California Science Center

CALIFORNIA STATE SCIENCE FAIR
2001 PROJECT SUMMARY

Your Name (List all student names if multiple authors.)
Amanda A. Kozlowski

Science Fair Use Only

S1408

Project Title (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9)
In Living Color: Colorimetric Calibration of an LED Display Using Spectroscopy

Division
_ Junior (6-8) _X_ Senior (9-12)

Preferred Category (See page 5 for descriptions.)
14 - Physics & Astronomy

Abstract (Include Objective, Methods, Results, Conclusion. See samples on page 14.)
Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.

The purpose of this experiment is to calibrate and verify the colorimetric accuracy of candidate LED displays by constructing a homemade spectrometer using a diffraction grating and a black-and-white CCD.

Construct a light-tight box with a narrow entrance slit. Perform experiments with the prism and diffraction grating inside the box to determine the better device for separating light into component colors. Optimize the angle of diffraction grating relative to the entrance slit to maximize the spectrum seen by the CCD. Mount diffraction grating inside box at a 22° angle. Mount CCD inside box on a platform so that it is level with the entrance slit and diffraction grating. Once the spectrometer is completed, hook up the computer with video-capturing software to the CCD camera. Use the narrow spectral filters to calibrate the spectrometer. Test the Nichia baseline, flashlight, laser pointer, UV light source, Linrose LEDs, and white LEDs. In all tests, use software to capture the image created. Test the 4 displays both with and without the ground glass diffuser. Using the test results, determine which display has the best color accuracy by comparing their spectra to the spectra of white light created by the various white light sources and by plotting the red, green, and blue LEDs on an industry standard CIE diagram.

I was able to verify the colors emitted by various LEDs including those constructed from InGaN, AlIn, and AlInGaP. An LED display built from Nichia LEDs most accurately reproduces white light. Next in order of ranking, a display consisting of Infineon LEDs did a reasonable job but I determined that the red diodes needed improvement Specifically, the spectrum clearly showed a red deficiency. Finally, a matrix of Panasonic LEDs had the poorest color fidelity because the orange diode needed to be red to better balance the spectrum. In addition, I observed that white LEDs produce a broad color spectrum since these use phosphor to produce the white light. In comparison, the light from a red laser pointer was very narrow, as expected. With regard to the spectrometer, I was able to achieve good sensitivity and repeatability by using a black-and-white CCD sensor with video output. By connecting the video to a personal computer, I took snapshots of the various spectra and performed accurate spectral analysis.

Summary Statement (In one sentence, state what your project is about.)
My project strives to quanitatively assess the viability of four LED displays using a homemade spectrometer.

Help Received in Doing Project (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4.
My father supervised the wiring of the four displays.