

# THE PEARL DIGITAL ELECTRONICS LAB: FULL ACCESS TO THE WORKBENCH VIA THE WEB

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## Abstract

*Web-based course management and delivery software is becoming common in many areas of education, but the facilities provided by such systems do not support practical laboratory work. In many technical areas this limitation constitutes a serious restriction on the usefulness of any web-based educational frameworks, since "pen-and-paper" courseware is but a small part of the overall pedagogic materials that must be provided to the students. The system described in this paper addresses this need in the area of digital electronics and is being developed in the scope of an IST project called PEARL.*

## 1. Introduction

Experimental work is a vital component of science and engineering teaching at all levels. The increasing use of multimedia packages or "virtual science" has much to offer in terms of teaching scientific facts and principles, but does not generally focus on the process of scientific enquiry or engineering practice. The PEARL project aims at developing a system to enable real-world experiments remotely in an e-learning context. The students will be able to interact with the remote experiment, change parameters and in some cases modify and design experiments. They will also be able to discuss their actions and what they anticipate will happen, and observe the

results and analyse them, using Internet-based collaborative tools (e.g. CUSeeMe) embedded in the PEARL system. The process is real and so has an authenticity and unpredictability that simulations or descriptions cannot replicate. PEARL uses a thin-client approach and considers four areas of demonstration: bio-chemistry (remote access to an electron microscope), fundamental physics, PCB visual inspection, and digital electronics.

This paper deals with the digital electronics area and starts by presenting the overall system set up, followed by a description of the three types of experiments supported: 80C51 (microcontroller) programming, introductory logic design, and design for test using the IEEE 1149.1 and 1149.4 standards. The results of the trials conducted thus far are then presented, and a final section discusses the main conclusions derived from the work done to this date and the main guidelines for future developments.

## 2. Overall system set up

The implementation of the PEARL system is based on three main components (excluding the user computer and the network, i.e. the Internet): the Web server, the Lab server, and the remote laboratory infrastructure. The Web server hosts the course management and delivery software (in the case of PEARL, WebCT was used), processes all the actions / requests from the user side, and