# Design and Implementation of an Ethernet Laser Projector Controller

**James Johnston, Jerry Mayers and Ivan Delgado**

*Southern Adventist University*

**EXTENDED ABSTRACT**

Laser projectors are beneficial over traditional projection systems because of their high contrast, visibility in bright light environments, and their precision. Current laser projector controllers frequently use a USB or PCI interface that limits the scalability of the system and places a proximity requirement on the host computer. This project solves that problem by replacing the traditional interface with a custom Ethernet-based laser projector controller board. This allows a single PC to control a virtually unlimited number of laser projectors over any TCP/IP network.

A standard laser projector utilizes scanners (galvanometers with mirrors) to direct a laser based on analog inputs. A laser projector unit contains a laser, two scanners for the X and Y axes, and analog circuits with a standard low-current analog signal interface to drive these components. An image is essentially vector-based and consists of a list of points. A laser projector controller continuously iterates through this list and sends each point over the analog interface.

**Design and Implementation**

Requirements were to iterate through the points in the image at a frequency of 30 kHz while achieving the same level of still image quality and functionality of a commercial PCI card. Three subsystems were designed and developed to control the laser projector. A dedicated Atmel AVR8 microcontroller interfaces with the scanners and laser through digital-to-analog converters (DACs). A second Microchip PIC18 microcontroller handles Ethernet communication and hosts a custom TCP server. A custom C# GUI drawing program on the PC allows user entry of images and downloads them to the Ethernet microcontroller, which in turn forwards commands and data to the first microcontroller via a serial interface.

**Testing and Results**

Numerous images of various sizes have been successfully downloaded and projected. Results visually indistinguishable from the commercial PCI card were achieved on the second prototype after changing the DACs and op-amps. Due to external memory issues encountered on the Atmel microcontroller, iteration of points had to be moved to the Ethernet microcontroller. This limited the point frequency to 25 kHz. A future board revision would solve this problem.

**Team Structure**

A decentralized organizational structure was chosen, and the team divided the project into separate areas. James Johnston was responsible for the hardware design. Ivan Delgado was responsible for firmware. Jerry Mayers was responsible for application development on the PC. Integration was achieved through working meetings between the leaders in each area.