MicroTutor – An Interactive Web-Based Tutorial for Microprocessors and their Applications

Tayeb A. Giuma, Tammi Robson

Department of Electrical Engineering
University of North Florida
Jacksonville, Fl 32224
Ph: 904-620-2970; Fx: 904-620-2975
tgiuma@unf.edu

Abstract

This paper describes the design of an interactive web-based microprocessor and applications tutorial "MicroTutor." The basic goal of this interactive web-based system is to help students build an integrated understanding of the basic concepts, functions and operations of microprocessors and their applications MicroTutor was developed as an additional learning tool for an undergraduate course in microprocessors and their applications. It was designed to (1) be compatible with various web browsers and (2) provide an overview of the architecture, organization, operation and applications of a microprocessor. The system was structured in units where teaching aids such as interactivity, animation, and audio were incorporated. Additionally, MicroTutor automatically tracks, updates, and maintains a database for each user. It identifies each user, maintains a log for each user's progress and performance in the tutorial.

Introduction

When IBM introduced the first microcomputer in 1981, not many observers could have predicted the profound changes that this machine would cause the computer industry. The microcomputer has not only changed the computer industry as a whole, society has been permeated by the microcomputer at every level. The World-Wide-Web extended further this technological revolution.

The information age does indeed bring exciting new opportunities for improving instruction. At the very least, we must take account of the fact that our entering students grew up with video games, probably became literate during high school, and may have spent many hours surfing the net. So borrowing words from Thomas Wolf, "we can't go home again." [1].

Multimedia and interactive Computer-Aided-Instructions (CAI) can be valuable tools in improving the learning experience of undergraduate engineering students. This learning experience can be tremendously enhanced by incorporating sound, graphics, and animations in the delivery methods when teaching engineering subjects. By combining the multimedia capabilities of today's powerful personnel computers with easy to use software package, such as Animated Shop [2], Paint Shop Pro in 24 Hours [3], Java Script in a Week [4], NetObjects Fusion 4.0 [5], Hypertext Markup Language (HTML) [6], creating web-based CAI tools for engineering education is both cost and time efficient.

In the study of electrical engineering, it is often difficult for students to develop a true understanding of the more complex concepts without experimenting with appropriate electrical circuits. While actual hardware usage is arguably the best technique for student investigation, the complexity and cost associated with appropriate commercial or industrial hardware system make such system, in many cases, unattractive for wide use by all the students at convenient times.

The Department of Electrical Engineering at the University of North Florida places strong emphasis on laboratory and simulation exercises in its undergraduate curriculum. These exercises are designed to enrich and expand upon the theoretical concepts of each course. This paper describes the development of a an interactive web-based microprocessor and applications tutorial. The basic goal of this interactive web-based system is to help students build an integrated understanding of the basic concepts, functions and operations of microprocessors and their applications that are commonly covered in an undergraduate core electrical and/or computer engineering curriculum. Intuitive understanding is often associated with visualization skills, and many students tend to spontaneously visualize concepts and relationships while they are learning [7]. Therefore, the emphasis in on the graphical presentation of concepts.

This paper covers all aspects of the tutorial's planning, design phases, and all intricacies that were dealt with during those phases. The procedure and the strategy for achieving the objectives will also be described.

Design Procedure

The first step in designing MicroTutor was to outline the course material from the class notes. These notes cover the pertinent subjects taught in the Microprocessor & Applications course at the University of North Florida. The outline of this material can be viewed by visiting the first author web-page at http://www.unf.edu/~tgiuma/. The second step of the design was to develop a block/flow diagram for the project. The block/flow diagram divides the course subject matter into units and identifies the placement of interconnecting web-page links. Block/flow diagram is an essential component in the top-down design of any major project.

