The Power of Spectral Data

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Abstract

This paper describes our experience in building a low-cost spectrophotometer called Colortron, initially available on the Macintosh platform. It discusses both technical considerations we faced in building the device as well as what we've learned about the uses of such an instrument.

Introduction

Spectral data has not been widely available on the desktop. We believe that instruments that measure spectral data could gain widespread acceptance, given the right combination of price and software to make it accessible.

Lack of spectral data is one of the main reasons that control of color has been so problematic on the desktop. For example, the most common device available to users for calibrating a monitor is a photometer, which measures the intensity of light but not its color. If the monitor's phosphor chromaticities are not measured, the colors on the screen will not look right, even on a "calibrated" monitor. As another example, vendors of color management systems generally do not allow users to measure their own printers to create custom calibrations, since this calibration requires precise color measurements that are performed in the laboratory of the CMS vendor. With spectral measurements readily available, CMS vendors could give average users the ability to calibrate their own printers.

In addition to solving these problems, the widespread availability of spectral data should change the way people use and communicate color. It is a quantitative change that has qualitative implications. Until now, this data has been available primarily to those involved in the production of color (for applications such as press control and quality control). But when this data is readily available beyond the traditional users to the buyers and designers of color as well, it can be used to specify color and provide an unambiguous communication of color intent. This could extend even to the home user, whose color intent could be "match the paint to my existing wall."

Hardware Considerations

We felt it was important to have a single device that could measure several types of sources. Transmissive, emissive and ambient sources can be measured by turning off the instrument's internal lights; transmissive targets require using a light box as an illuminant. Because ambient sources vary significantly in intensity, the unit was built with an autoranging capability to allow it to measure a wide range of intensities. A diffraction grating approach was used to implement the tent filter measurement specified in the ANSI / ISO standard, which is especially important in measuring sources with emission lines, such as monitors and fluorescent lights.

Software Considerations

Software is the key to making the data useful and accessible to users who until now have been unfamiliar with spectral data. Higher level functions include the ability to pick the nearest match to a color from a swatchbook, and the ability to perform that match under any specified lighting condition.

The software is modular, so that all of the significant functionality is contained in modular plug-in tools. Spectral data is useful in a wide range of specialized application areas, and this approach allows the software to be customized to the needs of each application.

Connectivity to the existing workflow is also extremely important. The software tools can also be used from the color picker. The file format for storing palettes of color is an extension of the EPSF format and uses the standard fields for the color name, RGB, and CMYK information and comments for the spectral data. Existing applications can read these files without modification, though they will of course need to be modified if they are to take advantage of the new fields they contain, such as spectral data. The data can also be exported to the clipboard for use in spreadsheets or other programs.

Conclusions

Controlling color requires precise measurement information, and the lack of this information is the cause of many of the color problems on the desktop today. We believe that the widespread availability of spectral data will allow unambiguous color communication and the precise control of desktop color.