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NUTS AND VOLTS: A WEB-BASED HANDS-ON ELECTRICAL AND ELECTRONICS REMOTE WIRING AND MEASUREMENT LABORATORY (*RwmLAB*)

Johnson A. Asumadu, Ralph Tanner, Jon Fitzmaurice, Michael Kelly, Hakeem Ogunleye, Jake Belter, and Song Chin
Electrical and Computer Engineering Department
3045 Kohrman Hall
Western Michigan University
Kalamazoo, MI 49008
TEL: (616) 387-9201 (616) 387-6489
FAX: (616) 387-4096
asumadu@wmich.edu ralph.tanner@wmich.edu

ABSTRACT

In this project, a new architecture called "Remote Wiring and Measurement Laboratory (*RwmLAB*)" acts as a local multi-circuit board on a common distributed panel on the Internet. Matrix switching, data acquisition, data processing and analysis, and graphical unit interface enabled device characterize the *RwmLAB*. Students are physically able to wire up electrical and electronics circuits at the host lab site using the Internet access and by means of a conventional circuit board. The data acquisition interface allows students to make measurements at the nodes. The data collected at the nodes are made available on Web. The *RwmLAB* interface is greatly simplified by using a graphical interface to allow the students to experience the frustrations and hands-on experiences of a real-world laboratory environment.

INTRODUCTION

This paper presents the progress work on *RwLAB*. A prototype of RwLAB was demonstrated at ASEE 2001 in Albuquerque, NM [1]. *RwLAB* consists of a matrix switching board, *Xecom's* [2] AWC86A as the main controller with a Web-based server, and a CPLD (Complex Programmable Logic Device). At the front-end of the AWC86 is a Web server and at the back-end is an AMD 40-MHz AM186ES-based micro controller with SRAM and Flash memory. The AWC86A Web server incorporates a multi-tasking operating system and TCP/IP stacks with 10Base-T Ethernet access. The controller portion allows the setting and resetting of up to sixteen dedicated TTL signals.

METHODOLOGY

The switching matrix board is wired using standard electronic relay latch components and laid on a standard breadboard. A pictorial representation of the various components of the switching matrix board is shown in Fig. 1. Figure 2 shows the features of a portion of the matrix board. The CPLD is used to control the switching pattern of the relays. The setting and resetting of the matrix board relays are accomplished by the sixteen dedicated TTL signals of the AWC86A controller through the CPLD.

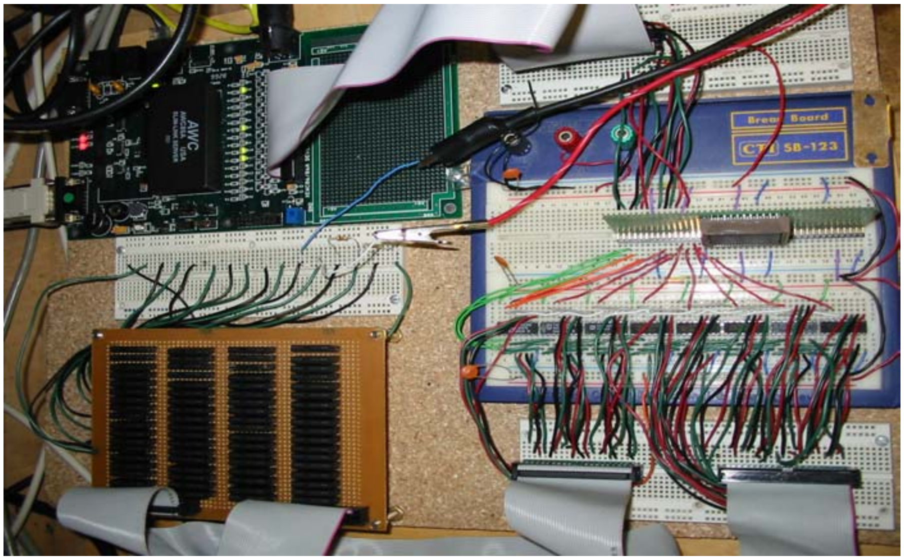

Fig. 1 Pictorial Representation of the Various Components on Breadboard

An Internet enabled embedded system software is created that appears like a standard "virtual breadboard" similar to those typically used in undergraduate electronics laboratories. A pictorial representation of the various components available for the laboratory is also presented on the side of the screen. In some components, color-coded bands are displayed to indicate the appropriate values of the component. For example, resistors look like the actual color-coded resistors. For other components, a tool tip is used to display the appropriate value or perhaps display a data-sheet.

