# USER INTERFACE DESIGN, ANIMATIONS AND INTERACTIVE EXAMPLES FOR WEB-BASED LEARNING

**Ahmed Abul Hussain**
Electrical Engineering Department
King Fahd University of Petroleum and Minerals
Dhahran, 31261, Saudi Arabia
*ahussain@kfupm.edu.sa*

## Abstract

Effective use of multimedia rich e-learning material depends on a well thought-out and properly designed User Interface to enable trouble free and easy access to the multimedia features in the e-material. The design of the User Interface should be user-friendly and sophisticated at the same time while being conscious of accessibility issues. This paper describes a User Interface developed by the author and outlines his experience in the development of animations and interactive examples for e-learning material obtained through the development of several courses in Electrical Engineering at King Fahd University of Petroleum and Minerals.

## Keywords
User Interface, Interactivity, animations, Macromedia Authorware, Text-to-Speech

## 1. INTRODUCTION

With the ever-increasing use of Internet, e-learning is becoming very popular giving one the ability to learn new information or new skills whenever and wherever desired. This offers far greater opportunities for education than ever before. The scope and reach of education broadens to far greater horizons than ever imagined. The online courses are an innovative educational approach to teaching using the Internet.

However, effective use of multimedia rich e-learning material depends on a well thought-out and properly designed User Interface to enable trouble free and easy access to the e-material (note: the term e-material here refers to material developed with multimedia features for online delivery, also known as online lectures). It also depends on how many interactive examples and animations are utilized in explaining and demonstrating concepts to the user.

The design of the User Interface should be user-friendly and sophisticated at the same time while being conscious of accessibility issues. The user interface developed by the author is described in section 3.0.

Section 2 describes the online course development activities at King Fahd University of Petroleum and Minerals. Some of the animations and interactive examples developed by the author are described in Section 4.

The development of online courses that the author has participated in [1] has been mainly carried out using Macromedia Authorware [3] including the development of the user interface and interactive examples.

## 2. ONLINE COURSE DEVELOPMENT AT KFUPM

The Deanship of Academic Development at KFUPM has embarked on an initiative to develop [5], [9] interactive web-based e-learning tools by supporting the development of online courses. The following are some of the courses that have been developed at the Department of Electrical Engineering at King Fahd University of Petroleum & Minerals:

- EE 200 Digital Circuit Design
- EE 201 Electric Circuit Analysis
- EE 203 Electronic Circuits I
- EE 207 Signal & Systems
- EE 303 Electronic Circuits II
- EE 380 Control Systems

These courses have been made available to the students via the WebCT for use as supplementary material.

Material for online courses is developed by a team which consists of subject matter experts, graphics programmers and content developers [2]. The job of subject matter experts is to develop course material which is based on some text book and also their years of experience in teaching that course. It should also be tailored for special requirements of distance learning. The graphics programmers and content developers (who may the same persons) develop the course material (provided by the subject matter experts) into a form that can be easily published and uploaded on a delivery platform such as the WebCT. They also create animations, interactive examples and embed audio into the course material.

The different stages involved in the development of online courses at KFUPM are described in the following sections.

## 2.1 Preparation of Course Contents

The course material is first prepared in electronic format using Microsoft Word, MathType and Visio. The entire course is then developed for e-learning using Macromedia Authorware [3], [4], [5] as an authoring tool which allows the publishing of course lectures in HTML format for delivery over the internet.

The course material consists of a set of modules where each module has a number of lectures. Each lecture features a number of examples and practice problems enriched with interactivity, graphics, and animations with supporting speech. An automatic Text-to-Speech software tool has been used to generate the speech files.

The developed material goes through the following phases:

**Phase I:** Transfer of Course Material to Authorware

This involves preparation of course contents in electronic format (e.g. MS Word) especially tailored for online delivery. The prepared material is, then, transferred from MS Word format to Macromedia Authorware.

