

Web-Based Programming Courses in ECET

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I. Introduction

Indiana University Purdue University Fort Wayne (IPFW) is a state-supported commuter campus with over 12,000 students. The School of Engineering, Technology, and Computer Science has 5 departments: civil and architectural engineering technology, computer science, electrical and computer engineering technology, engineering, and manufacturing technology. Our department, ECET, provides instruction for accredited¹ A.S. and B.S. programs in Electrical Engineering Technology (EET), with options in computer engineering technology. There are about 200 students majoring in EET and over 1100 students have received Purdue EET degrees from IPFW during the past 36 years. The average age of ECET students is approximately 28 and most are employed full-time while taking courses toward their degrees.

The first two Internet courses offered in ECET were presented during the Fall 2000 semester. Both courses introduce programming languages. One, EET/CS 114, used Visual Basic 6 to teach introductory windows programming and is structured as a lecture course, with no scheduled laboratory. The other, EET 205, uses Microchip PIC Assembly language to introduce assembly language programming and is structured as a lecture course with an assigned laboratory component. WebCT² is a Web-based program that is specifically designed for distance learning via the Internet and is widely used in colleges and universities. WebCT is used as the focal point of all interaction in the web course and provides all required administration necessary to teach an Internet course. RealPresenter Plus G2³ was used to meet the need for lecture-like presentations via the Internet. This program enables the instructor to record presentations using Powerpoint slides, a microphone and an inexpensive camera. The presentation must then be uploaded to a RealServer so that students can listen to and/or watch the presentation over the Internet using streaming media technology.

Some of the specifics of how these Internet based classes were taught; using WebCT and RealPresenter G2 will be discussed. In addition, an overview of the courses with lessons learned from teaching the classes will be presented. It is our hope that this paper will make it easier for instructors desiring to use these or similar methods to create a web course from a course previously taught in the classroom.

II. Course Basics and the use of WebCT

A fundamental goal when creating and teaching these web courses was to cover the same material as the classroom course that was taught the previous semester. This was easily scheduled and covered in lectures and labs using the methods to be discussed. However, more students fell behind in their assignments than in a classroom setting.

WebCT was founded at The University of British Columbia and is the most popular course management system in the higher education marketplace. WebCT has a user base of 1,528 colleges and universities in 57 countries with more than 70,000 instructors teaching over 174,000 WebCT courses during the 2000-2001 academic year². WebCT provides a Web interface with all of the features needed to administer a class. Some of the most important features of WebCT are: password protection, a built-in bulletin board, private email for each class, automatic quiz administration and grading, a spreadsheet like interface that enables the instructor to keep all grades on the web, a calendar to highlight important class events when they occur, student homepages so personal/professional information can be presented to introduce members of the class, the ability for individual students to view all of their current grades on quizzes, homework, labs, etc. at any time, and the ability to easily link to other web sites.

An example from a web class will be used to explain some of these features and how they were used in these courses. Figure 1 shows the homepage for the course that is titled EET 114 for ECET students and CS 114 for CS students.

Each of the icons shown in Figure 1 is a link to another page in the WebCT environment. These icons and their functions are discussed below:

1. The Lectures using RealPlayer⁴ icon, in Figure 1, will be explained in the next section. It takes the student to a page where he/she can click on a particular lecture and then listen to the presentation using the Internet.
2. The VB Labs icon, in Figure 1, takes you to a table of contents that contains all 15 "laboratory" exercises, one per week of the semester. Each of these exercises was uploaded in HTML format to WebCT and the student can click on the links for each of the exercises to view the requirements that were written in MS Word⁵. The students can complete the lab exercises and submit the results for consideration by attaching the files to an email within WebCT.
3. The Bulletin Board icon, in Figure 1, takes you to the WebCT bulletin board. This feature is the best method to provide information to all students in the class. One aspect of WebCT is that whenever a student signs on to the WebCT system, they are immediately notified if there are new Bulletin Board or Email postings, if new grades are posted, or if a quiz is available. The Bulletin Board also enables the instructor to set up discussion groups so that specific groups of students can contact each other or so that certain topics can be placed in a particular discussion group. Assignments can also be attached to Bulletins so that all students can download required material from the Bulletin Board.

