

Kalskaya Yuliya Aleksandrovna

Student

Ural Federal University

Russia, Yekaterinburg

Research advisor: Kurmanova Dilyara Ilshatovna

OVERVIEW OF VARIOUS COLOR MODELS OF COMPUTER GRAPHICS

***Abstract:** This article defines the term «color model» and presents a review of various color models, their description and comparison. To utilize color as a visual signal in multimedia, image processing, graphics and computer vision applications, an appropriate method for representing the color signal is needed. The different color models address this need.*

***Keywords:** color model, color space, computer graphics, RGB, CMYK, HSB, LAB.*

Кальская Юлия Александровна

Студент

Уральский федеральный университет

Россия, г. Екатеринбург

Научный руководитель: Курманова Диляра Ильшатовна

ОБЗОР РАЗЛИЧНЫХ ЦВЕТОВЫХ МОДЕЛЕЙ КОМПЬЮТЕРНОЙ ГРАФИКИ

***Аннотация:** Данная статья дает определение термину «цветовая модель» и представляет обзор различных цветовых моделей, их описание и сравнение. Чтобы использовать цвет в качестве визуального сигнала в приложениях мультимедиа, обработки изображений, графики и компьютерного зрения, необходим соответствующий метод для представления*

цветового сигнала. Различные цветовые модели удовлетворяют эту потребность.

Ключевые слова: цветовая модель, цветовое пространство, компьютерная графика, RGB, CMYK, HSB, LAB.

We live in a colorful world. A huge number of different colors and shades surround us. Modern technologies such as telephones, televisions, monitors also show us color images. However, few people think about how a computer screen or TV transmits such bright and realistic colors. Putting the color in those mediums requires processes, which have to start with a color model.

A color model is a system for creating a full range of colors from a small set of primary colors. There are different kinds of color models used for different purposes, and each has a slightly different range of colors they can produce. The whole range of colors that a specific type of color model produces is called a color space. All color result from how our eye processes light waves, but depending on the type of media, creating that color comes from different methods.

RGB color model

The RGB color model is the most popular way of presenting graphics, which is suitable for describing the colors that are visible on a monitor, TV, video projector. It is used to describe the colors obtained by mixing three rays: Red, Green and Blue. Figure 1 shows what colors are obtained by adding the primary colors.

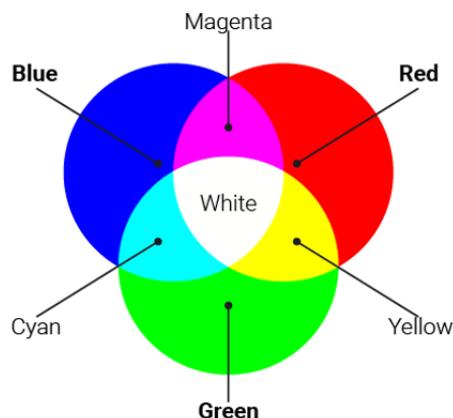


Fig. 1. Combinations of base colors in the RGB model

In the RGB model, each basic color is characterized by brightness, which can take 256 values – from 0 to 255. Therefore, it is possible to mix colors in various proportions, changing the brightness of each component.

From the point of view of editing images on a computer screen, this color model is the most convenient, as it provides access to all 16 million colors that can be displayed on the screen. The disadvantage of this model is that not all created colors can be printed.

CMYK color model

The CMYK color model is used for mixing inks by printing devices. The colors of this model are obtained by subtracting the base colors of the RGB model from white. The basic colors for CMYK are Cyan (white minus red), Magenta (white minus green), Yellow (white minus blue). In addition to these, black color is used, which is the Key in the process of color printing. Figure 2 shows what colors are obtained by adding the primary colors.

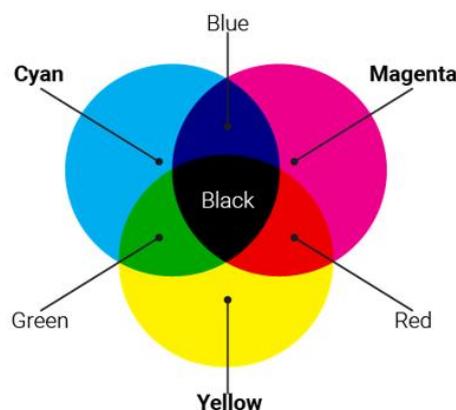


Fig. 2. Combinations of base colors in the CMYK model

An interesting feature of this model is that, despite the fact that the number of channels in CMYK is four, and each of them contains 256 gradations of brightness, the CMYK color space is narrower than that of RGB. Inks cannot convey all RGB colors, so visually the CMYK saturation is lower than that of RGB.

