Creating a Color Map to be used to Convert a Gray Image to Color Image

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ABSTRACT
We introduce a simple and efficient method for coloring the gray-scale images into the color images with the existing color map or with creating a new one. The general problem of adding chromatic values to a gray-scale image has no exact solution, the current approach attempts to provide a method to minimize the amount of human labor required for this task, rather than choosing RGB colors to individual components, we convert the entire gray-scale image to color by creating a color map then the color map is to be used to color the gray scale image.

We show that this simple method can be successfully applied to a variety of gray scale images and it can be applicable in deferent applications.

Keywords
Gray scale image, RGB image, colormap, lockup table, interpolation.

1. INTRODUCTION
A gray scale image is a scale of shades from black to white used in digital image technology, such as facsimile machines. Grayscale is a variation on the theme of black and white. Grayscale measures the intensity of the light reflected from an area (dot) of a plane surface and defines each pixel (picture element) as a byte, generally of eight bits, which yields 2 8, or 256, shades of gray. Gray scale images are stored as an m-by-n data array that defines the intensity for each individual pixel.

An RGB image, sometimes referred to as a true color image, is stored as an m-by-n-by-3 data array that defines red, green, and blue color components for each individual pixel. RGB images do not use a palette. The color of each pixel is determined by the combination of the red, green, and blue intensities stored in each color plane at the pixel's location [2], [3].

Color mapping is a function that maps (transforms) the colors of one (source) image to the colors of another (target) image. A color mapping may be referred to as the algorithm that results in the mapping function or the algorithm that transforms the image colors. A lookup table specifying the colors to be used in rendering a palletized image.

A colormap is an m-by-3 matrix of real numbers between 0.0 and 1.0. Each row is an RGB vector that defines one color. The kith row of the colormap defines the kith color, where $map(k,:) =[r(k)\ g(k)\ b(k)])$ specifies the intensity of red, green, and blue.

2. RELATED WORKS
Mrs. Karthikeyani, Dr.K.Duraiswamy, and Mr.P.Kamalakkannan in [4] proposed a technique that works well on scenes where the image is divided into distinct luminance clusters or where each of the regions has distinct textures. It was shown that the algorithm works well in a number of image domains, and it was shown that the running time of the algorithm for one image can range from 15 seconds to 4 minutes, this technique as mentioned in [4] was not a technique that will work on most images. Studies on converting gray scale images to color ones showed not too much progress comparing with image processing, as in Mahmud used Pseudo Coloring technique to color medical images and completely restricted, which the same topic can be found at and See also[5] [6] [7] . In another report Haldankar and colleagues had provided the benefit of a color image as a sample image, created a mapping of color image to black and white image and then they use the appropriate mapping to color gray levels of black and white image, the results of this technique had Further improvement than had[8]. In another technique that Cheng and colleagues had expressed the operation of image histogram and definition of an overlap to select different intensity of light in different levels of color image, is basic idea, although this technique is not entitled of good quality in images details and in some situations of image color contrast is developed but is still acceptable and desirable in images with not a lot of details, in Xiang and colleagues for coloring industrial images are acting, of course that the images are divided into smaller pieces thus the obtained results[9] [10]. In another technique that Rujuta R Mahambare, introduce a general technique for "colorizing" grayscale images by transferring color from the colored reference image to the black and white grayscale image. This technique helps in minimizing the amount of human labor required for this task. They transfer the entire color "mood" of the source to the target image by matching luminance and texture information between their image[11].

Technique suggested by Ingmar Lissner, Jens Preiss emphasis on placed on using color information to improve the assessment of gamut-mapped images. Our best image-difference measure shows significantly higher prediction accuracy on a gamut-mapping dataset than all other evaluated measures. The objective is to have a converter, which will be useful for number of applications with a basic function of

converting from one color space to another and the inverse on same architecture. This paper presents an efficient parallel implementation for two color space converters [12] [13] [14]. G.Sapiro, present an approach for adding color to a monochrome image or movie, based on considering the geometry and structure of the monochrome luminance input, given by its gradient information, as representing the geometry and structure of the whole colored version[15] . D. Sỳkorả, J. Buriǎnek, and J. Žǎra, present a novel color-by example technique that combines image segmentation, patch-based sampling and probabilistic reasoning .This method is able to automatic colorization when new color information is applied on the already designed black and –white cartoon. In this case, the background is usually a static image and only the dynamic foreground needs to be colored frame by frame. They also assume that objects in the foreground layer consist of several well visible outlines, which will emphasize the shape of homogeneous regions. They state the problem as having two segmented frames. First frame serves as a color example where each region has one color index assigned from the user-defined palette. The second frame contains unlabelled target regions. The colorization task, then, is to assign color indices to target regions similarly to as they are assigned in the example frame [16].