Figure 3 shows a typical Web-based "virtual breadboard". The user is able to drag any components around the virtual breadboard as desired to accomplish the necessary wiring. When the user completes the circuit and presses a "SUBMITT" button, the software analyzes the circuit to determine which hardware leads are connected together. These connections represent nodes. The software first sends a reset signal to clear all the physical relays. The software then sends a digital code associated with each lead/node combination sequentially through the hardware.

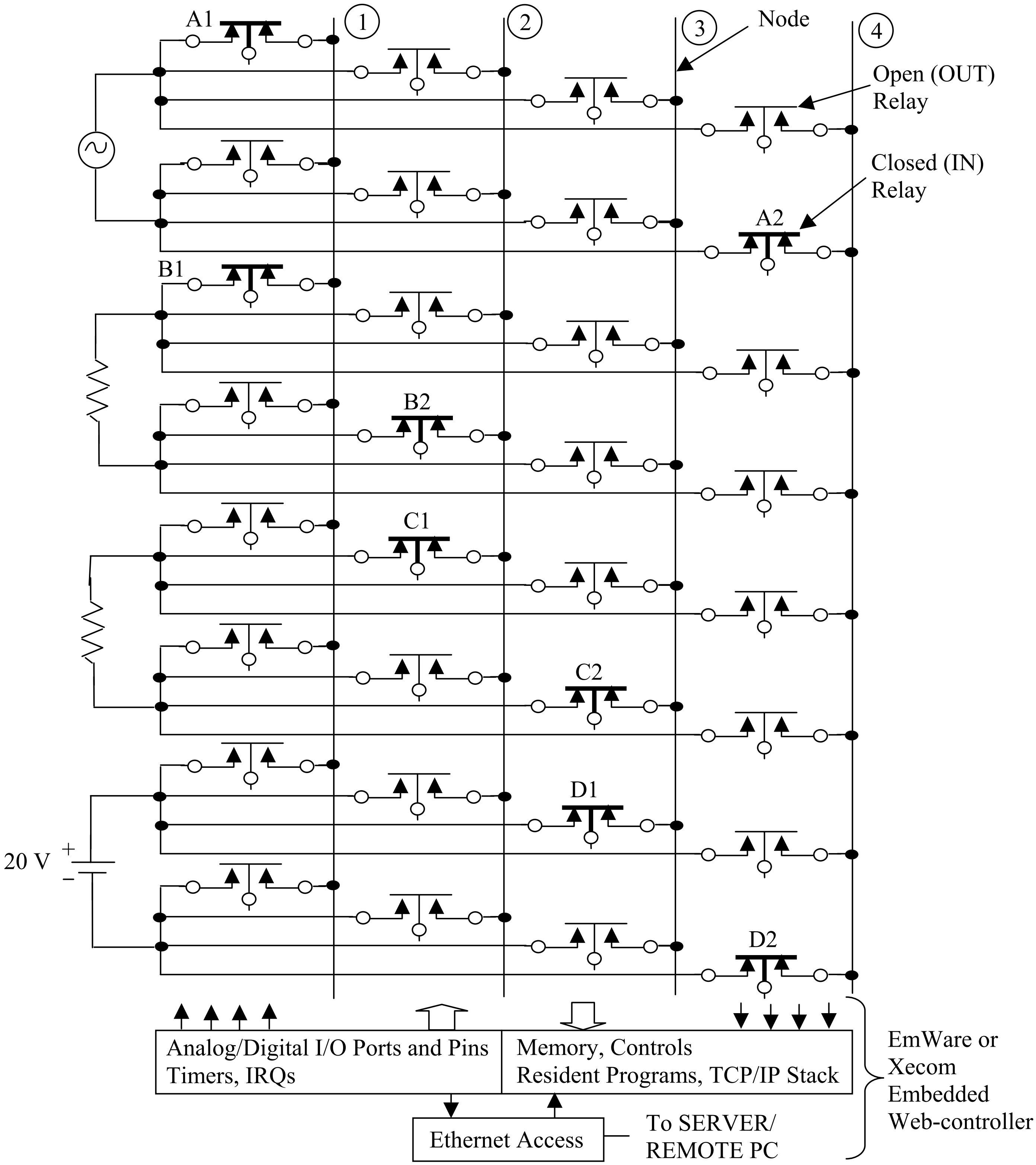

Fig. 2 Features of the *RwmLab*

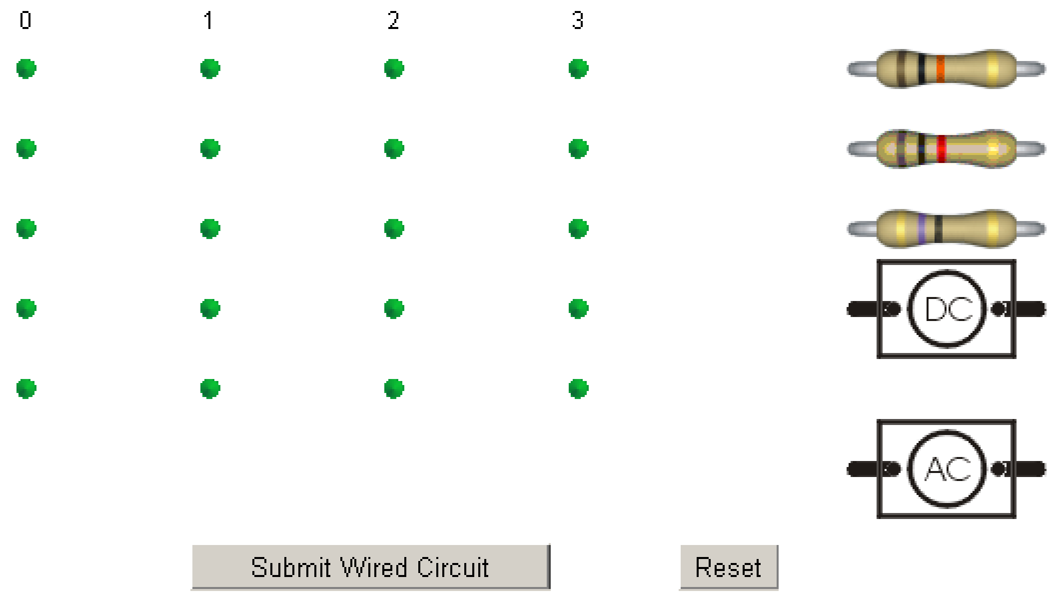

Fig. 3 Web-based Virtual Breadboard

The software running on this website sends a clear signal, then sequentially sends the digital code associated with each lead/node combination through the dedicated TTL signals using a CGI (Common Gate Interface) protocol. These signals are decoded by a CPLD and routed to appropriate relay latches. The latches in turn drive electronic LED-based relays. When a relay is set, it physically connects a leg of the component to a node. Any other components connected to that node are then also physically in the circuit.

All the software is done in HTML, JavaScript, Java, and in C language for the CGI interface. The HTML, JavaScript and the Java reside in the Web server of the AWC86A and the C language resides in the controller portion of the AWC86A. The AWC86A fully integrates the Web sever and the micro controller.

