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TRANSFER COLOR FROM COLOR IMAGE TO GRAYSCALE IMAGE

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ABSTRACT

While there exist various techniques that can be used in coloring a grayscale image , in this paper we present new methods of colorization of grayscale image by transfer color between source color image to target grayscale image , generally colorizing grayscale image involves color space ,source color image and target greyscale image , here in this method we trying to minimize the human efforts needed in manually coloring the grayscale image , the human interaction is needed only to select a source color image , then the job of transfer color traits from source color image to grayscale image is done automatically by the proposed method.

Here the method of colors transfer to grayscale image has been performed by using two different color spaces together in the coloring process, these color space are YCbCr and HSV color spaces along with different pixel window size start from (2 x 2), (3 x 3) up to (10 x 10).

The proposed methods implemented in two file format types (JPEG and PNG) and on different types of imagesuch us (animals, Flower, plants).

KeyWords: *Color space, grayscale image, Pixel*

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1. INTRODUCTION

The colorization of grayscale images is a valuable tool for many applications such as “colorizing” black and white films or restoring old photographs. Color can be added to grayscale images in order to increase the visual appeal of images such as old black and white photos, classic movies or scientific illustrations [9].

The task of “colorizing” a grayscale image involves assigning three dimensional (RGB) pixel values to an image which varies along only one dimension (luminance or intensity). Since different colors may have the same luminance value but vary in hue or saturation, the problem of colorizing grayscale images has no inherently “correct” solution, [8] converting a color image to gray means that dropping information about color and it is quite easy to convert color image to grayscale but its reverse is not that easy, it look like that we can reverse the process of converting a color image to gray to get colors back, but it's not that true. Reason for this is that there can be numerous colors which lead to one gray level but when we go reverse of it, we cannot decide which color corresponds to this one particular gray level which we try to convert to color [10].

Our proposed colorization method require selection of source color image whose chromatic information is transferred to target grayscale image , unfortunately empirical evidence suggests that the degree of similarity between source and target image has a strong influence on the quality of the result obtain . thus the obtaining of reasonable coloring result is depend on the selection of an appropriate color source image for each give grayscale image[11].

Introduction

2. COLOR SPACE

2.1 RGB color space (Standard)

The RGB model is represented by a 3-dimensional cube with red green and blue at the corners on each axis (Figure 1). Black is at the origin. White is at the opposite endof the cube. The gray scale follows the line from black to white. In a 24-bit colorgraphics system with 8 bits per color channel, red is (255,0,0). On the color cube, it is(1,0,0)[1].

The RGB model simplifies the design of computer graphics systems but it is not ideal for all applications that red, green, and blue color components are highly correlated. This makes it difficult to execute some image processing algorithms. Many processing techniques, such as histogram equalization, work on the intensity component of an image only. These processes are easier implemented using the HIS or YIQ color models [2].

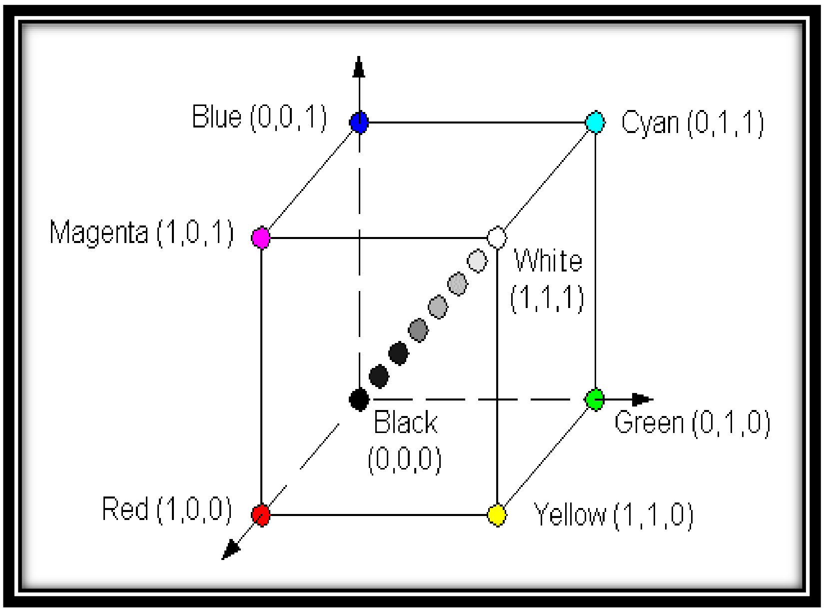

Figure (1) RGB color cube[7]