Next, we focused on the implementation tools and the desire of using a dependable web development package for the construction of the project. Different software products available for web design were considered and evaluated at the beginning of the project. During the design of the project, more different software packages were evaluated as the need for them became evident.
The product Macromedia was downloaded from the Internet and tested. This product was found to be difficult to use although it featured many desirable attributes for the project. Also, although Macromedia was informed that the use of their product was for educational purposes only, the cost of the product was not lowered below its retail value of $400.00. This made the product undesirable and therefore it was not used in the design of the project.

A trial version of the product Front Page 2000 was downloaded from the internet and tested. This product was found to be easy to use and offered a variety of desirable web page design characteristics. Therefore, this product was used for the basic design of the web page.

The ability to jump to other web pages from "hot spots" within a large graphic was a desired feature of MicroTutor. Experiments were conducted to obtain the present methods used for accomplishing this action. It was found that mapping of graphic was necessary to achieve this task. A trial version of the product MapEdit was downloaded from the internet and tested. This product was found to be easy to use and accomplished the desired task. The distributor of MapEdit, Boutel Corporation, authorized the use of this product without charge. MapEdit was used for the purpose of mapping in the web pages.

Interactivity between user and web site was also a desired feature of MicroTutor. An image that changes when a mouse pointer is over it, or changes (or does something else) when it is clicked - known as a roll-over, provides interactivity between the user and web site. The product Microsoft Front Page 2000 provides a design feature available for accomplishing roll-overs. Therefore it was used for accomplishing simple roll-overs.

More complex interactivity was a desired feature of MicroTutor. The ability to cause an event to occur in conjunction with the use of a large graphical image-map was needed. The Microsoft Front Page 2000 program provided the feature of simple roll-overs - the act of swapping a graphical image for a second graphical image, or vice versa. Yet, this type of roll-over only applies to graphical image as a whole - it could not be used to cause events to happen from "hot-spots" located within a large graphic, such as an image-map. More complex interactivity was accomplished through the use of JavaScripts that were manually written into the web page text and entered during the mapping of image-maps.

Also, Popup windows were desired features of MicroTutor. The use of popup windows would allow the user to get quick information such as notes, definitions, or even images from within the same web site page, without having to travel to a new web page. Again, Javascripts were found to be capable of performing this task. Therefore, JavaScripts were used to accomplish the popup windows in the MicroTutor.

Site Layout

The site layout for MicroTutor was developed around the concept that students are more likely to remember information if it is presented in graphic form. Therefore, vivid colors were used on the site and graphical images were incorporated wherever they were relative.

Navigation throughout a web site is also an important aspect of the site's effectiveness. Many web sites were visited during the research phase of the MicroTutor's design phase. The most professional of the sites implemented a site map as the main vehicle for traveling throughout the site. Although most of the sites implementing site maps were effective, not all were graphically appealing. The site map for MicroTutor was developed to make navigation within the site easy to recognize and be graphically pleasing at the same time. Figure 1 is the site map implemented for MicroTutor.

Page Layout

The individual pages of MicroTutor were developed to be logical, and again, esthetically pleasing to the user. Each major section of MicroTutor follows a color scheme via the page's background. The user can quickly recognize which module within the MicroTutor they are in.
The main page layout of MicroTutor is shown in figure 2.

MicroTutor site also implemented a navigational tool that is very popular in educational web sites. The arrows at the bottom of each of the interior pages allow the user to travel to the next link, or the previous one. The right arrows ultimately take the user throughout the whole website in the sequence best followed for interpreting the Microprocessor Applications course material. Figures 3 and 4 below illustrate two sample pages of MicroTutor.

Interactivity

Interactivity between user and web site can be accomplished in many ways. MicroTutor uses roll-overs to perform basic interactivity. A graphical image is swapped with a second graphical image when the mouse pointer is moved over it or the image is clicked. The second graphical image changes back to the first once the mouse pointer is moved off the image or clicked for a second time. The web page development software package Microsoft Front Page 2000 achieved these types of simple roll-overs. Throughout MicroTutor, these various simple roll-overs were used to give the appearance of a graphic moving. This feature allows the user to recognize when a link was present, or that something is about to happen - such as a popup window opening.
Microsoft Front Page 2000 could only perform roll-overs that

involved an entire graphic changing once to a second graphic, and back again.