EET 114 Introduction to Microcomputers

CS-114 Structured Microcomputer Programming

This course uses Microsoft Visual Basic 6 to introduce programming in a Windows environment

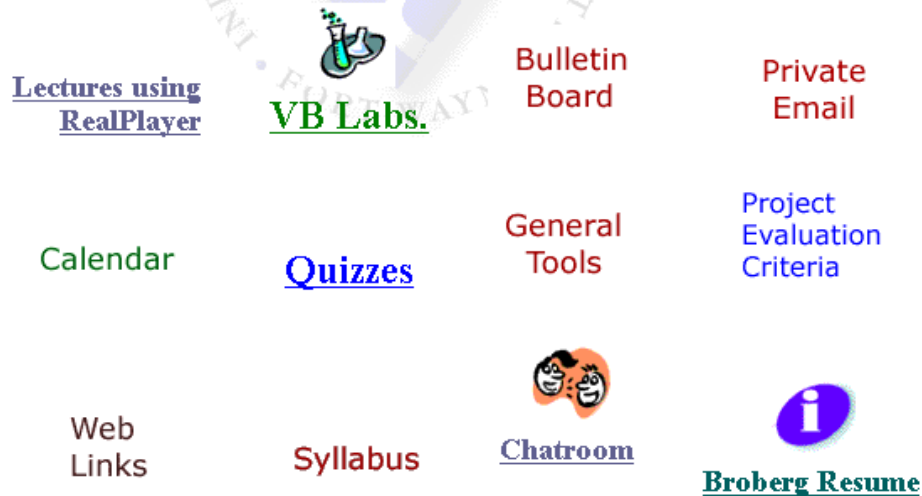


Figure 1: WebCT Home Page for EET/CS 114

4. The Private Email icon, in Figure 1, provides the most used contact from the student to the instructor. Students submitted all of their programming assignments by attaching files to emails in WebCT. They also frequently asked questions and received replies via email. Email was also used to remind individual (or groups of) students of late and missing assignments. Note that a student can also see a list of all names and email addresses of other students in the class and can correspond with them via the WebCT private email system.
5. The Calendar icon, in Figure 1, shows a monthly calendar that is used to remind students of due dates for assignments and quizzes. The WebCT calendar shows some of the same information that is on the class syllabus. However, the calendar format is easier for many of our busy students to relate to their daily lives and several commented that they value the calendar to remind them about when assignments are due and other class events.
6. The Quizzes icon, in Figure 1, takes you to a list of quizzes for the course. Figure 2 shows the quizzes page. Quizzes only become available during a specific time frame assigned by the instructor. It is time consuming to enter quiz questions into the system, but after entry, WebCT automatically grades multiple choice and true-false type questions and the grades are automatically entered into each student's spreadsheet in WebCT after the quiz is completed. The instructor can assign the number of minutes allowed to take the quiz, the

number of times the quiz can be taken, and can have WebCT choose a random set of questions in random order for a quiz.

Title	Availability	Duration	Grade	Attempts
Quiz1	From: Sep 18, 2000 08:00 To: Sep 24, 2000 22:00	90 minutes	/ 100	Completed: 0 Remaining: 2
Quiz2	From: Oct 16, 2000 08:00 To: Oct 22, 2000 22:00	90 minutes	/ 100	Completed: 0 Remaining: 2
Quiz_3	From: Dec 06, 2000 10:25 To: Dec 10, 2000 22:00	90 minutes	/ 100	Completed: 0 Remaining: 2
Quiz_4	From: Dec 09, 2000 08:00 To: Dec 16, 2000 22:00	90 minutes	/ 100	Completed: 0 Remaining: 2

Figure 2: Quizzes Page

7. The General tools icon, in Figure 1, takes you to another page of icons. This page is shown in Figure 3 and is discussed below:
 - a. The View Your Marks and Course Record icon, in Figure 3, enables each student to see only his/her grade. This is conditional on the student's ID and Password being provided correctly.
 - b. The View Your Progress Tracking Information icon, in Figure 3, enables the student to see other information about his/her progress, such as the number of the times various pages of the website have been accessed.

