Grey level to RGB using YCbCr color space Technique

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ABSTRACT
Converting color images to grayscale is used for various reasons, like for reproducing on monochrome devices, subsequent processing. Each pixel in color image is described by a triple (R, G, B) of intensities like red, green, and blue. But how do you map that to a single value i.e. grayscale value. There are three methods to convert it. Average, Luminosity, Lightness. Different color models are used for different applications such as computer graphics, image processing, TV broadcasting, and computer vision. But still now there is no particular method for converting of grayscale to color image. In this paper a new approach was introduce to convert the grayscale image to color by using an YCbCr color space technique. Simulation results are presented to show how this approach is used to convert the grayscale to color image.

Keywords
Image Processing, Gray level, RGB, YCbCr

1. INTRODUCTION
The colors that humans and other animals perceive in an object are determined by the nature of the light reflected from the object. Converting color images to grayscale is used for various reasons, like for reproducing on monochrome devices, subsequent processing. Color-to-grayscale conversions perform a reduction of the three-dimension. The colors that humans and other animals perceive in an object are determined by the nature of the light reflected from the object. Converting color images to grayscale is used for various reasons, like for reproducing on monochrome devices, subsequent processing. Color-to-grayscale conversions perform a reduction of the three-dimensional color data into a single dimension. A grayscale is an image in which the value of each pixel is a single sample; define intensity information of the pixel. Images of this sort are composed exclusively of shades of gray, varying from black at the zero intensity to white at the 255 known as black-and-white. Grayscale images have many shades of gray in between 0 and 255 values which changes by value of the pixel. Grayscale images are also called monochromatic, denoting the presence of only one (mono) color (chrome). Recently, various approaches to the color to grayscale conversion problem have been proposed. However, until now, there has not been an evaluation of grayscale to color conversions involving a representative number of subjects and input stimuli.

Adding colors to a grayscale image actually involves assigning three-dimensional (RGB) pixel values to an image which varies along only one dimension (luminance or intensity). In fact, different colors may have the same luminance value but may vary in hue or saturation, hence, the problem of colorizing grayscale images has no inherently “correct” solution. Choosing another decorrelated color space YCbCr for colorization purpose. YCbCr color space also provides three decorrelated channels Y, Cb and Cr. Channel Y is achromatic luminance channel, whereas chromatic channels Cb and Cr correspond to the difference between blue component with a reference value and difference between red components with a reference value, respectively. This space also allows selective transfer of chromatic Cb and Cr channels from color image to grayscale image without introducing cross channel artifacts [8].

In RGB color space, each color appears in its primary color components of red, green and blue. This model is based on Cartesian coordinate system. Images represented in RGB color model consist of three component images. The number bits required to represent an RGB image is 24 bits i.e. for which colours like red, green and blue images are defined by 8 bits each. Under these conditions each color image pixel is said to have a depth of 24 bit. The task of coloring a gray-scale image involves assigning RGB values to an image which varies along only the luminance value. Since different colors may have the same luminance value but vary in hue or saturation, the problem of coloring gray-scale images has no accurate solution but approximate solution. In this paper, we present the results of grayscale to color image. For this purpose first take a sample RGB image is converted into grayscale image and then using YCbCr color space with luminance Comparison. Conversion of a grey image to RGB image based on the color of the destination image is the final step in this process.

The rest of the paper is organized as follows: In Section 2 Color to grayscale conversion Methods. The section 3 gives details about RGB and YCbCr color space. Section 4 proposed algorithm been introduced Section 5 presents simulation results. And draw the conclusion in Section 6.

2. COLOR TO GRAYSCALE CONVERSION
Color space is a mathematical model to represent color information as three different color components. Color space explains how the colours are represented and specifies the components of color image accurately to learn how each colors looks in spectrum [2]. In different applications, different color models are used such as computer graphics, image processing, TV broadcasting, and computer vision. How do you convert a color image to grayscale? If each pixel in color image is described by a triple (R, G, B) of intensities like red, green, and blue, how do you map that to a single value i.e. grayscale value. There are three methods to convert it. Average, Luminosity, Lightness.

In lightness method, averages the most prominent and least prominent colors:

$$\text{Lightness} = (\text{Max}(R, G, B) + \text{Min}(R, G, B)) / 2. \quad (1)$$

In Average method, simply average the values of red, green, and blue values of an image

Average = (R + G + B) / 3. (2)

Luminosity method is a more sophisticated version of the average method. It also averages the values, but it forms a weighted average to account for human perception. Humans are more sensitive to green than other colors, so green is weighted most heavily [3].

