Evaluation of Remote Laboratories in the Effectiveness of Course Delivery

Erin Sorbella, Student, Pace University Alexander J. Hughes, Student, Pace University

Abstract:

Computing technology is constantly evolving; today, most people are accompanied by palm-sized devices that greatly assist in day-to-day living. How do we even begin to comprehend the inner workings of such machines? Understanding how the parts of a computer work can be a daunting task, even for fledgling computer science students.

Computer organization is a course usually taken by computer science students. It seeks to demystify computer hardware and discuss how these components may best be utilized to develop high-performance programs. Understanding the basics of hardware is seen as a necessity for students who will eventually pursue a job within computer science, even if they wish to specialize in software.

Previous research suggests that computer organization benefits from hands-on laboratory exercises. Hardware design is abstract, and relying solely on lecture does little to provide a student concrete evidence of the applicability of concepts and theorems taught in class. Some variations of the course include laboratory components focusing on field-programmable gate arrays, or FPGAs. FPGAs are hardware circuits that allow a user to test digital circuit designs. FPGA boards, such as the Altera DE2 Board, are equipped with switches, buttons, and displays that provide visual and tactile feedback to the user. Due to this, FPGAs can help to reinforce concepts learned in computer organization.

However, due to an increased demand for online and hybrid classes, the use of a physical board for lab exercises may no longer be feasible. FPGAs are costly, and loaning them to long-distance students can potentially pose a liability for the university. In these cases where a physical board is not ideal, an alternate solution is required.

LabsLand offers remote laboratories to students and universities. With LabsLand, students can interact with FPGAs through an online interface. Students use hardware description languages such as Verilog or VHDL to describe a digital circuit and upload this code to an FPGA board located at another institution. Students can then test their designs using virtual buttons and switches, and view how the FPGA reacts through a video feed. This experience can replicate the use of an FPGA without the use of a physical board.

As part of this research project, we aim to create lab exercises suitable for computer organization and test the feasibility of performing these labs through LabsLand.

Keywords/Index Terms: Computer Organization, FPGA Boards, Remote Laboratories

Received, revised, submitted
Author is with Pace University