AN INTERNET-BASED APPROACH TO RECRUITMENT AND RETENTION OF MINORITY STUDENTS

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Abstract — *In this paper, we discuss a fairly novel project to recruit and retain minority students in a new electrical engineering collaborative program that has recently been articulated by University of Maryland Eastern Shore (UMES), Salisbury University (SU), and University of Maryland College Park (UMCP). In the first phase, fifty minority students from area high schools are enrolled in the project. Students in the project engage in hands-on activities that involve remote manipulation and control of simple engineering devices over the Internet. The students assemble robotics kits and visit the laboratories at UMES and install their projects. The students will then return to their respective schools and manipulate and control the operation of their assembled kits. Digital cameras installed at UMES laboratories enable the students to monitor and verify the satisfactory operation of their experiments. This project has sufficient novelty and excitement to capture the students' interest and motivate them toward a career in engineering.*

Index Terms *— Minority Students, Student Recruitment, Student Retention, Internet-Based Activities, Remote Education, Remote Access and Control.*

INTRODUCTION

According to data prepared by Davis for division of Science Resources Studies of National Science Foundation [1], more than 3.2 million persons were employed in science and engineering fields in 1993. Almost three quarters of a million were woman. Just fewer than 500,000 were members of minority racial or ethnic groups and 200,000 were underrepresented minority. Women and underrepresented minorities were more highly represented in the social sciences than in other disciplines.

One major difference that is usually obvious in engineering programs is the ratio of male and female students. Most students graduated in engineering fields are male and Caucasian. The number of women and minority students in Electrical Engineering program is considerably less than other engineering fields. The following table gives the percentage of male-female ratio in different engineering fields at Carnegie Mellon University in 1992 [2].

TYPE OF ENGINEERING	FEMALE % OF CLASS	MALE % OF CLASS
Chemical	35%	65%
Civil	23%	77%
Electrical &Computer	7%	93%
Mechanical	8%	92%
Material Science	6%	94%

The data of minority graduate students in engineering programs at master and doctoral level at Massachusetts Institute of technology in academic year 1999-2000 indicates that the number of Asian American students (A) leads the number of graduates from African American (Af), Native American (N), and Hispanic American (H) groups [3]. The following table shows the number of graduate students for each ethnic group.

	M.S. in Engg				Ph.D. in Engg			
	Af	*N*	*H*	*A*	*Af*	*N*	*H*	*A*
Aeronautics	6	-	6	12	-	-	-	2
Chemical	1	1	1	1	3	-	3	11
Civil and Envoi.	2	-	6	7	-	-	1	-
Electrical	6	-	6	15	11	1	6	63
Material Science	3	-	1	12	-	-	-	5
Mechanical	10	2	2	24	5	-	1	12
Nuclear	3	-	1	5	-	-	2	2
Ocean Engineering	-	-	-	2	-	-	-	-
Naval Construction	1	-	1	-	-	-	-	-
Bioengineering	-	-	-	-	2	-	2	9
Engineering system	-	-	1	5	-	-	-	1
System Management	1	-	1	5	-	-	-	-

Although participation of women and minorities in science and engineering fields of higher education continues to increase, but this advancement does not match their representation in the U.S. population of 18 to 30 years olds [4]. To overcome this shortage, a number of universities and colleges have developed programs to increase the number of underrepresented, minorities and women students in engineering and science fields.

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In summer of 1997, a program called Summer Experience in Science and Engineering for Youth (SESEY) was started at Oregon State University to encourage ethnic and economic diversity in the science and engineering fields through recruitment of the underrepresented minority high school students [5]. In this program, faculty mentors and undergraduate/graduate students work with the high school students daily as advisors of the research project and as career counselors. The high school students work on developing engineering modules in plastic recycling, semiconductor processing, Pulp and paper processing, and high strength material processing and bring back to their respective high schools to present to the students in their science classes.

About 14% of the undergraduate students in the College of Engineering and Applied Sciences (CEAS) at Arizona State University (ASU) are underrepresented minorities. In [6] the Office of Minority Engineering Programs (OMEP) at the ASU discusses the way OMEP and ASU are overcoming many obstacles through their service. Some of the programs this service provides are: minority bridge program for incoming freshman engineering students, Minority summer institutes for high school students, and peer tutoring program, to name a few.

Dolle and Price in [7] describe a project that is completely organized and taught by junior and senior engineering students, each of which facilitates one or two sections of an orientation course, known as Engineering 100. The high school students or the upcoming freshmen are introduced to the course requirements and they are given a general idea on Engineering 100 before they take this basic and important course.