CONCLUSION

The present work adapts existing, proven, and workable technologies to implement an electrical and electronics, and power electronics laboratory. The system works and here the intention is to use existing technologies to enhance active learning using the Internet. An added advantage is that the web now becomes a medium for active teaching and learning.

ACKNOWLEDGMENT

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REFERENCES

[1] Asumadu, J.A. and Tanner, R., "Remote Wiring and Measurement Lab," *Proceedings of the 2001 American Society of Engineering Education Annual Conference & Exposition*, June 24-27, 2001, Session 1526.

[2] Xecom (http://www.xecom.com/_PageFiles/telefamily.htm).

BIOGRAPHIES

JOHNSON A. ASUMADU is an Assistant Professor in the Electrical and Computer Engineering Department. His research interests include power electronics, control systems, embedded applications, and engineering education. He may be contacted at: johnson.asumadu@wmich.edu.

RALPH TANNER is an Associate Professor in the Electrical and Computer Engineering Department. His research interests include mobile robots, walking machines, and controls. He may be contacted at: ralph.tanner@wmich.edu.

JON FITZMAURICE, NICHAEL KELLY, HAKEEM OGUNLEYE, JAKE BELTER, and SONG CHIN are undergraduate students at the Electrical and Computer Engineering Department of Western Michigan University, Kalamazoo, Michigan.