3. PROPOSED METHOD

Sometimes grayscale and color images have a color maps, and if they do have it is easy to convert the colored colormap to gray colormap using a built-in function available in matlab as illustrated in the following matlab example, the implementation results of this code are shown in figures 1 and 2.

[X,map] = imread('trees.tif');

gmap = rgb2gray(map);

figure, imshow(X,map), figure, imshow(X,gmap);
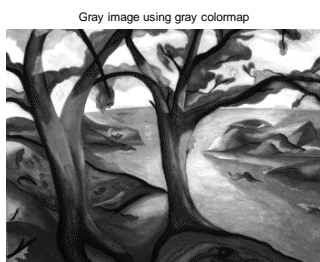
figure; imshow(X,gmap); colormap(map);TYPESET TEXT

Gray image using gray colormap

Figure 1: Gray image using gray colormap
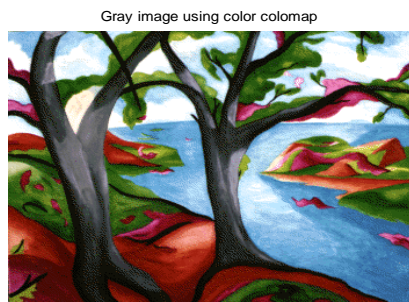
Gray image using color colomap

Figure 2: The same gray image using color colormap

The proposed method can be implemented applying the following steps:

1. Get the gray image and the colormap.

2. If the colormap is empty then apply the next steps else exit

3. Create an empty 256x3 lockup matrix(colormap).

4. Referring to the gray image and studying it's features define the gray level ranges, and for each range define the corresponding color by setting R, G, And B to a certain color.

5. From step 4 create a matrix with the R, G, and B values.

6. From step 4 create a rang vector.

7. Use interpolation of the matrix values and rang vector to create a color color- map .

8. Use the obtained colormap with the gray image to get the color one.

Here we can illustrate a work example:

• Here we use the gray image pout,tif.

• The color map of this image is empty so proceed to the next step.

• Create map1 as an empty 256X3 matrix.

• Define the ranges and the color for each range as show in table 1:

Table 1: Example of forming the gray level ranges

Gray level range	Red value	Green value	Blue value	Remarks
0 to 49	0	0	0	Dark
50 to 119	101	67	33	Brown
120 to 159	255	105	180	Pink
160 to 255	255	255	255	White

• From table 1 create a matrix with color values, the matrix must be divided by 255 to get the results with the range 0 to 1. For the above example the matrix will be as follows:

```
T = [0,    0,    0          %// dark
     101, 67,   33          %// brown
     255, 105, 180          %// pink
     255, 255, 255          %// white
     255, 255, 255]./255;   %// white again]
```

- Create the range vector as follows:

```
x = [0
     50
     120
     160
     255];
```

- Interpolate the matrix and the vector ot get the colormap.
- The above example was implemented using the following matlab code:

```
%from 255 to 160 -> white
%from 159 to 120 -> pink
%from 119 to 50 -> brown
%from 49 to 0 -> dark
clc
close all
clear all
tic
[a,map]=imread('pout.tif');
if(isempty(map)) % image is RGB or grayscale
m = 256;
map1 = zeros(m , 3);

T = [0,    0,    0        %// dark
     101, 67,   33        %// brown
     255, 105, 180        %// pink
     255, 255, 255        %// white
     255, 255, 255]./255; %// white again]
 x = [0
      50
      120
      160
      255];
 map1 = interp1(x/255,T,linspace(0,1,255));
z1=imread('pout.tif');imshow(z1)
z2=histeq(z1);
figure, imshow(z2,map1)
else
    imshow(a,map)
end
toc
```

The results of implementation are shown in figures 3, 4 , and 5:

Figure 3: Original gray image

Figure 4:Coloring the gray image

```
Elapsed time is 0.310000 seconds.
>> whos
  Name       Size                 Bytes  Class

  T          5x3                    120  double array
  a          291x240              69840  uint8 array
  m          1x1                      8  double array
  map        0x0                      0  double array
  map1       255x3                 6120  double array
  x          5x1                     40  double array
  z1         291x240              69840  uint8 array
  z2         291x240              69840  uint8 array

Grand total is 210306 elements using 215808 bytes
```

Figure 5: Memory usage and processing time

The proposed method was implemented several times and after analyzing the experimental results we have to focus on the following:

- The proposed method is very simple and it can be easily implemented.
- The processing time of the proposed method is ranges from 0.3 s to 0.5 s for various gray images which is faster than the proposed in [4].
- It is very easy to create the color matrix and the range vector by simply analyzing the original gray image.
- The color matrix and the rang vector are flexible and it is vary easy to change them and reuse them again.

4. CONCLUSIONS

A method of getting the color image equivalent to a given source gray image was proposed, tested and implemented.

It was shown that the proposed method is vary effective, simple and flexible.

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