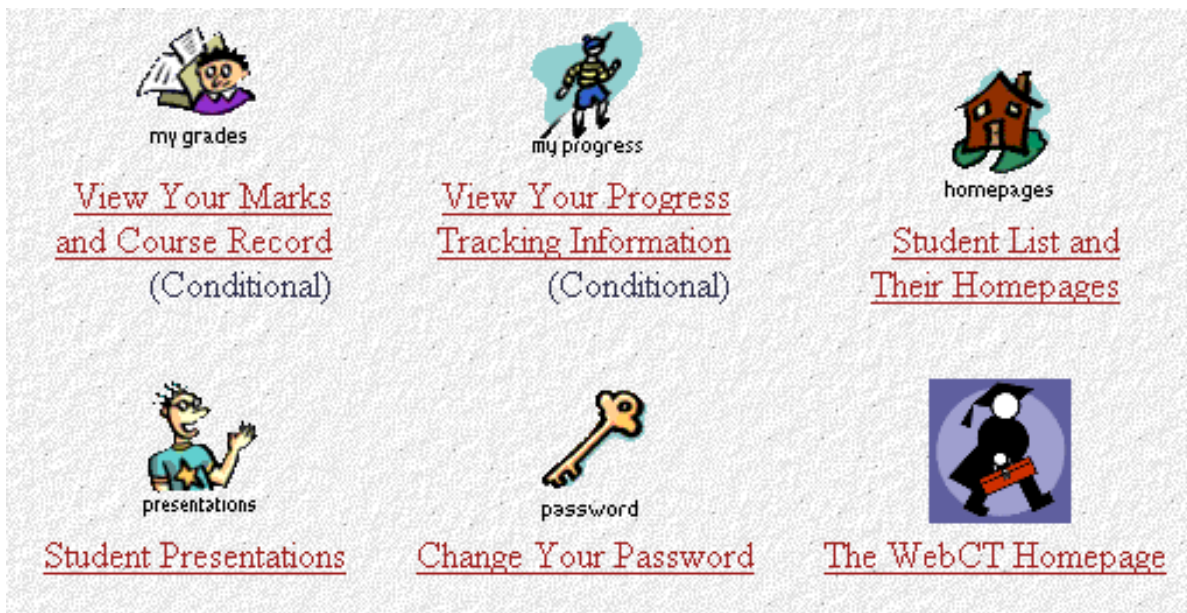
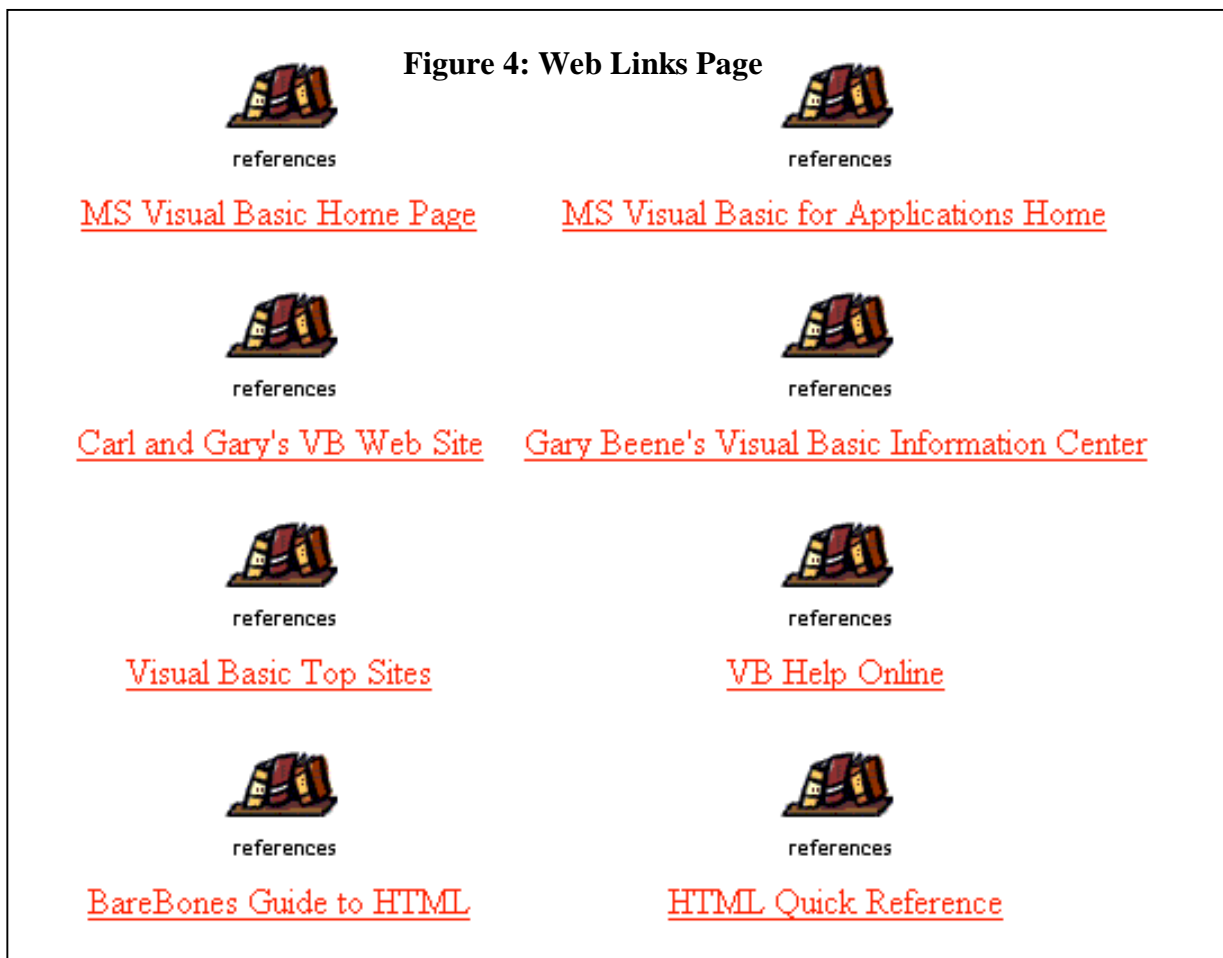


