Project Year
2004

Project Team
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Project Title
Biomedical Instrumentation Online Simulator (BIOS)

Audience
Students taking the *Biomedical Instrumentation* course (EN580.471) and other courses that teach circuit design

Pedagogical Issue
Some students enrolled in *Biomedical Instrumentation* are not conversant with circuit design, a major component of this course. Available simulators (e.g., PSPICE, MICROCAP) are not intuitive to learn, and limited class time is available for training on these applications. These issues make it difficult for students to prepare for lab assignments, and may become a deterrent to developing an interest in the field.

Solution
The team proposes to develop a Biomedical Instrumentation Online Simulator (BIOS). This simulator will serve as an online interface for the circuit simulator SPICE, and will allow students to design and test virtual circuits on an easy-to-use website without installing or learning SPICE. Specifically, students will be able to design sensor circuits and test their impact in a biomedical measurement. Six major laboratory exercises will be designed and integrated with this resource. For one activity, students will design a strain gauge sensor to measure forces exerted by surgical forceps. Using BIOS, students will be able to simulate the design and application of the sensors before actually building such instruments.

Technologies Used
JAVA, JavaScript, PERL

Project Abstract
This project will result in the development of a Biomedical Instrumentation Online Simulator (BIOS), planned for the *Biomedical Instrumentation* course (EN580.471). The course is an introduction to biomedical instrumentation, principally to electronic circuits used for medical purposes. There is also a laboratory component to this course, where students build these circuits and test them. These circuits need to be built to certain specifications, depending on their use. Thorough design is required before wiring the components. The present approach is for each student to come up with a paper design and then to build it on a prototyping board. We believe that computer simulation will improve student productivity: it would be useful to see the results of the design before actually building the circuit. This is

where BIOS comes in. BIOS is designed to be a online circuit simulator; nothing will need to be downloaded or installed in order to use it. The only requirements will be a Web browser and an Internet connection. All the simulations and calculations will be performed on the Web server. We will use the UC Berkeley-developed circuit simulator SPICE (http://bwrc.eecs.berkeley.edu/classes/icbook/spice/) as the engine for this project. SPICE will perform the simulation and dump the results onto the Web server. We will develop the front end, where the users will design the circuit, with HTML/Java and CGI/PHP scripting. The interface between the front end and the simulation engine will be created in PERL. This interface will be responsible for converting the user's design into a SPICE input format and converting the SPICE-dumped results on the Web server into a graphical output which can be returned to the user. At the end of this project, we hope to have a system that permits users not familiar with the intricacies of circuit analysis to make virtual circuits and run them to see the result. The system is designed to be very light and simple on the user side. Since computer-simulated design can be done remotely, BIOS will also facilitate distance education, collaborative learning, and group design activities. The faculty member will design and define the laboratory exercises, and the Fellow will implement the automation and the web-based design interface. Our goal is to end up with six major laboratory exercises for the semester, broken into 12 design projects that can be staggered into one lab a week. The project will take place over the summer so that BIOS will be ready for the fall semester. BIOS could also benefit students in Electrical Engineering who take the *Circuits and Electronics* lab courses and the *Signals and Circuits* course offered to all BME undergraduates. After this summer, the BIOS resource will be maintained by the TAs of the *Instrumentation* and the *Sensors/Instrumentation* (professional program) courses. Besides performing routine maintenance, they will continually upgrade and update the design problems and simulations.

A link to the Biomedical Instrumentation Online Simulator (BIOS) is available here: http://florina.bme.jhu.edu/bios/