JavaScripts

MicroTutor had a need for more complex roll-overs. Several large graphics were used throughout Microtutor and these graphics contained hot-spots that served as links to other pages, or pop-up windows. These hot-spots were made with a mapping program called MapEdit. Though hot-spots existed and functioned as links, the large graphic didn't indicate to the user that a hotspot/link existed except for the small mouse pointer changing. Javascripts were used to accomplish this more complex interactivity. MapEdit was used only when hot-spots were needed in large graphics. Most of the graphics in the MicroTutor did not require mapping. Therefore, the JavaScript to open a pop-up window, where needed, had to be entered into the HTML code for that web page manually.

Animation

The graphical approach to learning in MicroTutor was also implemented using animation. For example and as shown in Figure 5, animated movies of bit additions demonstrated how flags are set when certain arithmetic functions are performed . These animations were made with Paint Shop Pro 5.0 (PSP) and Animation Shop 1.0 (AS). The individual images were created using PSP and then looped into a single gif fileusing AS. The gif files were then inserted into MicroTutor's web pages and viewed as animation.

Conclusions

This paper described the design of an interactive web-based microprocessor and applications tutorial "MicroTutor." The basic goal of this interactive web-based system was to help students build an integrated understanding of the basic concepts, functions and operations of microprocessors and their applications MicroTutor was developed as an additional learning tool for an undergraduate course in microprocessors and their applications. MicroTutor was designed to (1) be compatible with various web browsers and (2) provide an overview of the architecture, organization, operation and applications of a microprocessor. The system was structured in units where teaching aids such as interactivity, animation, and audio were incorporated. This project sought to present the subject of microprocessors and their applications to the students of the course in a graphical way that would be easier to comprehend and remember. Through the graphical methods designed in this project, this has been accomplished. The URL for MicroTutor is: http://www.jacksonville.net/tmrobson/.

Bibliography

1. A. Bruce Carlson. RM Division of ASEE -- At the Frontiers. Proceedings of ASEE-IEEE Fontiers in Education. San Jose, CA, pg. 11. (Nov. 1994).
2. Jasc Software. Animated Shop. Jasc Software Inc. Minnetonka, MN. (1998).
3. T. Michael Clark. Paint Shop Pro in 24 Hours. Sams Publishing. Indianapolis, IN. (1999).
4. Arman Danesh. Java Script in a Week. Sams Publishing. Indianapolis, IN. (1996).
5. NetObjects. NetObjects Fusion 4.0: Building Business Web-sites. Netobjects. Redwood City, CA. (1988).
6. L. Lemay. Teach Yourself HTML 4 in a Week. Sams Publishing. Indianapolis, IN. (1997).
7. Sally L. Wood. Tutorial Software for Engineering Mathematics. Proceedings. of ASEE-IEEE Fontiers in Education. San Jose, CA. Pg. 39. (Nov. 1994).

TAYEB A. GIUMA

Dr. Giuma is currently on the faculty of the Electrical Engineering Department at the University of North Florida. Prior to joining the University of North Florida, Dr. Giuma was on the faculty of the Electrical and Computer Engineering Department at the University of Miami, Florida. Dr. Giuma has taught a wide variety of electrical and computer engineering courses and won five awards for excellence in teaching. Dr. Giuma's interests are in quality teaching and research in the fields of Electrical and/or Computer Engineering. Special interests are in microprocessors, digital systems design, computer architecture, CAI/CAD, multimedia, and multivalued logic .

TAMMI ROBSON

Tammi is an electrical engineer with Balck and Veatch. She is currently working on Power Quality issues for the Jacksonville Electric Authority in Jacksonville, Florida. Tammi received her B.S. in Electrical Engineering from the University of North Florida, Jacksonville, Florida. Tammi interests are in computer engineering, multimedia, instrumentation and control and power systems. She is a member of Eta Kappa Nu, Phi Kappa Phi, Phi Theta Kappa, IEEE and the Society for Women Engineers.