**Phase II:** Animations & Embedding of Speech Files

In this phase, animations are added and speech files are generated for each lecture. The speech files are then embedded in the Authorware files and synchronized with the flow of text and animations on each slide.

**Phase III:** Refinement of Lectures & Interactivity

In this important phase each lecture is reviewed for improvement of the material in all its aspects and its overall presentation. Interactive examples are added to enhance the students' understanding of concepts presented in the lecture.

**Phase IV:** Publishing of Lectures for WebCT

Lectures are published in HTML format and uploaded to the EE200 course shell in WebCT and then hyper-linked and organized under modules. The communication and managements tools available under WebCT are activated. Other documents related to the course are also made available on WebCT.

## 2.2 Generation of Speech Files

An Automatic Text-to-Speech software [6] tool is used to generate the speech files. This tool allows the speech files to be generated from text very easily and provides great flexibility in the maintenance of the speech files. Any time a speech file needs to be changed; only the related text file is modified and a new speech file is created.

The audio/speech files that are created are embedded in the e-material and synchronized with the flow of text and animations. These audio files help support the material presented on each slide by way of verbally explaining concepts, procedures and ideas. One down side of embedding audio/speech files is that the size of online lectures becomes very large. This in turn increases the downloading time of online material and has been a common complaint of students using such material. This problem is particularly acute when downloading online material via a modem.

## 3.0 USER INTERFACE AND MULTIMEDIA FEATURES

An effective use of multi-media rich e-learning material depends on an appropriate interface design to enable trouble free and easy access to these features [2] [8]. The interface design provides ease of navigation, a sense of human interaction, and responsiveness to the needs of learners studying in an information rich, self directed medium.

The author has developed a template for the user interface which can be adopted very quickly for development of online lectures. The user interface provides each online lecture with multimedia features and buttons for navigation through the material and a few special functions as illustrated in Figure 1 and described in the following paragraphs.

