

Project Year

2005

Project Team

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Project Title

Online Sensor Simulator

Audience

This simulator will be designed for the *Principles of Design of Medical Instrumentation* class (580.471) in which students build circuits using several sensors - e.g., strain gauges, phototransistors, thermistors, etc. It will also be used by students in the *Molecular and Cellular Instrumentation* course (580.472), and potentially, in the future, by students in professional/part-time programs.

Pedagogical Issue

Many of the students do not have previous experience with sensors and electronics, so the simulator will be designed to familiarize them with the characteristics and properties of the sensors.

Solution

We propose creating a new program, called the Online Sensor Simulator (OSS). This program will be run off the Internet, without downloading or installing any software, and could be effectively used to teach students about the properties of sensors needed for the design of medical instrumentation. The OSS will be integrated with the [Biomedical Instrumentation Online Simulator \(BIOS\)](#), an online circuit simulator funded through the 2004 Technology Fellowships. The integration of these two simulators will create a complete sensor-electronics simulation tool. Once students are comfortable with the sensors, they can use the sensors as front ends to circuits and, eventually, simulate entire systems.

Technologies Used

HTML/Web Design, JAVA, Perl

Project Abstract

This project proposes the development of an Online Sensor Simulator (OSS) program, which will be a simulation tool that can be run off the Internet, without downloading or installing any software. It is designed with the *Principles of Design of Medical Instrumentation* class in mind, where students build circuits using several sensors. Many of the students do not have significant experience with sensors and electronics, so the simulator will be designed to familiarize them with the characteristics and properties of the sensors. The OSS will be integrated with the Biomedical Instrumentation Online Simulator (BIOS), an online circuit simulator funded through the 2004 Technology Fellowships, thereby leading to a

complete sensor-electronics simulation tool. The OSS will have a Java/HTML based front end with which the user can interact with the simulator. A CGI/Perl script on the web server will convert the user's interactions into numbers. These numbers will then be processed by programs written in C, based on the physics of the sensors. The output of the programs will be presented back to the user in terms of figures and graphs. Printable figures in postscript/PDF format will be provided. Some explanatory text (with animated figures) about the sensors will also be provided. The output of the sensors can, if the user wishes, be piped into circuits (from BIOS) to simulate sensors coupled to electronics. The overall objective is to create a virtual environment under which the students can learn about sensor properties, their physical principles, and circuit network interface. The applied goal is to design the sensor and circuit interface in the virtual world before doing actual physical implementation. The educational goal is to set up virtual laboratory experiments that can be conducted remotely, off any computer with access to the Internet, and in the increasingly popular distance education format. OSS will be a unique tool, both educational and practical, for learning principles and for actual design simulation. It will set the stage for remote education and research, and afford opportunities for interactivity and experimentation. The short-term goal is to incorporate OSS (and BIOS) in *Principles of Design of Medical Instrumentation*, and to produce several laboratory modules which are appropriate for that course. The long term goal is to make these tools available to other departments, such as Mechanical Engineering and Chemical Engineering (and even Physics and Electrical Engineering, at the introductory level), where the faculty and students may be interested in the sensor technology, but not familiar with the physical principles or the circuitry. Eventually, we hope that this work and our experience will be presented at the American Society of Engineering Education and published in journals such as *IEEE Transactions on Education*, with the goal of disseminating these practices to other educational institutions.