Figure 3: General Tools Page

- c. The Student List and Their Homepages icon, in Figure 3, enables students to see all of the students in the class, to view the homepages of other students, and to keep their homepage up-to-date.
- d. The Student Presentations icon, in Figure 3, enables the instructor to set up an area for a student or groups of students to prepare presentations for the instructor or for the class.

- e. The Change Your Password icon, in Figure 3, is self-explanatory. The IT department assigns an initial password and then the student can change the password to one that makes the site private to him/her.
 - f. The WebCT Homepage icon, in Figure 3, takes the student to the commercial homepage of WebCT and can be removed, if desired. However, WebCT does offer services to students and the web site is quite interesting, so this icon was included.
8. The Project Evaluation Criteria icon, in Figure 1, shows several pages that explain the method of evaluation of each of the programming projects assigned for the course.
 9. The Web Links icon, in Figure 1, shows another page that contains links to other websites pertaining to the class. Figure 4 shows the Web Links used for



this course. Note that all of the sites pertain to Visual Basic or help the students use HTML, which can be used for student web pages. When the student clicks on a link, the instructor can select to display the web site in a new window or in the current window. A new window is best for most information links so that the student can easily close the window and return to WebCT.

10. The Syllabus icon, in Figure 1, shows the student the complete course syllabus on a new web page.
11. The Chatroom icon, in Figure 1, takes you to a series of chat-rooms that can be used for office hours or for chatting about different subjects assigned by the instructor. Figure 5 shows the Chatroom page, which has six different chat rooms. Each of these rooms can be assigned to a different subject, or different group. The Office Hours Chatroom, shown in Figure 5, was used to hold office hours twice a week for each course at a time that was convenient to students. Holding office hours using a Chatroom was much like physical office hours in that only a few students attended and asked questions. Most students preferred email correspondence so that they could send their questions and attach copies of the pertinent program. The instructor could then troubleshoot the program and reply with the answer to the student's question or attach the code for the corrected program.

The last chatroom office hours was Tuesday, December 5

Office Hours Chatroom	Room 2	Room 3	Room 4
General Chat for broberg_01			
General Chat for All Courses			

**Note: Conversations in the following rooms will be recorded:
Office Hours Chatroom, Room 2, Room 3, Room 4.**

Figure 5: Chatroom page

12. The Broberg resume icon, in Figure 1, provides a brief resume so students can become familiar with the background and experience of the instructor.