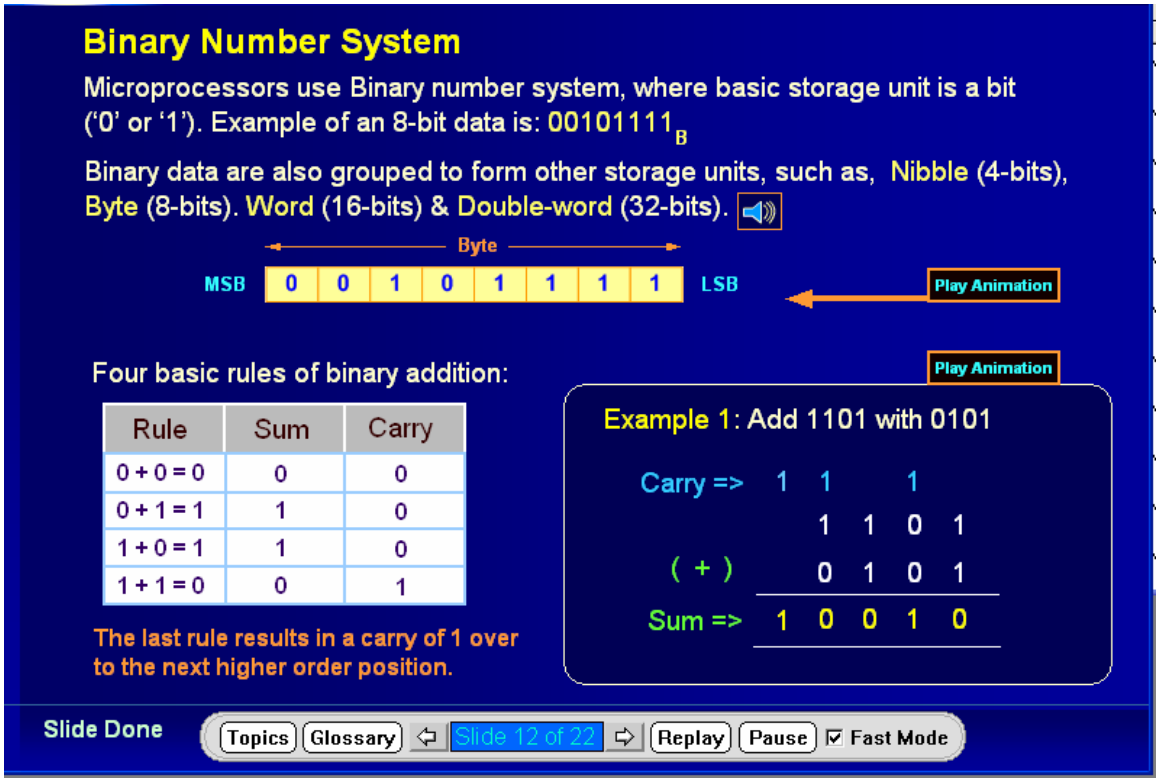


**Figure 1. Typical Lecture Slide showing navigation buttons and multimedia features**

- **Previous** and **Next** slide buttons
  These buttons allow navigation through the material one slide at a time.

- **Topics** button
  Each lecture is divided into sub-topics which can be directly accessed through the Menu. Pressing the Menu button brings up the "Topics Menu"

- **Glossary** button
  Upon clicking this button a user is presented with a list of glossary terms.

- **Replay** button
  This button allows the user to repeat the presentation on that slide.

- **Fast Mode** (Check box button)
  This button allows the user to view the material without audio if he so wishes. This is particularly useful for a quick review of material when the user has already gone through it once with all its multimedia features playing.

- **Pause** button
  The Pause buttons allows the user to stop the presentation including speech on the slide at any time. The slide presentation can be resumed by clicking on the **Resume** button which is displayed when the **Pause** button is clicked.

- **Speaker Icon**
  Upon clicking this icon an audio file is played. The user can play this audio file as many times as the icon is clicked.

- **Play Animation** button
  This button lets the user repeat an animation shown on a slide without repeating the entire slide.

- **Slide number** indicator is located between **NEXT SLIDE** and **PREV SLIDE** buttons. It shows the current slide you are on and the total number of slides that constitute a lecture.

- Once the presentation on a slide is completed, it is indicated by a "**Slide Done"** indicator on the bottom left corner of the slide.

## 4.0 INTERACTIVITY & ANIMATIONS

Interactivity and animations are very important elements of a good online course. They help in better understanding of concepts and ideas. Well designed interactivity and animations make discussion of a topic/concept very lively and arouse students' interest in the material and encourage active participation in learning online. The term, interactivity, describes the forms of communication that a medium supports enabling dialogue between the learner and the instructor and is an important attribute of technology-supported educational environments. The intelligence of the technology is used in place of the instructor and exchanges are made between the learner and the programmed instructional system. The interactions in electronic learning environments are able to enhance learning through the feedback they provide and the context and purpose they are able to encourage support [7].

With the above in mind, a number of interactive examples were developed which allow a student to interact with a circuit, change input values and watch how the output is affected. It must be noted that what can be demonstrated through animations and interactive circuits and examples in the e-material is not possible at all in a traditional face-to-face class. This is a distinct advantage of online courses over the classical form.

A student can try out the interactive circuits and check their functionality by changing the inputs in real time through the "button switches" shown. As the input switches are toggled, the change is reflected in the output according to the behavior of the circuit.

Animations and animated examples are also immensely useful in explaining concepts and in showing how to solve problems in a step-by-step manner. It has also been found from student feedback that concepts that are difficult to understand in a face-to-face class or which take longer for an instructor to explain in the class are easily understood by way of animations and interactivities.

Figure 2 shows an animated interactive circuit for a 4-bit binary adder/subtractor circuit. A user can select 4-bit values for inputs A & B and select what operation (addition or subtraction) needs to be performed. The script behind the circuit will compute the result of the operation requested and display the sum/difference on the screen.