Figure 1: MicroTutor Site Map

Figure 2: MicroTutor Main Page Layout

Figure 3: MicroTutor Introduction Page

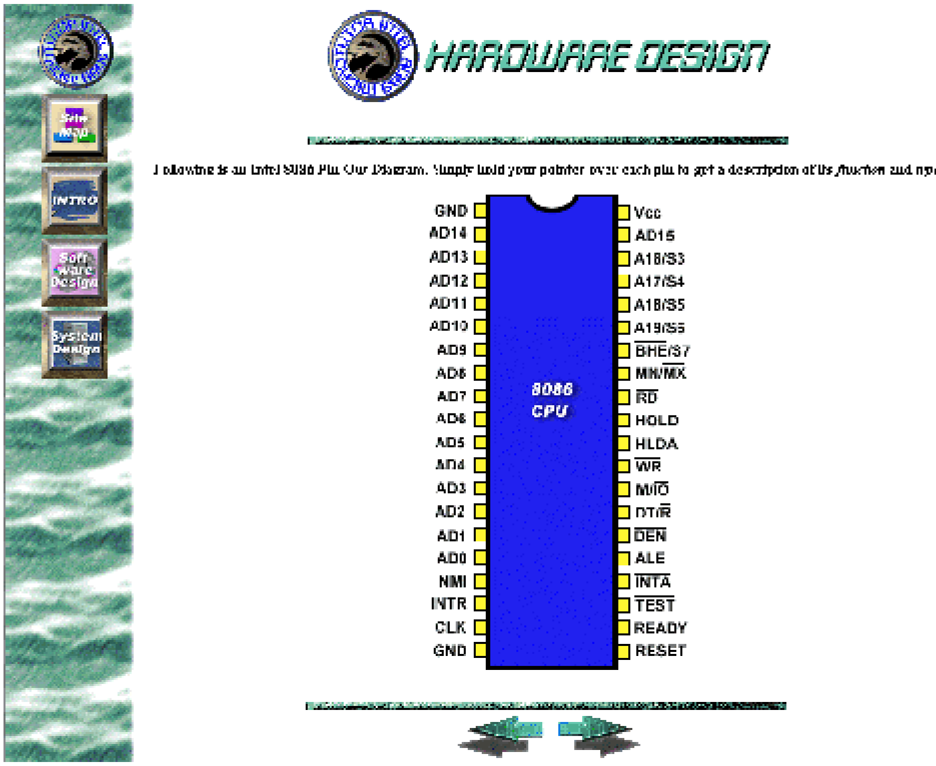

Figure 4: MicroTutor Hardware Design page

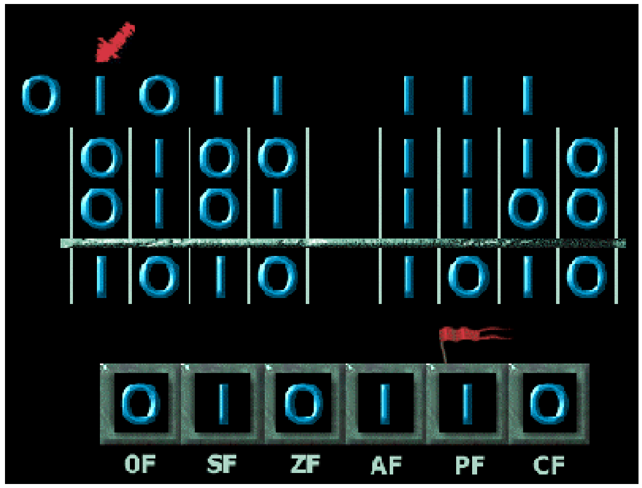

Figure 5: MicroTutor Bit Animation