2.2 YCbCr COLOR SPACE

YCbCr or sometimes written as Y′CbCr is a family of color spaces used as a part of the color image pipeline in video and digital photography systems. Y′ is the luma component and Cb and Cr are the blue-difference and red-difference Chromacomponents [5]. In the YCbCr color space, luminance information is stored as a single component (Y), andchrominance information is stored as two color differencecomponents (Cb and Cr). Cb represents the difference between the blue component and a reference value. Cr represents the difference between the red component and a reference value. [3]

To convert from RGB to YCbCr

$$Y= 0.299*R + 0.587*G + 0.144*B \quad \text{---------------} \ (1)$$

$$Cb=128 – 0.169*R -0.331*G + 0.500*B \ \text{----------} \ (2)$$

$$Cr= 128 + 0.500*R – 0.419*G – 0.081*B\text{---------} \ (3)$$

Where:

R, G, B:Red, Green and blue Channels

Y, Cb, Cr: Channels of YCbCr color space

The inverse transform equations are

$$R= Y + (Cb-128) + (Cr-128) \quad \text{----------------------------}(4)$$

$$G= Y-0.343*(Cb-128) – 0.711*(Cr-128) \ \text{--------------}(5)$$

$$B= Y + 1.765*(Cr-128) \quad \text{--------------------------------}(6)$$

2.3 HSV COLOR SPACE

HSV is stands for (Hue, Saturation Value/Brightness). This color spaceis three dimensions put together gives a volume shaped like a cone, Figure (2) illustrate the cone shape of the HSV color space, this color space has the following characteristic [1]

a. The *hue* (H) of a color refers to which pure color it resembles. All tints, tones and shades of red have the same hue [4].
b. The saturation (S) of a color describes how white the color is. A pure red is fully saturated, with a saturation of 1; tints of red have saturations less than 1; and white has a saturation of 0 [4].
c. The value (V) of a color, also called its lightness, describes how dark the color is. A value of 0 is black, with increasing lightness moving away from black [4].

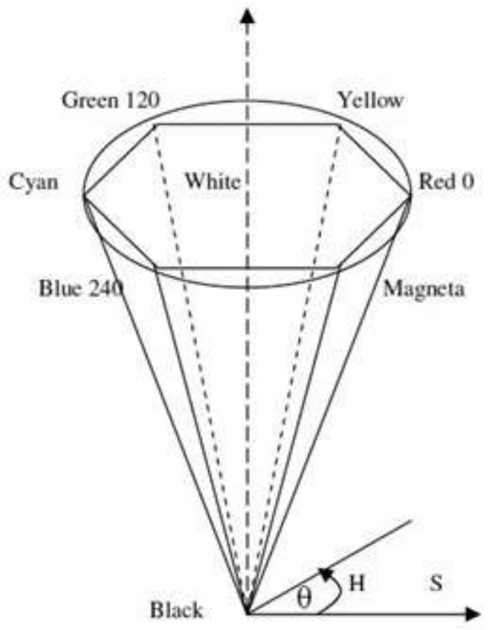

Figure (2) HSC color space [1]

3. PROPOSED METHOD

The following step describe the proposed coloring methods

A. Select color source image that has similar features to target grayscale image.
B. Convert both color source image and target grayscale image from RGB color space to both YCbCr and HSV color space.
C. Divide both the channels of YCbCr and HSV color space for both source and target image in to pixels windows size (M x N).
D. Calculate the Euclidian distance from Y-channel between the first pixel window form target grayscale image with all pixel windows from Y-channel of source color image separately.
E. The best matching pixel window from source color image to the first pixel window of target grayscale image that how has the smallest Euclidian distance.
F. Transfer the (H) and (S) channels from the best matching pixels window (source color image) to the first pixel window of target grayscale image and keep the (V) channel of target grayscale image unchanged.
G. Repeat step D,E, F above for all pixels windows of target grayscale image.
H. Transfer the result image from HSV color space to RGB color space.

4. QUALTY OF RESULT COLOR IMAGE

As the process of coloring grayscale image is very subjective to the target image and source color image the objective criteria to measure the quality of colored target image cannot be considered. At the most we can convert some color image into grayscale image and then recolor it using source color image how features is similar to features of the targetgrayscale image . Then calculate the Mean Squared Error (MSE) and peak signal to noise ratio (PSNR)between the result imageand original image could be considered to compare the result image according to pixel window size to find the best pixel window size give better result.

5. RESULT AND DISCUSSION

Quality of grayscale image colorization method is depends to the source color image selected for coloring and also to the grayscale image to be colored ,So to compare the proposed colorization method here 4 color test images as shown in Figure (3,4,5,6) are recolored by using 9pixel window size start from (2 x 2) up to (10 x 10) with recording of mean square error (MSE) and peak signal to noise ratio (PSNR) for each result color image according to pixels window size.