HSB color model

In HSB model, color is decomposed into three components:

- HUE (color tone) – the frequency of the light wave reflected from the object that you see.
- SATURATION – the percentage of white paint added to the color.
- BRIGHTNESS – percentage of addition of black paint.

Figure 3 is a graphical representation of the HSB model.

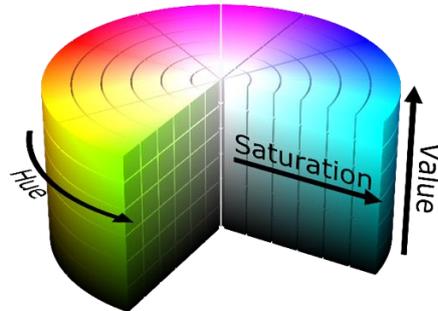


Fig. 3. Graphical representation of the HSB model

When working in graphic programs using this model, it is very convenient to select a color, since the representation of color is consistent with its perception by a person. The disadvantage is that the human eye perceives the colors of the rainbow wheel as colors with different brightness, but in the HSB color model, all colors of the circle have a brightness of 100%, which, unfortunately, is not true.

LAB color model

LAB is a device-independent color model that was developed to eliminate the disadvantage of the color models described above. The color in this model is determined by three parameters:

- Luminance – this is set of notions lightness and chroma;
- A – the color range from green to red;
- B – the color range from blue to yellow.

Figure 4 is a graphical representation of the HSB model.

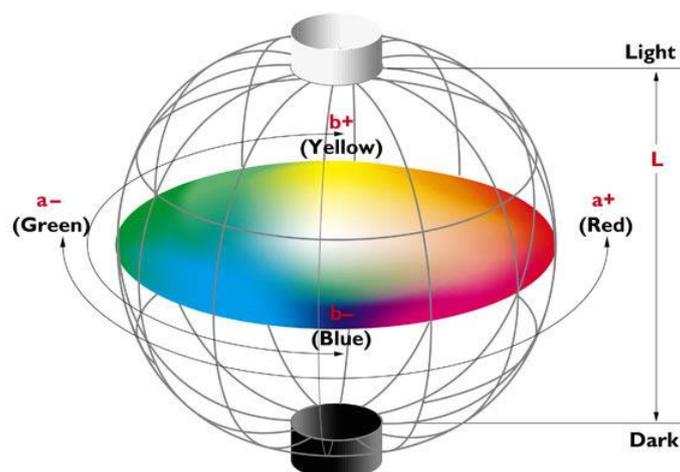


Fig. 4. Graphical representation of the LAB model

That is, the two indicators determine the color (in the aggregate) and one indicator measures the light.

This model contains color as RGB and CMYK, and grayscale, which allows it to convert with minimal loss of image quality from one color model to another.

Another advantage is that it, unlike the color model HSB, corresponds to features of perception of color by the human eye.

Thus, it is worth emphasizing that each color model has both advantages and disadvantages. No model is necessarily «better» than other. Typically, the choice of color model is determined by external factors, such as a graphics tool or the need to specify colors in accordance with certain standards.

REFERENCES

1. Granier, Xavier, and Wolfgang Heidrich. A simple layered RGB BRDF model. *Graphical Models* 65.4, 2003. – С. 171-184.
2. Understanding Color Models and Spot Color Systems: сайт. [Электронный ресурс]. – URL: <https://www.designersinsights.com/designer-resources/understanding-color-models/> (дата обращения: 21.11.2019).

3. What is a color model? [Электронный ресурс]. – URL: <https://www.script-tutorials.com/what-is-a-color-model/> (дата обращения: 22.11.2019).

4. Дёмин А. Ю., Кудинов А. В. Компьютерная графика: учеб. пособие. [Электронный ресурс]. - URL: http://compgraph.tpu.ru/Colors_models.htm (дата обращения: 22.11.2019).