Engineering freshmen at the University of Pittsburgh are required to take a seminar offered as a non-credit course, which is based on the importance of student peer relationship and includes guest speakers, panel discussions, and involvement by upper-class engineering students [8]. These are strong elements that can provide a guide for the engineering freshman students. The mentors are selected and trained to manage groups of twenty freshmen. They are also trained to direct recruitment activities. This program has improved the retention and recruitment statistics.

The U.S. Coast Guard Academy has designed a program to motivate and attract students to consider engineering as a career option [9]. This program awards scholarships to minority students across the country to attend a weeklong introduction to engineering program. The senior high school students participate in several design projects, such as boat building, bridge building, and robotic design and construction. These engineering projects have been developed to better introduce the engineering profession to minority high school students.

In this paper, we present a project that has been designed to increase enrollment and participation from local area high school students in the field of engineering at University of Maryland Eastern Shore (UMES) and Salisbury University (SU). This project also serves freshman and sophomore undergraduate Electrical Engineering students gain experience in mentoring the high school students to work with various projects in engineering.

PROJECT DESCRIPTION

Electrical Engineering program is a challenging and highly demanding field and requires dedication and hardworking. Theory classes cannot replace the practical aspect of this field. Therefore, more extracurricular projects and activities are essential for undergraduate students. This can also serve as an open door for high school students, who are attracted by or are willing to consider engineering as their future choice.

The University of Maryland Eastern Shore in collaboration with Salisbury University has designed a project for freshmen and sophomore engineering students, so that undergraduate Electrical Engineering students can improve their ability to communicate and gain experience working on various projects. The undergraduate student will also share their knowledge with local high school students. High school students will have the chance to come to the university to assemble and program a robot to accomplish certain tasks under the supervision of freshmen and sophomore engineering students. The high school students will learn how to control the actions of the robot from their school through the Internet by using remote control software.

Under the supervision of the undergraduate students and engineering and engineering technology faculty, local high school students actively participate in the project. The main objective of this project is to accomplish better communication between the local high schools and the university, and provide an opportunity for the undergraduate students to get a better appreciation for the real world engineering applications.

In order to get more local high school students involved and to gain recognition for the collaborative engineering program, the engineering department at UMES and the physics department at SU have developed a number of Internet-based projects. Through a funded grant, first the university donated multimedia computers to local high schools for use in conjunction with this program. Second, a camera with audio capability was installed in the engineering lab to enable the high school students to observe over the Internet the advanced equipment and college students at work. Third, this grant supports travel of the

local high school students to the lab for interaction with college students to utilize their assistance in assembling and setting up their robots that stay in the lab. Forth, the project requires high school students involvement after they return to home school by using the donated computers to control and manipulate their robots over the Internet and observe the robot action through the camera. Figure 1 shows one of the five workstations available in the lab.

Fig. 1 View of one of the Work Stations in the Electronics Lab

PROJECT IMPLEMENTATION

After evaluating many educational robots, we decided to use the Board of Education robotic kit known as BOE-Bot from Parallax. The BOE-Bot was chosen because of its relative simplicity and great potential for development. An assemble version of BOE-Bot is shown in fig. 2. The robot contains a BASIC Stamp II, which is a small microcontroller about the size of a postage stamp that runs PBASIC code. The BASIC Stamp II microcontroller is shown in fig.3. The BS2-IC has 16 fully programmable I/O pins that can be used to directly interface to logic level devices, such as LEDs, speakers, potentiometers, and shift registers. With just a few extra components, these I/O pins can be connected to non-TTL devices, such as solenoids, relays, RS-232 networks, and other high current/voltage devices.

BASIC Stamps have been used in an almost infinite variety of devices, from land-mine sensors to robots to weather stations to virtually any autonomous device imaginable [10].

The students can control the BOE-Bot by writing programs for it, uploading them to the BOE-Bot, and then observing the results in real-time over the Internet through the camera.

In order to set up the camera for viewing over the Internet, a computer is used as a server and video streaming. The computer used is a HP Pavilion with an Osprey-200 video/audio capture card. A CamMotion software with an applet for zoom/tilt/pan control of the camera were installed in order to allow the users to control the camera from a remote location through Internet. WebMedia software was used for the PC to act as a video and audio server for broadcasting live over the Internet. A chat feature has also been developed so that those viewing over the Internet can respond to those working in the lab.

The undergraduate students spent several weeks to become conversant with the BOE-Bot and the associate software and hardware packages. They designed different experiments using the photoresistors, LEDs, and other elements provided with the full kit.