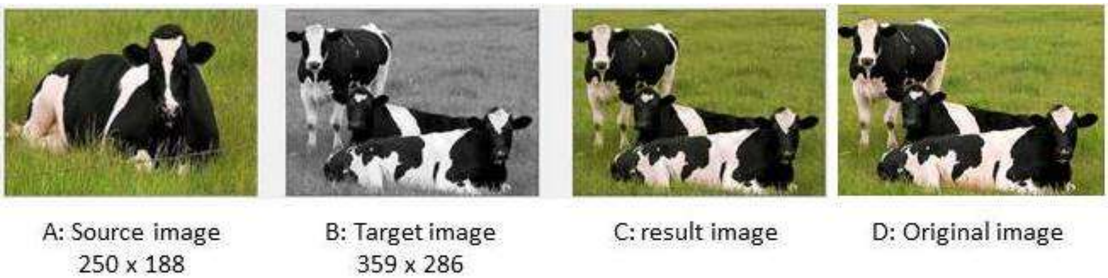

Figure (3):-coloring test image #1 (cow image)

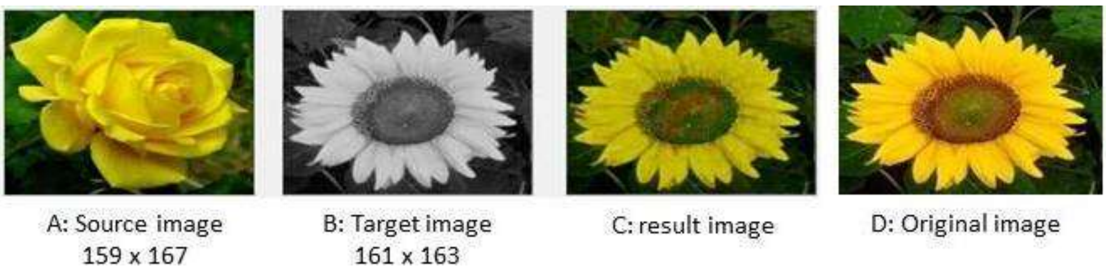

Figure (4):-Coloring test image #2 (flower image)

Figure (5):- Coloring test image #3 (plant image)

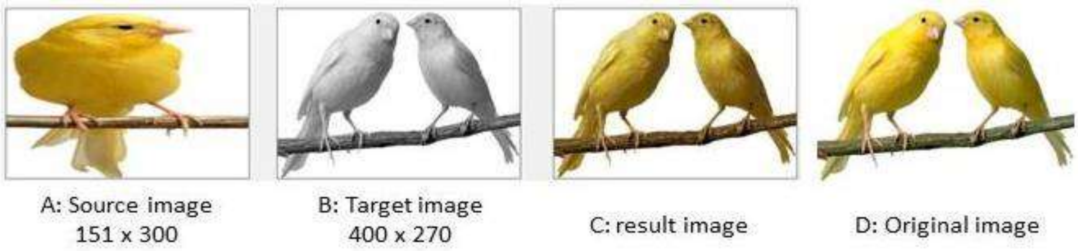

Figure (6):- Coloring test image #4 (bird image)

Below table (1) contain the recode of the mean square error (MSE) and peak signal to noise ratio (PSNR) for the entire above test image for pixel window size from (2 x 2) to (10 x 10).

Table (1) MSE and PSNR record for all test image

	Image #1		Image #2		Image #3		Image #4	
M x N	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR
2 x 2	228.757	24.537	965.151	18.284	269.767	23.82	486.434	21.26
3 x 3	213.902	24.828	950.88	18.349	263.328	23.925	486.139	21.263
4 x 4	211.731	24.872	945.33	18.374	265.649	23.887	502.165	21.122
5 x 5	222.194	24.663	953.119	18.339	251.228	24.13	524.202	20.935
6 x 6	233.96	24.439	948.325	18.361	258.445	24.007	525.076	20.928
7 x 7	237.407	24.375	966.12	18.28	250.882	24.136	561.226	20.639
8 x 8	264.49	23.906	987.26	18.186	248.913	24.17	609.406	20.281
9 x 9	253.908	24.084	1004.603	18.11	252.032	24.116	636.44	20.093
10 x 10	304.51	23.294	982.054	18.209	246.059	24.22	678.484	19.815

As show in the record of image#1 in table (1) the pixel window how give us the best coloring result is the one how has the lowest (MSE) value that is (4 x 4) and Alternatively, with the peak signal to noise ratio(PSNR) metrics a large number implies a better image , figure (7) show the MSE chart for the test images