Luminosity = 0.21 R + 0.72 G + 0.07 B. (3)

3. COLOR MODEL

Color space is a mathematical model to represent color information as three or four different color components [2]. Color space explains how the colors are represented and specifies the components of color space accurately to learn how each color spectrum looks like1. Different color models are used for different applications such as computer graphics, image processing, TV broadcasting, and computer vision [7].

3.1 RGB Color model

RGB color model representation shown in Figure 1 is additive in nature. In this additive color space, other colors are produced by adding the primary colors red, green and blue. The combination of all three primary colors produces white color and the absence of all primary color makes black. The RGB color model is represented by a unit cube and the axes are labelled as R, G and B. The origin (0, 0, 0) is considered black and the diagonally opposite corner (1, 1, 1) is considered as pure white. This color space is widely used in television and computer monitors. Any other color space can be obtained from a linear or non-linear transformation of RGB color space. This color space is device dependent which means that the same signal or image can look different on different devices. This RGB color model is not suited for analysis of color and color based segmentation algorithms because of chrominance and luminance component are mixed.

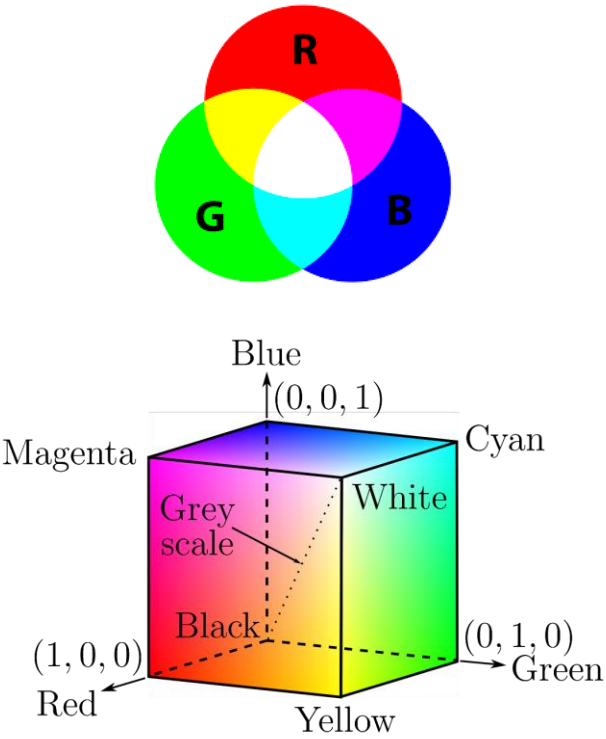

Figure 1. RGB color model representation.

3.2 YCbCr Color model

According to ITU (International Telecommunication Union) a standard ITU-R and YCbCr defined as a color space for digital television systems and also defines the transformation of coefficients between YCbCr and RGB color model. YCbCr color model is represented in terms of one luminance component (Y) and two chrominance components (Cb and Cr). In this color space, the light intensity is represented by 'Y' component. The intensities of the blue and red components relative to the green component are represented by 'Cb' and 'Cr' components respectively. YCbCr color model imitates the human vision i.e., exploits the properties of the human eye. Human eye is more sensitive to light intensity changes and less sensitive to hue changes. So it is very easy to eyes to perceive more information from luminance than any other components. YCbCr color model makes use of this property to achieve an efficient representation of images. YCbCr color model is widely used in image compression standards like Joint Photographic Experts Group (JPEG) and digital encoding of color information in computing systems. As per the definition of ITU-R BT.601 definition, for 8-bit unsigned integer images, the range for luminance (Y) component is [16,235] and the range for chrominance (Cb and Cr) components is [16,240].

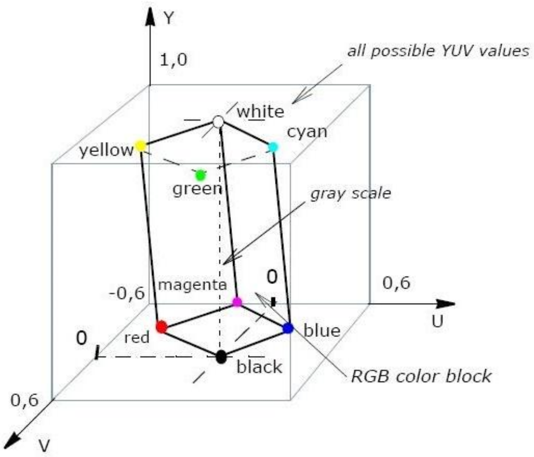

Figure 2. YCbCr color model representation on yuv plane.