The use of WebCT for the EET 205, PIC assembly language course was similar, except, this course had a physical lab at the university. Students were required to demonstrate each of their laboratory projects to the instructor. This included students downloading their assembly language programs to a microcontroller and showing that the programs worked properly on the hardware. Students had to be at the university at least 6 times during the semester to demonstrate their programs. Most of the challenges in this course were associated with the use of the Internet and were the same as with the Visual Basic course. Two additional difficulties were; the requirement to explain the projects in the presentations and the necessity to demonstrate, in detail, how to operate the assembler program over the Internet.

III. The Use of RealPresenter Plus G2³

The Lectures using the RealPlayer icon of Figure 1 moves the student to the page shown in Figure 6. The student can download the required RealPlayer Basic by clicking on that icon. Many files were zipped and then attached to the bulletin board for the students to download so an icon was also included to take the user to the Winzip⁷ website so they

***You must have RealPlayer Basic (free) installed on your computer to view these presentations.
Audio Only available from Sep 18 on.***

**If you have trouble listening to the audio presentation using your 56k modem, click on
Download Zipped Audio Files,
unzip the file and doubleclick on the trainer2.smi file. That will bring up RealPlayer and play the audio version.**

Remember the PowerPoint slides and the script are also on the bulletin board for downloading and viewing.

<u>Download RealPlayer Basic (Free)</u>	<u>Download WinZip (Free)</u>	<u>Download Zipped Audio Files</u>
<u>Presentation Week of Nov 13 to Nov 17</u>	<u>Presentation Week of Nov 20 to Nov 24</u>	<u>Presentation Week of Nov 27 to Dec 1</u>
<u>Presentation Week of Dec 4 to Dec 8</u>		

Figure 6: RealPlayer Page

could download the required software. In addition, the audio presentation was zipped and copied to another of the authors' websites and the student could download this zipped audio file and then unzip it and play it using RealPlayer, rather than using the streaming media technology over the Internet. The student could listen to any, or all, of the last 4 lecture presentations during the last week of class and finals week, as shown in Figure 6. Generally, the student had 4 weeks of lecture available on the Internet at all times during the semester. Clicking on the appropriate icon started RealPlayer on their home computer and started playing the selected presentation using streaming media from the RealServer located at IU Bloomington.

RealPresenter Plus G2 is \$99.95 (January 2001) and can be downloaded from the RealNetworks website. This program enables the user to record audio and video presentations using PowerPoint slides in a format that can be streamed over the Internet and played using RealPlayer⁴. A Real Systems Server⁶ must be available so that the completed presentation can be uploaded to this server. The standard professional solution includes a 100-stream Real System Server Professional and costs over \$8300 (January 2001), so this generally requires an investment by a university or college IT department, including the staff support for installation and maintenance of the software and hardware. For the courses discussed here, The Continuing Education Department of Indiana University, Bloomington, IN permitted the presentations to be uploaded to their RealServer via FTP each week. Using Real Presenter Plus G2 on a RealServer, 25 students can simultaneously listen/watch the presentation using RealPlayer⁴. Figure 7 shows the initial screen for RealPresenter Plus G2.

Several difficulties were encountered during the initial weeks of the semester. These were mostly due to bandwidth limitations of the modems that students used to see/hear the presentations. Initially, a small, inexpensive, USB, Intel™ video camera was used with a microphone headset to record audio and video presentations. The video used was

