



White Paper

Color Vision Deficiency Simulation with the FlexScan L797-U

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1 Introduction

In modern society, one important medium of communication is the use of ‘color.’ However, most designs are made for people with ordinary color vision. Because of this, the number of cases where a person with color vision deficiency is disadvantaged due to not being able to distinguish colors is increasing. Also, there is a worry that as technology such as electronic signs and electrical appliances with LEDs that involve more and more colors increases, the number of problems due to not being able to distinguish colors is increasing.

To counter these problems our company, working with Mr. Mitsuyoshi Maekawa of the Industrial Research Institute of Ishikawa who is conducting color barrier-free investigations and the non-profit organization CUDO (Color Universal Design Organization), conducted a series of tests targeting colorblind persons in order to improve detection accuracy of indistinguishable colors, and has developed the ‘FlexScan L797-U’ hardware color recognition simulation monitor. This White Paper describes the characteristics of the L797-U’s color recognition simulation and its applicability.

2 Color Recognition and Color Universal Design

This chapter gives an outline of color recognition and color universal design.

2-1 Color Recognition

Color recognition is the general recognition of colors. Due to hereditary causes and some eye diseases, color recognition may differ from that of ordinary people; especially widespread is the feature known as colorblindness. Color vision deficiency is usually one of two types, protanope or deuteranope, which make the colors red and green difficult to distinguish. It affects 5% of the Japanese male population.

2-2 Color Universal Design

Color universal design is a design which has been made while considering if the correct information is being given to a colorblind person. This is not only the color-scheme, but also the attractiveness and how easy it is to understand the overall design.

Currently investigations and educational activities are being carried out by the non-profit organization CUDO (Color Universal Design Organization.) (<http://www.cudo.jp>).

For more details regarding color recognition and color universal design, please refer to the EIZO's Color Universal Design Handbook available for download on www.eizo.com.

3 Color Vision Simulation

This chapter looks at the need for color recognition simulations and explains the L797-U color simulation.

3-1 The Need for Color Vision Simulations

The use of colors that both people with common-type vision and colorblind people can equally understand must be considered in color universal design. However, it is very difficult for a designer with common-type vision to judge which combinations of colors are appropriate. This is why there is a need for a mechanism to simulate the vision of colorblind people by computer. There are already some specialist software programs which can do this but there are also several problems with these programs when it comes to simulating color recognition.

3-2 Software Color Vision Simulation

Currently the conversion process for color vision simulations can be mostly carried out by specialist software. However, the amount of time required for software to convert such data is a problem. Each pixel of an image file must be computed individually by the software and this takes far too much time. Also having to open and check every existing design one at a time with the software is not practical. In particular it is impossible to display moving images.

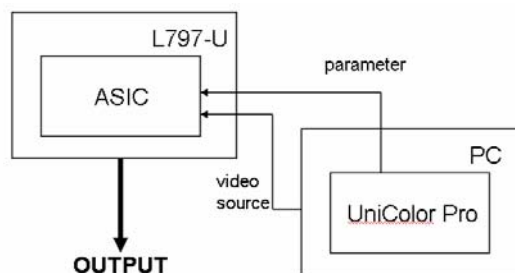
Another problem is that the OS running the image design software is not necessarily the same as that of the color vision simulator which means additional work is required in re-checking the image data on the correct OS. This is not a practical way to work.

3-3 Hardware Color Vision Simulation

Hardware color vision simulations can be achieved by using the L797-U. By performing a hardware color conversion completely with the monitor, the conversion process can be carried out in real time regardless of the computer's performance. Also, because it is possible to switch between the three modes (protanope, deuteranope and common-vision) in a fraction of a second, the differences can be verified more efficiently. And of course, since the conversion takes place entirely with the monitor hardware it is also possible to display moving images with no problems.

3-4 Practical Hardware Color Vision Simulation with the L797-U

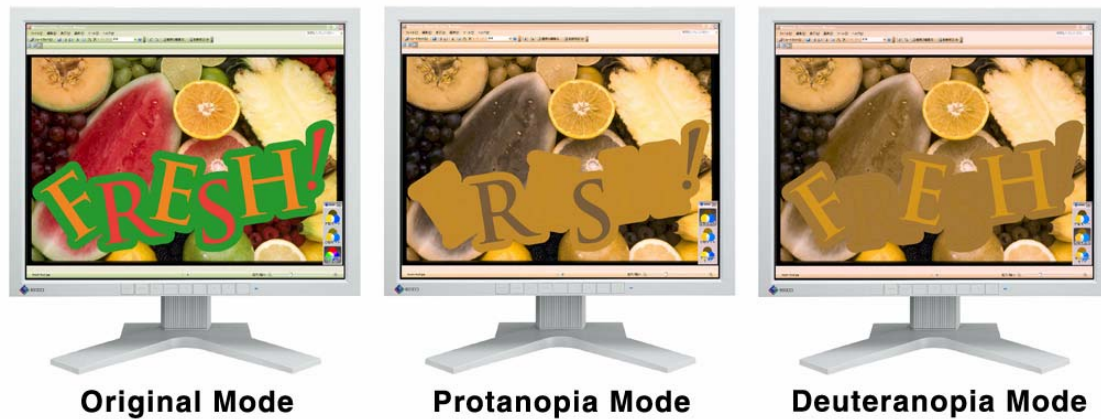
The L797-U uses an in-house developed ASIC (application specific integrated circuit) for the color space conversion process in order to carry out hardware color vision simulations. UniColor Pro, the specialist software bundled with the L797-U, uses a USB connection to send the parameters and commands for the color space conversion process (as shown in fig.1). This section explains hardware color vision simulation with the L797-U.



(fig.1.) Process diagram

3-4-1 Specialist Software – UniColor Pro

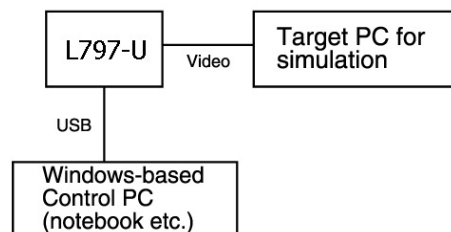
UniColor Pro is a Windows XP/2000 application used to send parameters to the L797-U for the color space conversion process. A user can practically simulate three different display modes on the monitor, protanope, deuteranope and common-vision (fig. 2). Of course, the original data is not changed in any way; the only changes are to the monitor display so there are no worries about overwriting data. It is then possible to capture the images shown in the simulation as Bitmap images so that the image data can be checked later to see which colors there were. (This is only possible with images shown on the Windows OS)



(fig.2.) UniColor Pro in action

3-4-2 Use on Other Operating Systems

With a separate Windows computer, UniColor Pro can support other operating systems such as Mac OS and Linux and handle images displayed in such systems. For example, as shown in the following diagram (fig. 3), by connecting the control PC (a notebook etc.) with a USB cable the simulation can be displayed using other operating systems. This was not possible with conventional specialist simulation software because of limitations of the OS, but now, thanks to the L797-U, hardware color recognition simulations can be carried out regardless of OS. Unlike for the Windows images, UniColor pro is not able to capture such images however.



(fig 3) Connection diagram for using other operating systems

4 Conclusion

The L797-U has the following functions mentioned above.

- Instantaneous color recognition simulation is possible through hardware color space conversion process using the ASIC, developed by EIZO (including real-time conversion of moving images)
- By using a control PC, color recognition simulation of images on any computer regardless of operating system is possible.

As you can see, using the L797-U monitor for hardware color recognition simulations makes barrier-free image design much more efficient.