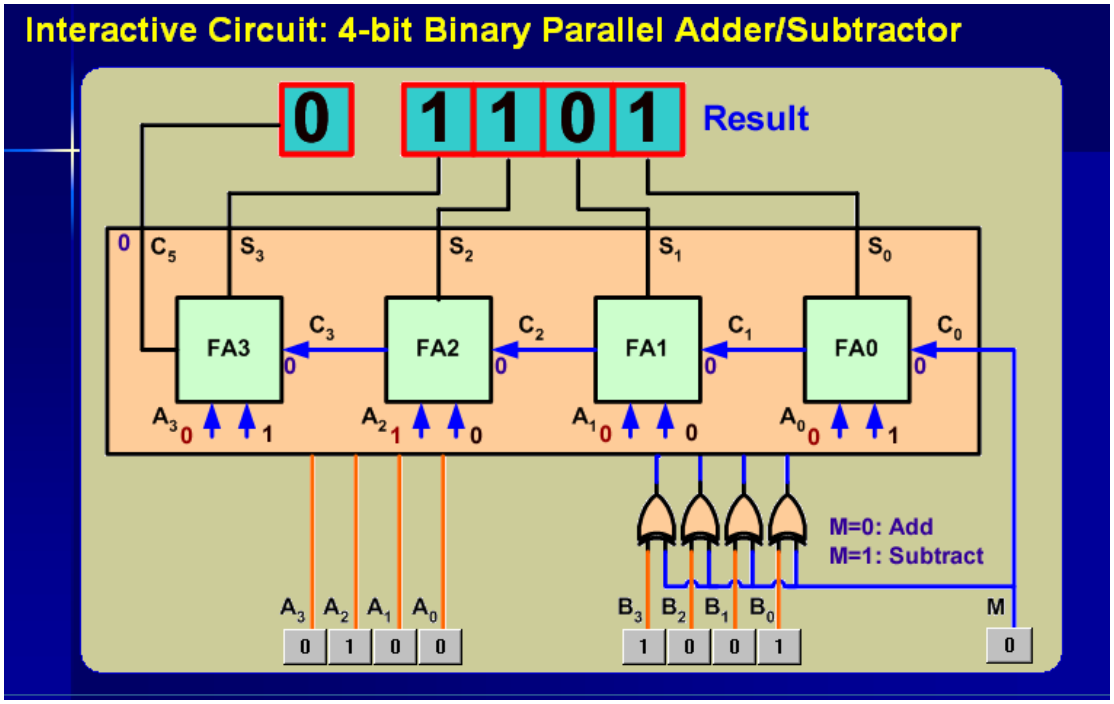


**Figure 2. A sample slide showing Interactive binary adder/subtractor circuit**

The next screen shot in Figure 3 shows an interactive example for computing the steady-state error of a basic feedback control system. A user can select several parameters and vary the gain of the system using the slider knob.