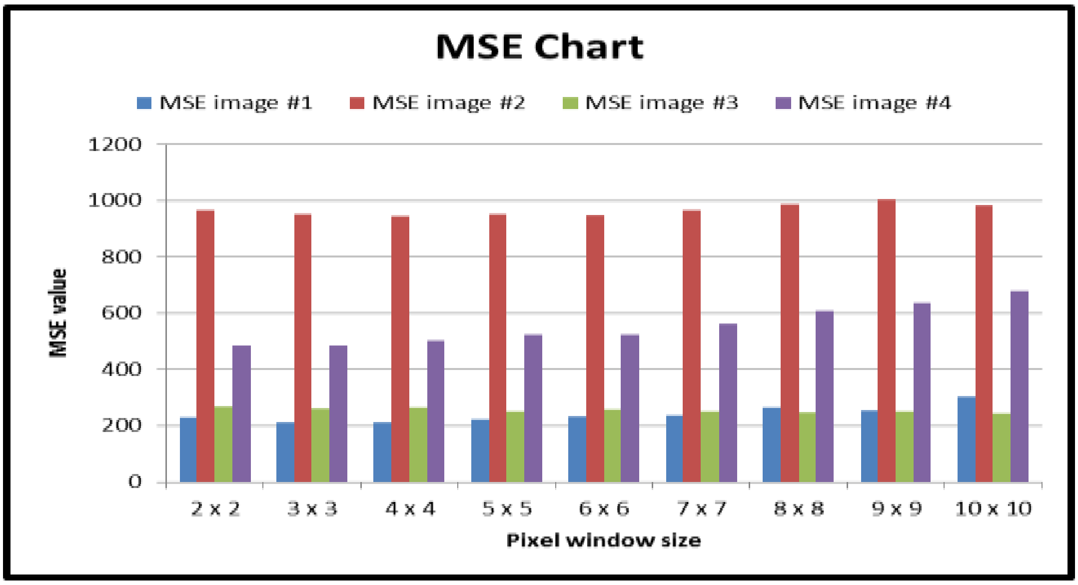

Figure (7):- The MSE chart for the test images

As for test image #2 the best coloring result occur on pixel window size (4 x 4), for test image #3 the best pixel window is (10 x 10) and for test image #4 the best coloring pixel window size is (3x 3), generally the best coloring pixel window depend on the feature of both source color image and target grayscale image , figure (8) show the PSNR for the all test images.

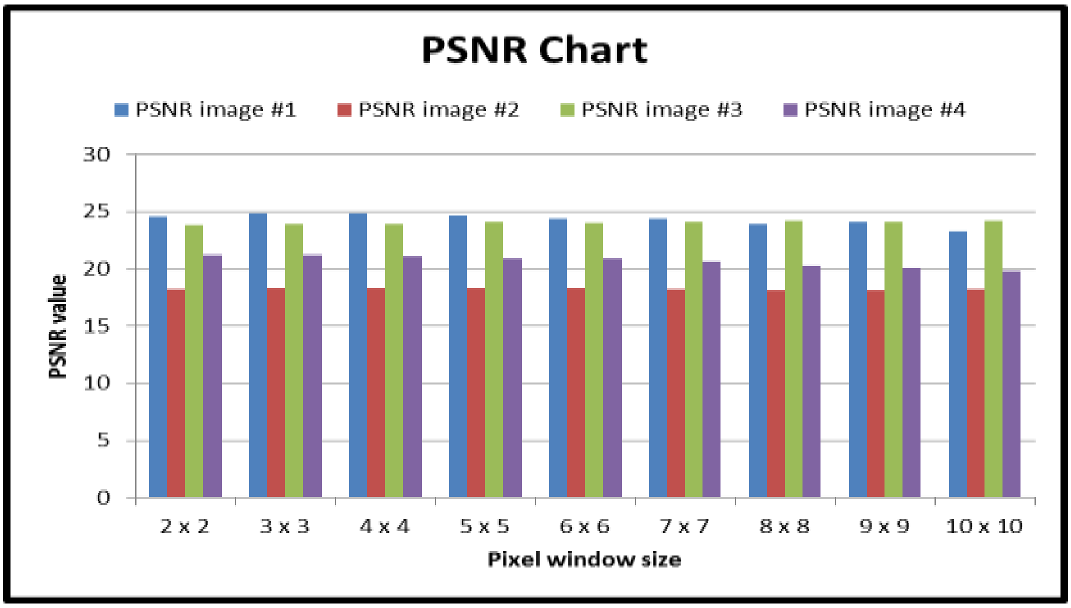

Figure (8):- PSNR chart for the all test images

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