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A Survey on Color Models for Image Enhancement

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ABSTRACT

These days, with the advancement in the techniques for image processing it is widely being used in multimedia, graphics and computer vision applications. A rational method provided by the color spaces is used to specify order, manipulate and display the object colors taken into consideration. The image processing system that interacts efficiently with human brain and human eye simultaneously is considered to be the most powerful system. A number of models based on human perception, on color recognition, on various color components etc are available. A number of papers have been published on various applications such as lane detection, face detection, fruit quality evaluation. A survey on widely used models RGB, HSI, HSV, RGI etc is highlighted in this paper.

***Keywords*--** Image processing, Color models, RGB, HSI, HSV, RGI

I. INTRODUCTION

Digital image processing is an emerging field in various technical systems such as radar tracking, communications, television, astronomy, etc.

Color Image processing is being used for digital image processing and it is in 2-dimensional format. Digital image processing is defined as a technique or process in which the digital images are processed /enhanced with the help of a digital computer. Basically, three color models are provided in the image processing technique. These models are called RGB (Red, Green, Blue) color model.

These color models are considered as the standard designs of a computer graphic system.

These color components are correlated and various processing techniques are applied on the intensity or the frequency components of an image. An image carries all the required information and is used for image analysis.

There are numerous methods of digital image processing techniques such as: histogram processing, local enhancement, smoothing and sharpening, color segmentation, a digital image filtration and edge detection.[1]

Image processing provides a large number of features. Some of these features are image shrinking, image scaling, image compression, image rotation. To rotate an image by some specified angle image Rotation is used, to increase the size of a pixel resembling is used and image shrinking is used to shrink any image.

The Human visual system can be distinguishes hundreds of thousands of different color shades and intensities but only around 100 shades of the grey.

II. COLOR MODELS FOR IMAGE ENHANCEMENT

To efficiently use the color as a visual cue in multimedia, image processing, graphics and computer vision applications, an appropriate method for representing the color signal is needed. So to cater this need the various color specification systems or color models are available. Color spaces provide a rational method to specify order, manipulate and effectively display the object colors taken into consideration. Thus the most appropriate color model that suits the problem's statement and solution, more efficiently, should be selected or used. To attain the best color representation it is mandatory to know the procedure for generating the color signals along with the type of information required from these signals. So, the color models may be used to define colors, discriminate between colors, judge similarity between color and indentify color categories for a number of applications. Color model literature can be found in the domain of modern sciences, such as physics, engineering, artificial intelligence, computer science and philosophy [3].

2.1 RGB color model

This color model works on the basis of the three primary colors (red, green, and blue) and their combinations. With different weights, (R, G, B), their combination can indicate different colors. The color cube

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which is obtained after normalizing the values of RGB is given in (Fig.1).

Fig 1: Color Cube

The colors on the diagonal line, from the origin to the coordinate (1, 1, 1) of the cube, means the gray-level values [3].

In the RGB model, each primary color is represented in a coordinate system. The "primary" RGB colors vary from zero to maximum value (e.g. from 0 to 1, or from 0% to 100%, or from 0 to 255 brightness levels, etc). *R* color and normalized *RG* colors (*r*, *g*) are used to set up the adaptive skin color model because (*r*, *g*, *R*) is less sensitive to changes in light source and suitable for real world applications [9]. The RGB color model is standard design of computer graphics systems. This color model is not ideal for all of its applications.

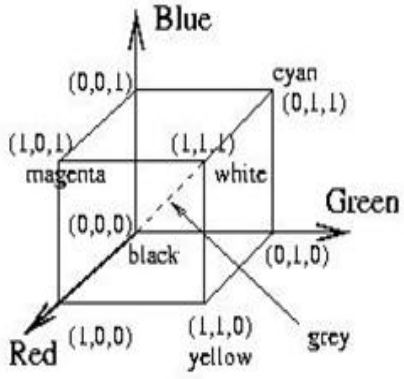

Fig 2: RGB graph of color cube

2.2 CMY color model

The CMY color model makes the use of the complementary colors. These complementary colors are cyan, magenta, yellow.

The representation of this model is given as:

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}.$$

Where, C represents Cyan
M represents Magenta
Y represents Yellow
R represents Red
G represents Green
B represents Blue

In the CMY color system equal proportions of Yellow and Cyan produces Green, Yellow plus Magenta produces Red, and Cyan ink plus Magenta produces Blue. Black is added to improve the quality of images [8]. Fig. 2 shows the relationship of the component color of the CMY color model. The CMY color model is applied to the output devices, such as printers [3].

2.3 YIQ color model

Basically, This color model is used for color TV. The YIQ color model is designed in such a manner that if refers to the functioning and characteristics of a human visual system. It is evident that the human visual system is more sensitive to light components than the hue components. So, YIQ model aims at separating the colors into luminance (*Y*) and hue (*I* and *Q*). In this model, a color TV set would take all these three channels i.e. Y, I and Q and map the information back to the R, G and B levels for display on a screen.

2.4 HSI color model

The improved version of RGB model is HIS Model. This is known as Hue Saturation Intensity (HSI) color model. It resembles the human vision. This model is somehow the complex one as compared to the other models. [2].

I denotes the light intensity, *H* denotes the hue that indicates the measure of the color purity, *S* is the saturation (the degree of a color permeated the white color). If a color is with high saturation value, it means the color is with the low white color. The relationship between HSI and RGB can be described as [3].

III. DIFFERENT CATEGORIES OF COLOR MODELS

a. Device-oriented color models: These are the Device dependent color models which relate and affected by the signal of the device. These are widely used in many of the applications that demand the color be consistent with hardware tools used like TV and video system.

b. User-oriented color models: It is considered as a bridge/path between the human operators and the hardware that handles the color information.

c. Device-independent color models: These models are used to specify color signals independently of the characteristics of a given device. These types of color models are very useful in network transmission information so that the visual data has to traverse through the different hardware devices.

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IV. CONCLUSION

In this paper, a survey on various color models and their description is presented. It also focused on the application of the different models with the help of image processing. It is concluded that the colors are used in object identification and simplify extraction from a scene and it is powerful descriptor. Color recognition and color components are the two main parameters on which the performance of the color models is dependent. . These color models are mainly arranged into two types i.e. device dependent and device independent and the further classifications are analog use or digital use. The research work shows the conversions of various models results in speeding up the process of image processing .

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