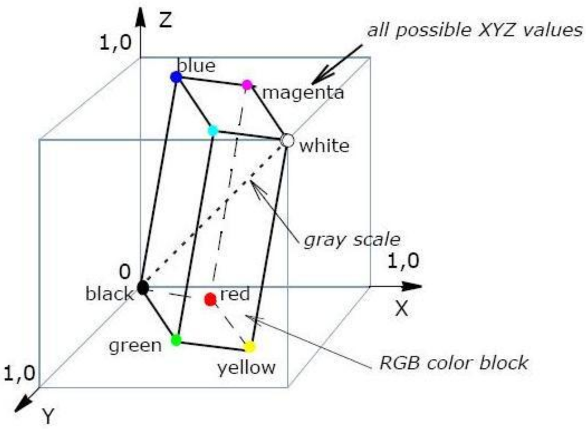

Figure 3. YCbCr color model representation on xyz plane.

The YCbCr color model is commonly used in image processing as it separates the luminance, in Y component, from the chrominance described through Cb and Cr components. The luminance component can be used separately for storage in high resolution and the two other chrominance components can separately be considered for improving the performance [4].

3.3 Transformation between RGB and YCbCr

According to ITU-R BT.601, for standard definition television applications, the conversion between RGB color space and YCbCr color space is described by the following equations [6]:

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 0.279 & 0.504 & 0.098 \\ -0.148 & -0.291 & 0.439 \\ 0.439 & -0.368 & -0.071 \end{bmatrix} \begin{bmatrix} R \\ B \\ G \end{bmatrix} \quad (4)$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1.164 & 0.000 & 1.596 \\ 1.164 & -0.392 & -0.813 \\ 1.164 & 2.017 & 0.000 \end{bmatrix} \begin{bmatrix} Y-16 \\ Cb-128 \\ Cr-128 \end{bmatrix} \quad (5)$$

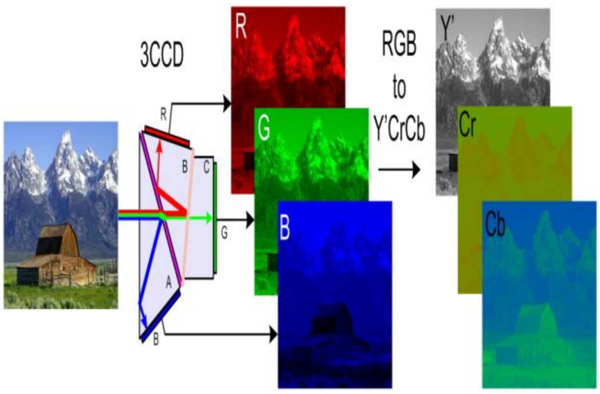

Figure 4. RGB to YCbCr color model Transformation

4. PROPOSED ALGORITHM

In this section, a new algorithm for transferring grayscale image to color image is described.

The general procedure requires a few simple steps.

Step 1: Sample color images are taken and convert into gray scale images.

Step 2: Next, take both original color image and converted gray scale image as an input to the algorithm.

Step 3: Now the pixel depth of both color and grayscale are taken in different variable. And if size of pixel depth of color image is not match with three then error is displayed, if matches continue to next step.

Step 4: Converting color image to YCbCr color image

Step 5: The YCbCr color image is be normalized then Luminance Comparison carried to get output color image.

5. SIMULATION RESULTS

Converts a gray image to RGB image based on the colors of the destination image. The better the destination image match with the source gray image, the better the coloring will be. For this purpose MATLAB 7.10 (R2010a) program has been adopted.

Table 1. Results of Gray level to RGB conversion image of nature.

Original color image	
Grayscale image	
Proposed color image	

Table 2. Results of Gray level to RGB conversion image of sunset

Original color image	
Grayscale image	
Proposed color image	

Table 3. Results of Gray level to RGB conversion image of cloud and sky

Original color image	
Grayscale image	
Proposed color image	

Table 4. Results of Gray level to RGB conversion image of fruits image

Original color image	
Grayscale image	
Proposed color image	

6. CONCLUSION

In this paper a new approach was introduce to convert the grayscale image to color by using an YCbCr color space technique. YCbCr color image is be normalized then Luminance Comparison carried to get output color image. This approach can use in different applications such as computer graphics; image processing, TV broadcasting, and computer vision .This reduce the total no of pixel value to be transferred through the media for processing of an image. And the Simulation result show the accuracy is increase when working with images having less color different in regions of the gray level and if more different in regions of the gray level image that coding is not that much of accuracy. In future an accuracy gray level to color transformation process may be developed with help of this approach.

7. REFERENCES

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