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Color Space Transformation for Visual Enhancement of noisy color Image

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ABSTRACT: Enhancement of color images is a very crucial and necessary task in the era of image processing. Image enhancement also plays a very essential role in the field of space science, medical imaging etc. improved medical images are more appropriate for analysis and correct diagnosis. This paper represents several color space techniques (RGB, YIQ, YCbCr, HSV etc.) to represents colored digital images. Also performs color space transformation on color images and simulates on MATLAB tool and compare result of several different color spaces. This paper transforms color space of the images from RGB to HSV, YIQ, YCbCr respectively. Hence it obtains a visually enhanced edition of the noised image.

KEYWORDS: Color Space transformation, RGB Color model, HSV Color model, YIQ Color model

I. INTRODUCTION

In Image processing computer algorithms are used to perform operations on digital images to analyze, enhance, modify and process digital images. Image processing permits a wide variety of algorithms to be functional to the input digital image data and can evade problems such as the in-build of signal distortion and noise for the period of processing of images.

In working with digital images, we will found many images that can be improved by the form of image enhancement. Image enrichment techniques[1][3][4][7] are premeditated to increase the quality of an image as seeming by a human being. Visual enhancement of digital image plays a very significant role in the field of medical imaging. Enhanced medical images are more appropriate for analysis and accurate diagnosis[5].

This paper shows various color spaces or color models that are used to represent digital images like HIS, YIQ, RGB, YCbCr etc. This paper shows how to converts noised color digital RGB image into another color space like HIS, YIQ, and YCbCr respectively and after that filters these images one by one reverse convert into RGB color space than computes PSNR that shows the peak signal noise ratio for different color spaces. Different PSNR computed for different color models are compared and shows result.

II. COLOR SPACE

An arrangement of coordinate system and subspace surrounded by the system, in which each one color is can be represented by a single point called color space, color system or color model. Many different color models have been proposed over the last 400 years. Modern color models have also used to specify colors for diverse purposes for example, color mixtures, photography, measurements of light, etc. RGB color space consists of three gray scale components like red, green and blue; every one of which is represented by 8 bits. An image in RGB space can be converted into another color space such as HIS, YCbCr and YUV[2].

A. The RGB color space

In RGB (Red, Green, Blue) color space model a Cartesian coordinate scheme is used. In this Cartesian coordinate scheme axes represent the three primary colors of light i.e. Red, Green, and Blue, usually normalized to the range (Figure 1). In the resulting cube eight vertices correspond to the three primary colors of light(R, G, B), the three secondary colors (Cyan, Yellow, Magenta), pure white and pure black. Figure below shows the Red, Green, and Blue values for each of these eight vertices.

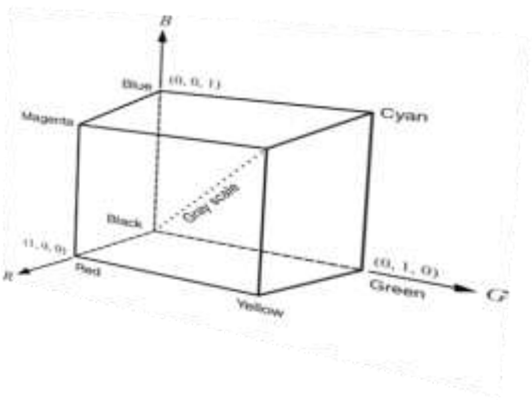

Figure 1(a): RGB-CMY Cube

Color Name	R	G	B
Black	0	0	0
Blue	0	0	1
Green	0	1	0
Cyan	0	1	1
Red	1	0	0
Magenta	1	0	1
Yellow	1	1	0
White	1	1	1

Figure 1 (b): Cartesian coordinate scheme

B. The CMY and CMYK Color Models

In the CMY model three primary colors of pigments are used these three primary colors of pigments are Cyan, Magenta, and Yellow. This model is used for color printers, in which each primary color represents to an ink or toner cartridge. When an equal amount of these three primary colors is added to produce black color the resulting color looks muddy black that is unacceptable black. So for acceptable black color a forth color black is added, this four color model (Cyan, Magenta, Yellow, Black) is called CMYK model. The translation from RGB to CMY Model is represented as:-

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

Figure 2: Conversion of RGB to CMY

The inverse conversion from CMY to RGB, is equally easy as per mathematical viewpoint.

C. HSV color Model

Color models like CMY, CMYK, and RGB defined earlier are very suitable to stipulate color coordinates for presenting or printing. But these kind of color models are not useful to imprisonment a typical human explanation of color. Rather, the human insight of color is best defined in terms of HSV hue, saturation, and value. Color type or tone or color name is described by Hue, measure of purity of a particular color or amount of which it has been diluted in white color is called **S**aturation, and the brightness of objects is referred by **V**alue.