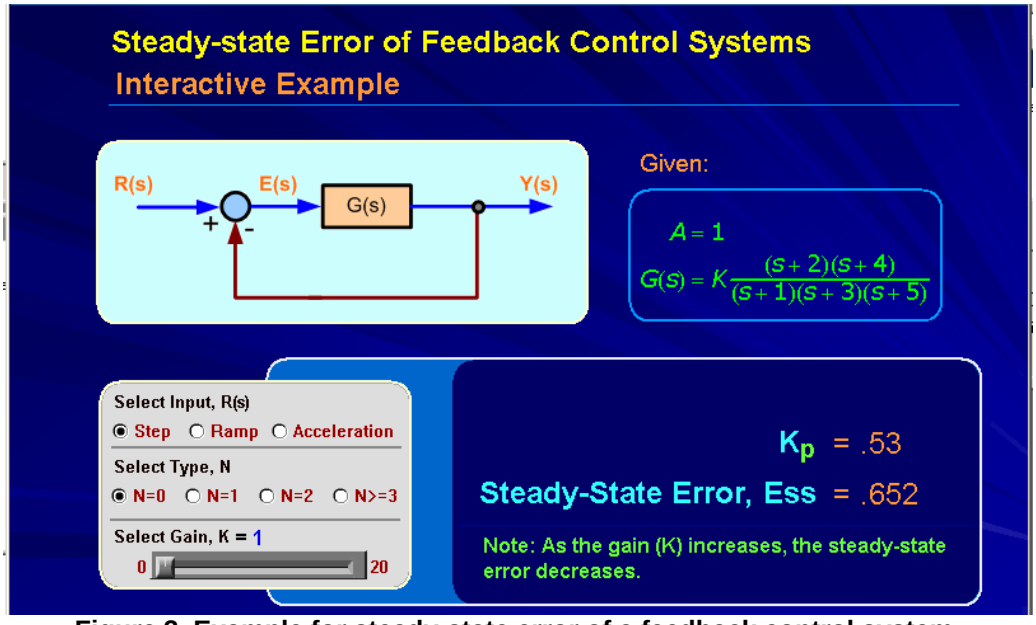


**Figure 3. Example for steady-state error of a feedback control system.**

Figure 4 shows an animated interactive example of maximum power absorbed by a load resistor.

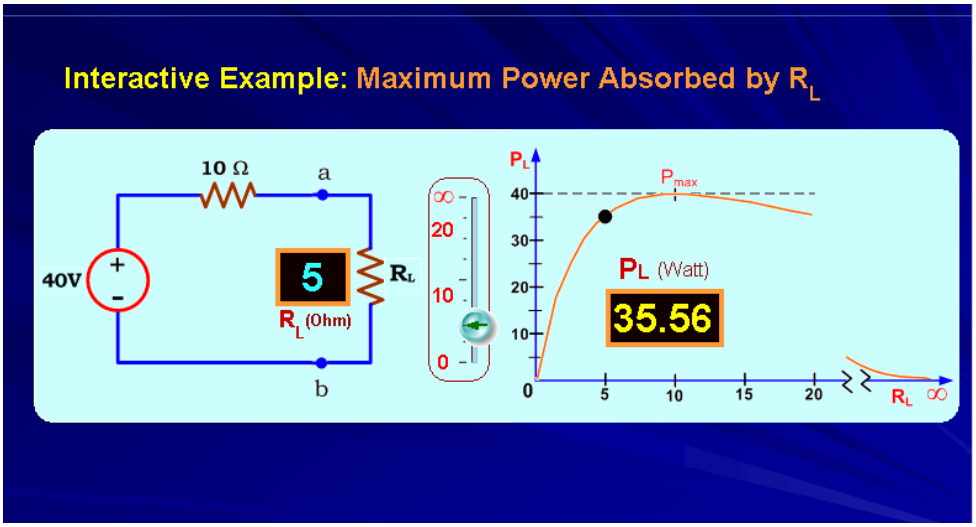


**Figure 4. Maximum Power absorbed by a load resistor**

Figure 5 demonstrates the concept of a simple parity error detection system through animation and interactivity, which is not possible to show on a chalk board in a face-to-face class. The system simulates a noisy communication channel for the data being transmitted. A user can select a 3-bit input and the system will generate the parity bit and send the data over the channel. The channel can randomly corrupt any data bit. The parity checker will check for an error in the data.