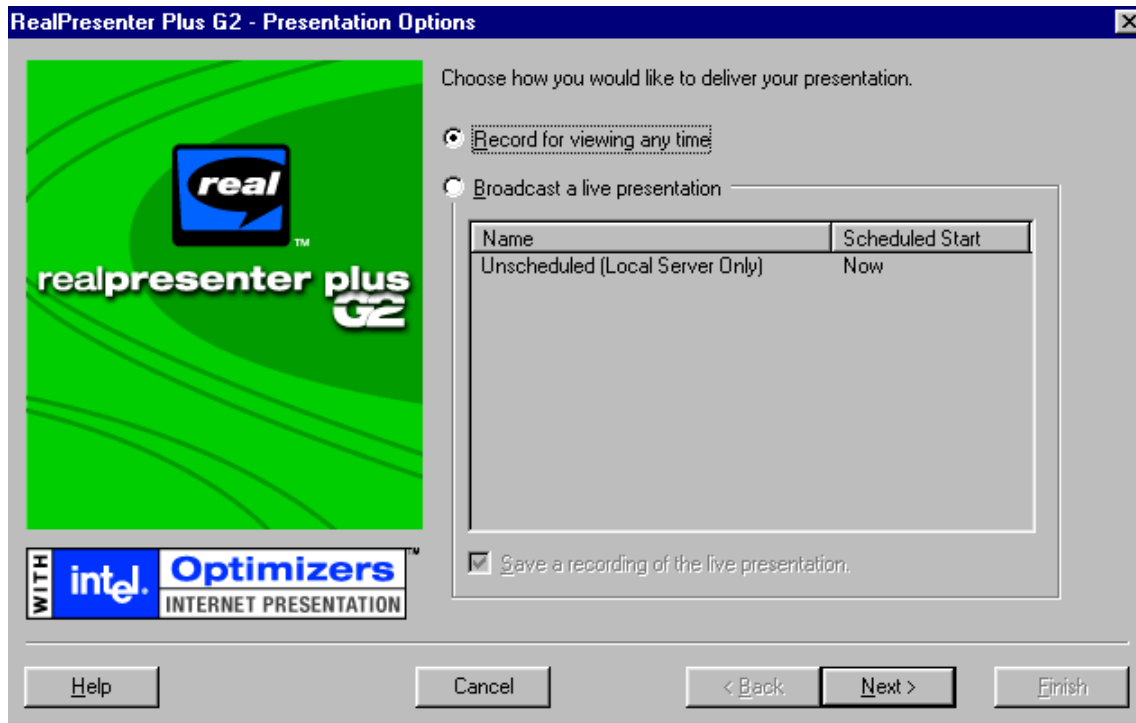


Figure 7: RealPresenter Plus G2

recorded at 2 frames per second and was a view of the instructor's head and shoulders so the student could see and hear the instructor at the same time that the PowerPoint slides were being displayed in the presentation. The completed file was about 200 Mbytes for a 50-minute presentation. This was uploaded via FTP to IU Bloomington, which took over 30 minutes with a fast Internet connection (T1 line). This was all quite reasonable, albeit time consuming, from an instructor viewpoint; however, the students needed a T1 line, Cable Modem, or DSL connection to view the video. Students with a 56k (or slower) modem could only listen to the audio.

After several weeks of recording the video/audio presentation and after polling students, it turned out that most did not care about the talking head (instructor) in the video and were only interested in the PowerPoint slides and the audio. Thus, after the 3rd week of the semester, the presentations were made using only audio with several photos (.gif format) of the instructor included on the PowerPoint slides to provide the students with some personal connection. A representative single slide, taken from EET 205, of a RealPlayer presentation is shown in Figure 8. The audio presentation was about 1Mbyte per minute of presentation or about 50 Mbytes for a 50-minute presentation. This turned out to be easier for the students to view with their 56k modems although some students

with 56k modem connections still had trouble seeing/hearing a complete presentation without being disconnected. It appears that this was the result of the Internet service provider in many cases rather than the result of having a 56k modem.