HSV (Hue, Saturation, Value) color model can be achieved by watching at the RGB (Red, Green, Blue) color cube sideways its main diagonal or gray axis, which outcomes in a hexagon molded color palette.

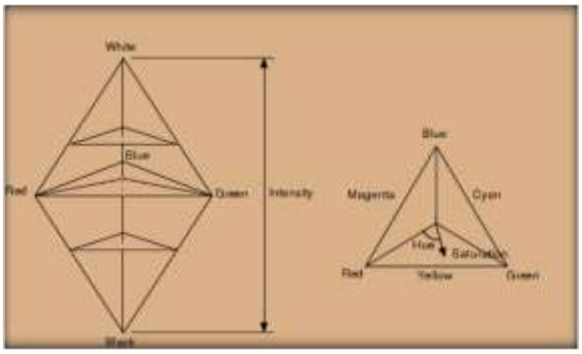

Figure 3: Hexagon molded color palette

D. YIQ Color Model

In YIQ color model Y represents a Luma value and I, Q represents two chrominance or Chroma values, parallel approximately to the quantity of blue and red color. YIQ color model is proposed to obtain advantage of human being color-response physiognomies. The human eye is more receptive to fluctuations in the orange-blue (I in YIQ color model) range than in the Q (purple-green range in YIQ model) hence small bandwidth is requisite for Q than for I.

The following formula are used to convert the YIQ color space from RGB color space and from RGB color space to YIQ color space.

R, G, B, Y [0, 1], I [-0.5957, 0.5957], Q [-0.5226, 0.5226]

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.595716 & -0.274453 & -0.321263 \\ 0.211456 & -0.522591 & 0.311135 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Figure 4 (a) : RGB to YIQ

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & 0.9563 & 0.6210 \\ 1 & -0.2721 & -0.6474 \\ 1 & -1.1070 & 1.7046 \end{bmatrix} \begin{bmatrix} Y \\ I \\ Q \end{bmatrix}$$

Figure 4(b) : YIQ to RGB

E. YCbCr Color Model

YCbCr or Y′CbCr, color model is in-group of color spaces used as a portion of the color image pipeline in digital photography and video systems. Y′ represents luma component, CB represents blue difference and CR red-difference chroma components. The following equation can be used to convert 8 bit RGB data in a range of 16-235 and YCbCr :-

RGB to YCbCr Conversion

Y = 0.299R + 0.587G + 0.114B…………(1)

Cb = -0.172R – 0.339G + 0.511B + 128…(2)

Cr = 0.511R – 0.428G – 0.083B + 128…..(3)

YCbCr to RGB Conversion

R = Y + 1.371(Cr - 128)……………………(5)

G = Y – 0.698(Cr - 128) – 0.336(Cb – 128)..(6)

B = Y + 1.732(Cb - 128)………………….. (7)

III. PROPOSED ALGORITHM

Step1. Load a speckle noised Image as RGB input image.
Step2. Store it into an image matrix variable called NI.
Step3. Convert NI (RGB image) into YCbCr image and store into a variable called YCBR.
Step4. Differentiate Y, Cb and Cr component from YCBR and store in Y, Cb and Cr variable respectively.
Step5. Filter Cr component using average filter and store output in a variable called Crf.
Step6. Concatenate the component Y,Cb and Crf and store output in YCbCrF variable.
Step7. Convert YCbCrF into RGB image and store in a variable NIF.
Step8. Calculate PSNR of NIF with NI.
Step9. Print PSNR.
Step10. Exit.

