Wide Color Gamut Displays Suitable for Soft Proofing of DTP

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Abstract

We have developed a prototype of wide color gamut monitor that has 130 [%] color gamut for conventional CRT ones. In this paper we would like to report our newly developed wide color gamut monitors. And more we have compared color gamut of our prototype vs. some major set of standard color patches. We would like to also touch upon this comparison. Specifications of our newly developed monitors are as follows: (1) Color gamut: more than 130 [%] for sRGB, (2) Screen size: 22 [inches] (480mm * 288mm), (3) Resolution: WXGA (H; 1280 * V; 768 [pixels]), (4) Maximum brightness: more than 300 [cd/m*m] and (5) liquid crystal mode: IPS (In-Plane-Switching). We consider that these specifications are suitable for soft proofing of DTP as replacement of conventional CRT displays. This research is organized in part by NEDO (New Energy and Industrial Technology Development Organization, Japan).

1. Introduction

Conventionally, cathode ray tube (CRT) monitors have been popular for soft proofing of Desk Top Publishing (DTP) and other high-end uses. For example, sRGB[1] has been defined as the standard color space for multimedia systems. The sRGB is the color space based on the conventional CRT color gamut. Recently some extended color spaces are discussed as the International Standards to eliminate defects of the sRGB. These color spaces can express a much wider color gamut than the sRGB. In order to reproduce images that follow extended color spaces, development of wide color gamut monitors are urged. The objective of our development is to produce a prototype of wide color gamut monitor that has features as follows:

(1) Color gamut: more than 130 [%] for sRGB
(2) Screen size: 22 [inches] (480mm * 288mm)
(3) Resolution: WXGA (H; 1280 * V; 768 [pixels])
(4) Maximum brightness: more than 300 [cd/m*m]
(5) Liquid crystal mode: IPS (In-Plane-Switching)
(6) Back lighting system: RGB power LED s
(7) Another features:
    (a) Built in automatic calibration system for keeping stable white point and brightness.
    (b) Adjustable white point from 3000 [K] to 10000 [K] by changing back light
    (c) These specifications are suitable for soft proofing of DTP as replacement of conventional CRT monitors.

2. Results

2.1 Outline of Prototype Monitor

Figure 1 shows the block diagram of our developed prototype. Table 1 shows the major specifications of the liquid crystal panel (LCD panel) used in the prototype. This panel stands on the extension of the technology of the panel created for trial by Ootsuki[2] and others in the last year, and it features the color sensors incorporated in the backlight section of the panel and the IPS adopted as the LCD type.

The following section elucidates the block diagram of figure 1.

(1) Input Interface Circuit

The product is provided with both D-SUB and DVI-D interfaces so that it can accept either analog or digital input. For analog input, in particular, a 10-bit Analog to Digital Converter (ADC) is adopted to support the most recent 10-bit interface.
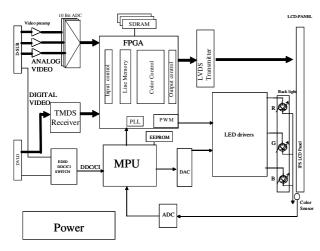
Figure 1. Block diagram of the prototype

Table 1. Specifications of the Panel

Item	Specifications
Type	CTFT LCD normally black IPS
Type name	AA220TB01
Maximum module size [mm^3]	521.35 x 330.8 x 34.5
Mass [g]	5,100
Active display area [mm^2]	480.0(H)x288.0(V) (Diagonal=22.0 inches)
Resolution [pixel]	1280(H) x 768(V)
Pixel Spacing [mm]	0.375 x 0.375
Number of colors	16,777,216
Brightness [cd/m^2]	635.9 @D65
Interfaces	LVDS single
Color gamut (CIE coordinates)	Red (x= 0.690, y=0.294)
	Green (x=0.191, y=0.705)
	Blue (x=0.145, y=0.081)
	104.4 [%] for NTSC

(2) Signal Processing Circuit

This circuit provides a scaling function to ensure that the format of input signals meets the number of panel pixels and a color control function to resolve the adverse phenomenon that three primary colors fluctuate with the temperature and other factors, which is specific to the LED-backlighting LCD. Those functions of this product are effectuated by means of FPGA because it is just a prototype.

(3) LED Control Circuit

This circuit supplies the information captured by the incorporated color sensors to the MPU, and then the circuit ensures a stable white point independent from temperature fluctuation or variation with time by illuminating R, G and B LED's at a desired level based on the results of the MPU's calculation. This function can be used to enable achievement of a white point that is optimal to the use without compromising the bit depth of image signals, as often happens in conventional liquid crystal monitors (LCD monitors).

Thus, we were successful in creation of a prototype that meets all features mentioned in the Introduction.

2.2 Comparison Between the Color Gamut of the Prototype and the Standard Color Patches

Soft proofing in the printing industry is one of the feasible applications of our developed monitor. For both our developed monitor and conventional CRT monitor, we studied how the color gamut of each monitor can cover the standard color patches specified by the Specification for Web Offset Publications (SWOP), which is the US standards for offset printing, in the CIELAB color space. The result is shown in figure 2. Figure 2 indicates increase in the coverage ratio by our developed prototype compared with the conventional CRT monitors.
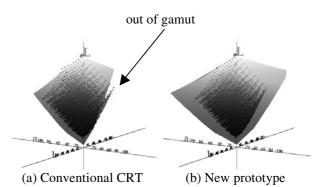

(a) Conventional CRT   (b) New prototype

Figure 2. Comparison between the color gamut of the prototype and the standard color patches

3. Conclusion

It has been known that LED-backlighting LCD is effective in extension of color gamut. However, it involved a weak point in the stability with temperature fluctuation and time change. Authors have resolved this problem and, moreover, created a prototype that functions as a monitor. As mentioned above, the color gamut of this prototype covers almost all of the standard color patches of the printing industry, and it enables high-accuracy soft proofing, which conventional CRT monitors could not implement.   This research is organized in part by NEDO (New Energy and Industrial Technology Development Organization, Japan).

References

1. IEC 61966-2-1, "Multimedia systems and equipment – colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB", Oct. 1999
2. Hideyo Ohtsuki, et al., "18.1-inch XGA TFT-LCD with wide color reproduction using high power LED-backlighting", SID 2002, digest of technical papers, pp 1155-1158, (2002)