaches students how to build a system for data collection, analysis, display and etc. which are operated by a microcontroller. A complete microcontroller system design usually contains modules shown in Figure 1:

![Figure 1: A sample microcontroller system](image-url)
For example, if the system is designed to collect the temperature of a room, the data will be stored and displayed during the process. With this basic structure, students may creatively design their own applications.

The “Microcontroller Computer System Engineering Kit” by Thames & Kosmos (Figure 2) was chosen to be the platform which features a BASIC type programming module to avoid detail programming language barrier for first time learner. Besides the microcontroller, it also introduces to students some basic circuit connection skills. Those elements include resistors, capacitors, diodes, and etc. Some virtual equipments, such as voltage meter, oscilloscope.

![Microcontroller kit](image)

Figure 2: Microcontroller kit

There is also a feature of infrared connection to the computer which students can make their own program by using some basic instructions as data transfer, sound from beep, delay time setting up. Example of microcontroller programming is shown in Figure 3.

Students can start with the example program shown in Figure 3, by manipulating the delay time to make music beat generating program with their own favorite songs, which motivates students to practice more in learning microcontroller techniques.

The whole project has three stages:

1. Introduce to computer engineering discipline.
2. Practice microcontroller skills by warming up with the microcontroller kits
3. Students will build their own system for a competition.
As during the summer project, students have tried several sound and display examples. The results of the project show that all the students are able to install and test the software. Also they can build their own circuits and make simple programs to drive the hardware to work.

II. 3D Anaglyph Imaging Project

We used another project to further introduce Computer Engineering and Engineering Technology program to the incoming freshmen. By exploring some basic concepts of 3D image processing technology and applications in this 3D anaglyph imaging project, students will have further understanding of how computer contributes to our daily lives from another view of point.

“Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video; the output of image processing can be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.” [3]

In this project, we focus on creating 3D anaglyph images through digital image processing techniques. “Anaglyph images, as shown in Figure 4, are used to provide a stereoscopic 3D effect, when viewed with 2 color glasses (each lens a chromatically opposite color, usually red and cyan). Images are made up of two color layers, superimposed, but offset with respect to each other to produce a depth effect.” [4]
The whole project has three stages:

1. Introduce to computer engineering and technology discipline and warm up with the image processing concepts.
2. Design the system which can produce anaglyph images, also students will learn to make their own 3D glasses.
3. Build and test the system to acquire the results and present the project.

**3D Anaglyph Imaging System**

Figure 5 shows the block diagram of 3D anaglyph images producing system:

![Diagram](image)

Figure 5: 3D anaglyph imaging system

The two cameras (or one taking pictures at two different locations) simulate human eyes. The left camera takes a left view picture, while the right camera snaps a right view image. The two images are input into the computer, in which a student’s designed digital image processing
program will impose them together to produce an anaglyph image. Then looking through two color glasses, people can see the image with the stereoscopic 3D effect.

Procedure and implementation

Initially, presentations were given to the students and let them understand the basic theory lying behind the proposed project activities. Through examples, students learned the concepts and the procedure to make anaglyph images, as shown in Figure 5.

After the students gained basic understanding on how anaglyph images work as well as how we can produce such images, they learned Matlab programming. They practiced on how to combine the two view images into an anaglyph image using Matlab program and wrote the program:

```matlab
function anaglyph(image_file_L, image_file_R, image_file_A)
    image_L = imread(image_file_L);
    image_R = imread(image_file_R);

    image_A(:, :, 1) = image_L(:, :, 1); %Red channel
    image_A(:, :, 2) = image_R(:, :, 2); %Green channel
    image_A(:, :, 3) = image_R(:, :, 3); %Blue channel

    imwrite(image_A, image_file_A, 'jpeg');
    image(image_A);

    % Then, they learned how to take the left and right view images using a single camera. Figure 6 shows several anaglyph examples taken by the students.
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Summary

The PVAMU COE CEEI was a very successful incoming freshmen summer program:

1. Students gained hands-on experience on real projects of what they can do in the future to benefit the society. They are motivated to complete their course work toward their degree in different program. At first, it is difficult to explain the difference of computer science, computer engineering, and electrical engineering, but a microcontroller project can explain the relationship with circuits, programs, how these two can work together. Just as Computer Engineering is a combination of Electrical Engineering and Computer Science. In the 3D Imaging project, the students worked very hard on learning how to take 3D pictures. Through the project, students also understand that what they learn in the class is tightly linked to our daily lives. The CPEG and CPET combined group showed interests in multimedia technique and positive feedback was obtained for the two projects designed.

2. Students practiced on teamwork skills. Teamwork is very important for engineering majors. The project gave the students opportunities to work within groups and practice on teamwork skills.

3. This 5-week camp also provides a channel for students to get knowledge of the university, the college, the department, and the labs. They are going to be the seeds we spread to the whole college incoming freshmen. They will lever up the whole quality of our students as a whole. The success of the CEEI program is not limited to the single project, or how much a student can learn in a 5 week period, but extends the influence to the whole incoming freshmen body. Also let the students know their professors in advance in the lab setting is a good approach to build faculty-students relationship among each department.

Figure 6: Students’ anaglyph images
Reference


Biography

Dr. Suxia Cui, assistant professor in the Electrical and Computer Engineering Department at Prairie View A&M University. Her research areas include image processing and video coding, data compression and wavelets. Her contact information: P.O.Box 519; Mail Stop 2520, New Engineering Bldg. Room 334, Prairie View A&M University, Prairie View, TX 77446
E-mail: sucui@pvamu.edu, Tel: 936-261-9917, Fax: 936-261-9930

Dr. Yonghui Wang, assistant professor in the Engineering Technology Department at Prairie View A&M University. He is also the Computer Engineering Technology program coordinator. His areas of research include computer graphics, visualization, image and video processing, and data analysis. His contact information: P.O.Box 519; Mail Stop 2530, S.R. Collins building Room 318, Prairie View A&M University, Prairie View, TX 77446
E-mail: yowang@pvamu.edu, Tel: 936-261-9863, Fax: 936-261-9867

Dr. Felecia M. Nave, associate professor in the Chemical Engineering Department at Prairie View A&M University. She is also the interim Assistant Dean of College of Engineering. Her contact information: Chemical Engineering building room 324, Prairie View A&M University, Prairie View, TX 77446. E-mail: fnnave@pvamu.edu, Tel: 936-261-9411

Dr. Kendall T. Harris, professor in the Mechanical Engineering Department, and Dean of College of Engineering at Prairie View A&M University. His contact information: Deans Office, S. R. Collins building, Prairie View A&M University, Prairie View, TX 77446. E-mail: ktharris@pvamu.edu, Tel: 936-261-9956