HANDS-ON REMOTE LABORATORY FOR FRESHMAN ENGINEERING EDUCATION

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Abstract - In this work, we are investigating a new laboratory experience for distance learners by utilizing a set of web-based, hands-on laboratory modules for building and testing a digital programmable robot in our introductory freshman engineering course. This new experience introduces and exposes students to modern technology tools (web-based instruction, interactive tutorials with video and sound clips, visualization applets, on-line quizzes, lab report templates, and the use of computer-controlled instruments for data acquisition) without sacrificing the real hands-on and teamwork aspects. Results from proof-of-concept trials indicate that the approach is most stimulating for an appropriate student target audience under close faculty supervision.

Index Terms – Distance learning, Remote laboratory, Web-based modules

APPROACH

In science and engineering education, a hardware-based laboratory experience is an integral part of the curriculum, and is critical to success in science and engineering careers. Laboratories provide real world, hands-on practice in “making things work,” and foster the process of discovery and independent thinking with a “learn-by-doing” pedagogy. The full laboratory experience, however, is a challenge for distance learning [1]. Multimedia demonstrations, applets, computer simulations, and remote-controlled fixed experiments often serve as “laboratories” in distance learning courses. These tools never require that students actually build anything, and they cannot capture all the real, non-ideal physical effects that are encountered in the laboratory. The hands-on process of design, build and test (including troubleshooting) is not nurtured and practiced. Here, we report on a laboratory that utilizes a set of web-based, hands-on laboratory modules for building and testing a digital programmable robot in our introductory freshman engineering course.

RESULTS

The most successful elements of the pilot study are summarized below:

- The ability to work at one’s own pace outside the traditional fixed, three-hour session in the regular laboratory section allows for a more thorough completion of laboratory exercises and encourages additional hands-on experimentation that can improve understanding of the course material.
- The use of a professional-looking template provides essential guidance to putting together an effective laboratory report, and is a good learning tool. Quality of lab reports are vastly superior to those currently submitted by freshman students in the course.
- Students gain valuable experience with computer-controlled instrumentation and data acquisition. Laptop control of e-LAB instrumentation device is done via browser Active-X panels within the web-based laboratory modules, as shown in Figure 1.

FIGURE 1
ON-LINE LABORATORY EXPERIMENT WITH BROWSER CONTROL OF e-LAB INSTRUMENTATION DEVICE.

The approach appears to be most stimulating for electrical engineering students who are willing to invest the additional time to learn and utilize these cutting-edge technology tools and who enjoy building and testing electronic circuits, such as the robot in this course. Close faculty supervision is necessary in the setup of hardware and software and in providing substantial “help-desk” assistance.

REFERENCE


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