IV. MATLAB SIMULATION

Figure 5 (a) to (d) ball.jpg

Figure 5(a):RGB corrected

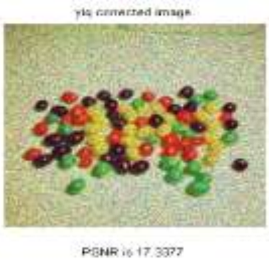

Figure 5 (b): YIQ corrected

Figure 5(c): YCbCr corrected

Figure 5(d): HSV corrected

Figure 6 (a) to (d) house.tiff

Figure 6(a): RGB corrected

Figure 6 (b): YIQ corrected

Figure 6(c): YCbCr corrected

Figure 6 (d): HSV corrected

Figure 7 (a) to (d) lake.tiff

Figure 7(a): RGB corrected

Figure 7 (b): YIQ corrected

Figure 7 (c): YCbCr corrected

Figure 7(d): HSV corrected

Figure 8(a) to (d) lena.tiff

Figure 8(a): RGB corrected

Figure 8 (b): YIQ corrected

Figure 8 (c): YCbCr corrected

Figure 8 (d): HSV corrected

V. RESULTS

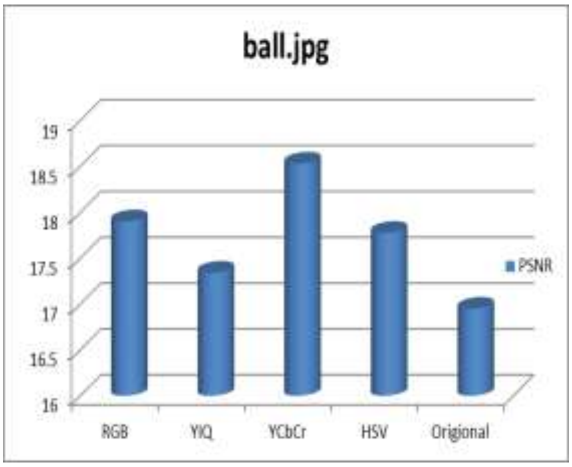

Figure 9: Experimental Result of ball.jpg image

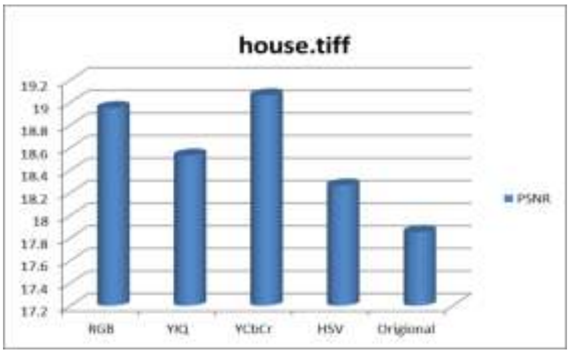

Figure 10: Experimental Result of house.tiff image

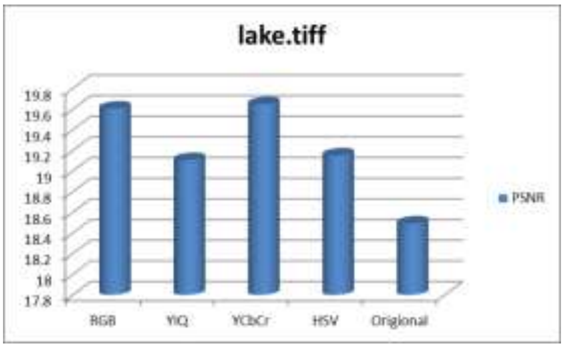

Figure 11: Experimental Result of lake.tiff image

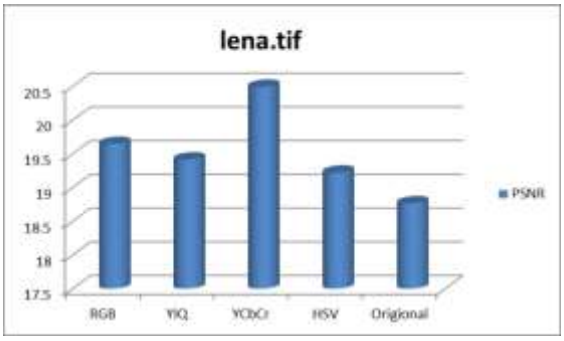

Figure 12: Experimental Result of lena.tif image

VI. CONCLUSIONS

After compiling of the result stored in the following table, we conclude that for visually enhancement of an image, and for removing the noise from a noised image if we convert the image into RGB color space to YCbCr color space than applying the appropriate filter we can the better result instead of directly applying the filter on RGB image.

After analysis and after comparing the following color spaces i.e. RGB, YIQ, YCbCr and HSV we can say For some images like house and lena YIQ color space gives better result than HSV and for some images like ball and lake HSV color space gives the better result than YIQ color space but in all the cases taken in this paper YCbCr color space gives better results.

Color Space-> Image Name	**RGB**	**YIQ**	**YCbCr**	**HSV**	**Original**
ball.jpg	**17.9005**	**17.3411**	**18.5298**	**17.7748**	**16.9485**
house.tiff	**18.9522**	**18.5319**	**19.0651**	**18.2667**	**17.8537**
lake.tiff	**19.6041**	**19.1058**	**19.6467**	**19.151**	**18.4922**
lena.tif	**19.6468**	**19.4158**	**20.4944**	**19.2219**	**18.767**

Table 1: Experiment Result

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