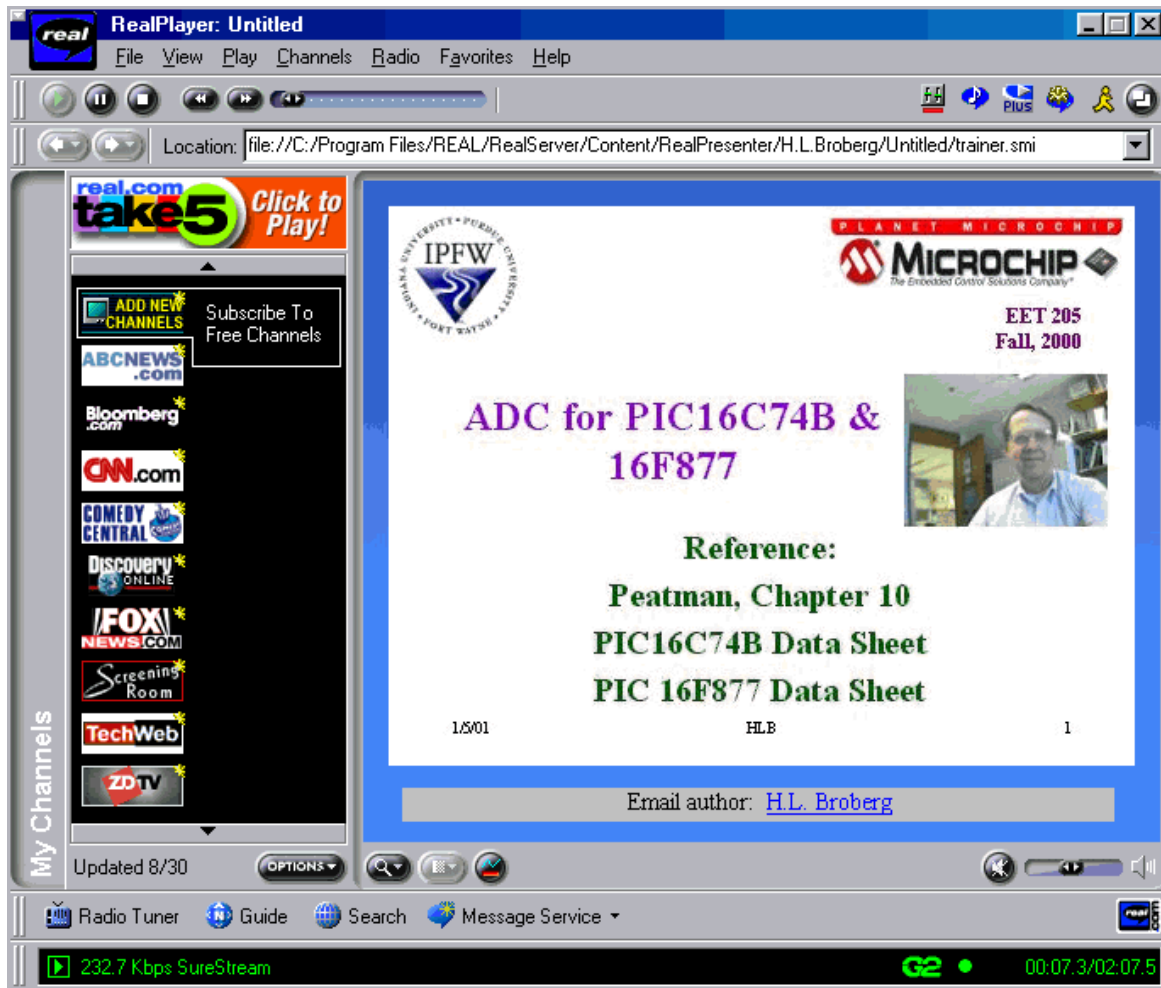


Figure 8: First Slide of a RealPlayer Presentation for EET 205

IV. Overview and Lessons Learned

The two most important parts of creating a presentation are: having PowerPoint slides that are viewable using RealPlayer and having a script to use with the slides for the presentation. The instructor taught EET/CS 114 and EET 205 in a classroom setting during Spring 2000 and taught EET/CS 114 in the classroom during Summer 2000. Thus, a good set of PowerPoint slides for EET/CS 114 and a reasonable set of PowerPoint slides for EET 205 were created and available as a starting point for the Internet courses. The instructor was also able to learn WebCT and create a good WebCT interface, as discussed above, to use during the Internet courses taught during Fall 2000. However, even though most of the slides for both courses were prepared in advance of the Fall 2000 semester, changing the slides so they were easily viewable in RealPlayer and writing the scripts for 2 courses was time intensive.

Four methods were used to enable all students to view the presentations and to provide students with options for the course. The primary method used by students was viewing the presentations as streaming media, using RealPlayer, on the web. A second method available to students was to download the entire presentation to a zip disk at the university (a very fast download since it is from a server at the university). They could, of course, also download the presentation to their home computer, but this was generally not feasible with a 56k modem due to the size (50 Mbytes) of the presentation. The third method that a number of students chose was to download the zipped PowerPoint presentation with the script attached (250 Kbytes to 5 Mbytes) to their home computer and then print the PowerPoint slides and the script and study the presentation without listening to the audio. This method had some advantages for students since the RealPlayer presentation, as shown at close to actual size in Figure 8, is rather small. Printing out or viewing the PowerPoint slides provided a full-page image, which was helpful for some of the diagrams and images used in the courses. A fourth method, for students unable to establish reliable modem connections, was to check out CD-R's recorded by the instructor.

The same courses will be offered in the future and the following lessons learned will be used when preparing for web classes.

