COLOR CORRECTION FOR SEE-THROUGH DISPLAYS

Optical See-Through Display (OSTD) is a transparent digital display that simultaneously gives access to the digital content and the real world objects behind it. OSTD is quickly becoming a reality for major industry players such as Epson, Lenovo, Samsung and even Google. These companies have started producing displays for the consumer market.

The major problem with OSTD is color constancy. Color constancy is defined as the ability to perceive the colors of objects, invariant to the color of the light source. In the case of OSTD's, the light from background objects blends with the light originating from the display which causes a color blending problem. Color blending negatively affects the legibility and color coding of digital content which compromises the general usability of these devices. Control over colors is essential for any display, especially with a see-through display which aims to increase one's vision of the world using digital information. There have been many studies performed which confirm the negative effects of color blending with OSTD in content legibility.

The research group at the University of Manitoba's "Human Computer Interaction Lab" continue to try and solve this problem. This research team is headed by Dr. Pourang Irani and also includes Mr. Srikanth Kirshnamachari Sridharam and Dr. Juan David Hincapie-Ramos. Also joining the team from the University of Dundee, UK, is Dr. David Flatla. They have recently published a paper titled "Color Correction for Optical See-Through Displays Using Display Color Profiles" at the 19th ACM Symposium on Virtual Reality Software and Technology (VRST-2013) held in Singapore. The research group is currently developing a real-time solution that can be adapted by any OSTD to render colors as per the content designer's intention, regardless of the background.

Figure 1: Use of CS-200 to capture Color

Display and Light Measurement

APPLICATION NOTES

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THE STANDARD IN MEASURING
LIGHT

COLOR CORRECTION FOR SEE-THROUGH DISPLAYS

Precise Color Measurement Using Konica Minolta's CS-200 Chroma Meter

The core of this research is the measurement of colors as seen by a human observer. This research allowed the team to characterize how color behaves in OSTD's. The group used Konica Minolta's CS-200 Chroma Meter to measure the color displayed by the OSTD's. The CS-200's non-contact design and remote connect capability enabled them to measure a large set of colors. Further, the CS-200's measurement can be obtained in CIE XYZ, LA*B* and xyY which makes the data collection more valuable.

With the technological capabilities of the CS-200, the research group collected a large set of color blends from the OSTD under the influence of various background colors. This data gave them an understanding of how color blends in OSTD's and the factors that contribute towards the blend. The information collected of how the colors blend on these displays led them towards a possible solution to counter balance color blending. They invented a new algorithm to pick alternate colors called "BP-color correction".

The CS-200 comes with "Communication Specifications" which helped the group in connecting the instrument remotely to a computer. This remote connection gave access to the measurement data collected in real-time. The communication specifications are a set of easy to understand commands that can be passed back and forth from the CS-200.

Background

Foreground

1:30 3:00 4:30
Blue Jasmine
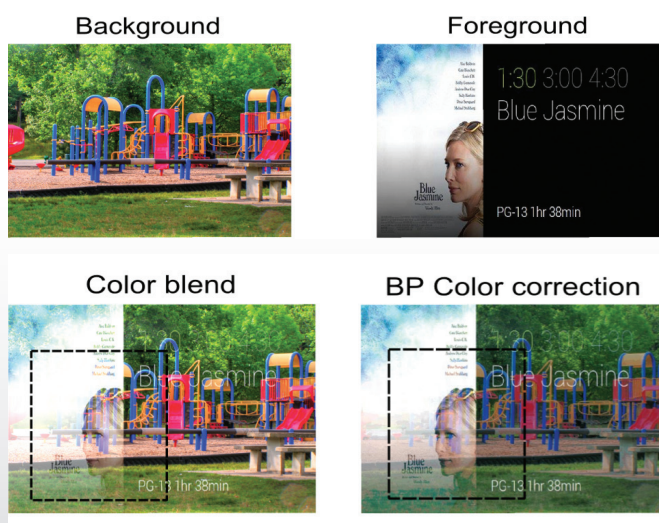
PG-13 1hr 38min

Color blend

BP Color correction

Figure 2: Example showing color blend and result of our color correction (highlighted by black box)

The CS-200 provided the group with flexibility in measuring color blends. When compared to other Chroma Meters, the CS-200 measures color irrespective of their light's incident angle. The non-contact nature of the CS-200 also enabled them to measure color for displays of any form factor; from a tiny head mounted display to a large window size display.

The research group is utilizing the data obtained from the CS-200 Chroma Meter towards a future where one can get digital information augmented with ambient light to provide content in the real world as seamless and legible as possible.

In addition to the CS-200, Konica Minolta offers a full line of light and display measurement instruments suitable for a wide range of industries. Contact us today to find the right equipment to fit your budget and needs.