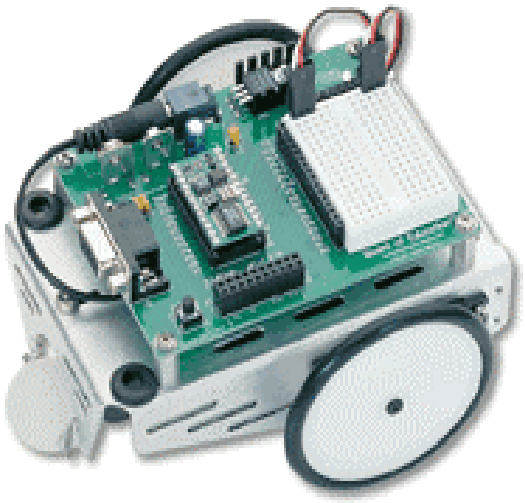

Fig. 2 The Robot (BOE-Bot)

After the students became fairly familiar with the software and hardware aspects of the BASIC Stamp, they learn how remotely control the computer that is connected to the BOE-Bot. The Famatech's Radmin Remote Administrator software was used to control the BOE-Bot remotely over the Internet.

Radmin software is a remote control program, which enables a user to work on one or more remote computers from his computer. The remote computer screen can be displayed either in a window or full screen, depending on the computer monitor used. The mouse and keyboard functions are transferred to the remote computer. The user can work with the remote computer as if sitting in front of it. It is fast and efficient and allows use of the two PCs simultaneously. The remote computer can be placed anywhere on the Internet or local area network, and neither computer needs to have an especially fast connection.

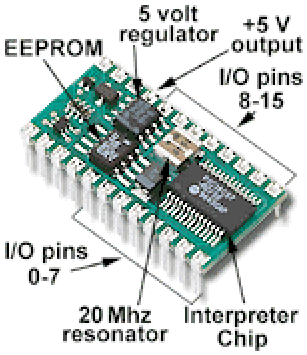

Fig. 3 BASIC Stamp II Microcontroller

CONCLUSION

We have delineated a fairly novel internet-based project to help us recruit and retain Engineering and Physics students. The combination of mechanical, electrical, software, and other engineering topics involved in this project provides a tremendous boost during the formative years of the undergraduate student. The scope and design of the project instills in the students time-management skills, helps them hone their teamwork abilities, and underscores how theory and practice are inextricably intertwined.

The undergraduate students will be facing challenges as they make decisions based on their knowledge, information gathered, budget, and time limitations. They should be able to give presentations to the local area high school students and perform other various related tasks. All these responsibilities and duties will teach them in a realistic way how Engineering can reach everywhere and can touch everyone.

This project is an excellent teaching and learning experience that involves several disciplines: electronics, programming, communications, computers, and the like. It also provides a professional know-how of dealing with financial constraints, deadlines, making presentations, writing reports, and accompanying necessary workplace skills.

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REFERENCES

[1] Davis, A.C., "Women and Underrepresented Minority Scientists and Engineers Have Lower Levels of Employment in Business and Industry," http://www.nsf.gov/sbe/srs/databrf/sdb96331.txt

[2] "A Guide for High School Women on Becoming an Engineer From High School to Career," http://www.swe.org/SWE/StudentServices/CareerGuidance/brochure2.html

[3] "Number of Minority Graduate Students by Course and Year, 1999-2000. http://web.mit.edu/acadinfo/mgrdfinal.html

[4] Olsen, K., "Despite Increases, Women and Minorities Still Underrepresented in Undergraduate and Graduate S&E Education," National Science Foundation Data Brief, NSF-99-320, January 1999. http://www.nsf.gov/sbe/srs/databrf/sdb99320.htm

[5] Rochefort, W.E. and Bothwell, M., "Recruitment and Advising of High School Students from non-traditional Groups," *Proceedings of ASEE Annual Conference and Exposition*, June 28-July 1, 1998. CD-ROM.

[6] McCartney, M.A., Reyes, M.A., and Anderson-Rowland, M.R., "Internal and External Challenges for Minority Engineering Programs," *Proceedings of ASEE Annual Conference and Exposition*, June 1997, CD-ROM.

[7] Dolle, J. and Price, R., " Students Teaching Students: Engineering 100", *Proceedings of ASEE Annual Conference and Exposition*, St. Louis, MO, June 2000, CD-ROM.

[8] Bishop, S.L. and Besterfield-Sacre, M., "Freshman Engineering Leadership Team: Students Mentors for Recruitment and Retention," *Proceedings of ASEE Annual Conference and Exposition*, June 1996, CD-ROM.

[9] Wilczynski, V., Dixon, G.W., and Kiemcik, C.G.,"A Robotics Competition to Interest Minorities in Engineering ," Proceedings of *ASEE Annual Conference and Exposition*, June 28-July 1, 1998. CD-ROM

[10] Johansson, C., "LOSA– List of Stamp Applications," March 5, 2001. http://www.hth.com/losa/