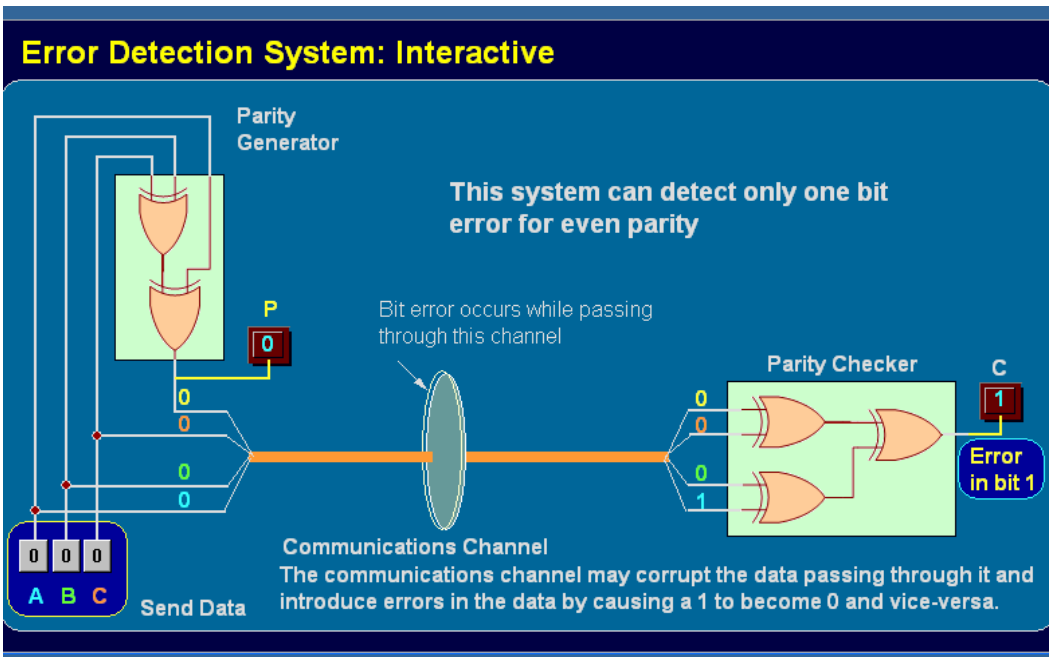


**Figure 5. Interactive error detection system**

## 5.0 CONCLUSIONS

A well designed user interface is essential for material that is meant for web-based learning. Interactive examples and animations are also a must-have ingredient of online courses, designed to help explain seemingly difficult concepts which otherwise are sometimes difficult for instructors to explain on a blackboard in class. The author has developed a user interface for the online

course projects he has worked on. This user interface has been adopted as a template for other online courses at the department of Electrical Engineering at KFUPM. He has also developed many interactive examples and animations some of which were also described in this paper.

**Acknowledgment**: The author acknowledges the support of the Deanship of Academic Development at King Fahd University of Petroleum and Minerals in the development of online courses.

## References

[1] Mohandes, M. Dawoud, A. Abul Hussain, S. Al Amoudi, "Online Development of Digital Logic Design Course", 2nd IEEE International Conference On Information & Communication Technologies: From Theory To Applications, April 24 - 28, 2006, Umayyad Palace, Damascus, Syria

[2] How to Develop an Online Course,
*http://stylusinc.com/online_course/tutorial/process.htm*

[3] Using Authorware, Macromedia, Inc., 600 Townsend St. San Francisco, CA 94103, First Edition, August 2001.

[4] S. Junaidu and J. Al-Ghamdi, "Developing an Online Data Structures Course Using Authorware", *USDLA Journal, Vol. 16 No.10, October 2002*
http://www.usdla.org/html/journal/OCT02_Issue/article07.html

[5] A Guide for Course Developers, Deanship of Academic Development, KFUPM

[6] TTS (Text-To_speech) Software, AT&T Bell Labs, http://public.research.att.com/~ttsweb/tts/

[7] Oliver, R., Herrington, J. and Omari, A. (1996). Creating effective instructional materials for the World Wide Web. [verified 3 May 2002] http://ausweb.scu.edu.au/aw96/educn/oliver/index.htm

[8] Allison Brown, "Designing for learning: What are the essential features of an effective online course?", *Australian Journal of Educational Technology 1*997, 13(2), 115-126

[9] Guidelines for Course Implementation, Deanship of Academic Development, KFUPM