1. Teach the course, in-class, prior to moving it to the Internet
2. Try to use the same content as the in-class course for ease of transition
3. Ensure that you are a good typist. Student interaction via email, chat rooms, bulletin boards, and especially typing scripts is time consuming.
4. Prepare the PowerPoint slides and use them in a classroom setting to judge student reactions and questions prior to teaching the Internet class.
5. Do not teach more than one new Internet class per semester. The time required to teach an Internet course is extensive. Some of the time consuming factors are:
 - a. Modifying PowerPoint presentations for the web including scanning new images.
 - b. Writing the script is the most time consuming process. Most instructors do not realize the depth of detail covered verbally. Writing this in script form was the equivalent of about 300 double spaced pages for each of the courses taught.
 - c. Student interaction via, email, chat room, bulletin, telephone calls and office visits.
 - d. Recording the presentation takes about twice the actual presentation time.
 - e. Uploading the presentation to the RealServer⁶.
 - f. Uploading files (PowerPoint), data, attachments, etc to the web site.
 - g. Copying presentations to CD-R.
 - h. Miscellaneous updating of web sites. This includes adding content and links during the semester.

6. Generally using audio only is best with current technology. However, if recording video, record at as low a frame rate as possible. RealPresenter Plus G2 had a minimum of 2 frames per second, which produced relatively large files (approximately 200 Mbytes per 50-minute presentation). If 1 frame per second were available, the file size could have been cut in half.
7. It is difficult to troubleshoot a program, Visual Basic or assembly language, over the web. The best technique was to have the student send the program as an email attachment, with his/her questions. Then, to troubleshoot it on the instructor's computer and then send the result to the student as an email attachment. This is also quite time-consuming.
8. The size of the PowerPoint file was from 250 Kbytes to 5 Mbytes. The file size increases when images are used. Generally GIF images were used, where possible, to reduce the file size, but many times, complex, scanned images were quite large.
9. Computer labs were scheduled with one class and computer lab assignments were used in the other class along with projects that had to be demonstrated to the instructor. Again, this is much more time consuming than with a physical lab because of the necessity to explain everything in great detail and show the steps using images on the PowerPoint slides. It is important to use a step-by-step lab procedure in an Internet class so students can ask questions about each step that they do not understand. This is especially important when there is no physical interaction with the student and all questions must be answered using the Internet. In future classes, video clips will be used to demonstrate laboratory techniques for Internet classes.
10. The bandwidth required for the presentation is important to student use and interaction. Streaming video requires the student to have wide bandwidth Internet service (T1, Cable Modem, or DSL) and even then there can be some breakup due to server overload, Internet connections, etc. Streaming audio requires less bandwidth and RealPlayer produced good results with 56k modems and a reliable provider.
11. Allow time to prepare and upload computer graded quizzes since this is extremely time consuming.
12. Encourage or require students to use the chat-room or to keep in touch with the instructor on a regular basis via email.
13. More students dropped than in a classroom setting. Student motivation in a distance learning environment or student ability to manage time appears to be the principal factor in this excessive number of drops. This appears to be common to all distance learning classes (TV, Videotape, and Internet), but is especially prevalent in Internet classes.
14. New Internet instructors should teach only one Internet course during their first semester of Internet teaching.

V. Conclusion

The Visual Basic and PIC assembly language courses, previously taught in the classroom, were good introductory courses to convert to the Internet. WebCT is a powerful and efficient program for Internet coursework and RealPresenter Plus G2 is a viable option for providing streaming presentations for use as lectures by students.

The methods used in these courses and the lessons learned and discussed will be valuable to the authors in future Internet courses. This discussion should provide insight and/or options to instructors contemplating or teaching Internet courses.

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Hal taught Electrical Engineering for 3 years at the U.S. Naval Academy and after retirement from the Marine Corps as a Lieutenant Colonel, chose to continue teaching. He received his PE license in Indiana in 1988 and his PhD in Engineering (EE) in 1993. His research area is servo systems and he has consulted and worked for ITT (Aerospace-Communications) on weather satellite servos for the past 10 years. He is currently an Associate Professor in the ECET department at Indiana Purdue University in Fort Wayne, IN, a senior member of IEEE, and a program evaluator for IEEE with eleven TAC/ABET accreditation visits completed.

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