Reconstructed Color Image Segmentation

Akram A. Moustafa and Ziad A. Alqadi

Abstract: **This paper discusses a new color model for digital image, which can be used to separate low, and high frequencies in the image without loosing any information from the image [12]. The proposed model was used as an initial step to image segmentation and the practical results shows the efficiency of using this method to get the actual objects of the color image. The proposed model can be used in different application such as separating low and high frequencies from the image, which are proposed in [10], and it also can be used to segment different types of color images.**

***Index term*:** Digital image processing (DIP), RGB, HSI, Direct transform, inverse transform, color model, object, segmentation.

I. INTRODUCTION

Color models: digital image, or bitmap, is a structure representing a rectangular grid of pixels, or points of colors, on a computer monitor. The color of each pixel defined in the RGB color space where each pixel defined by three bytes - one byte each for red, green and blue.

Digital image processing methods include various operations such as:

- Tone processing: brightening, lightening, contrast stretching.

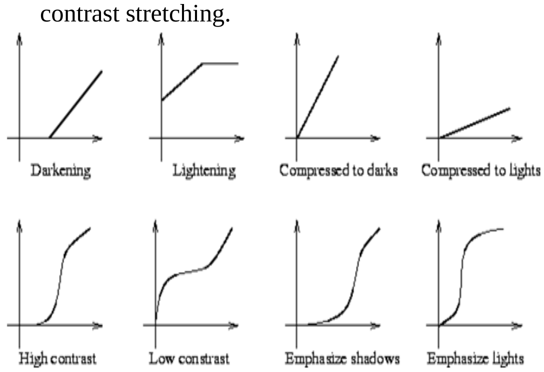

Figure 1: Tone processing

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- Image enhancement in spatial domain (histogram processing, gamma correction, image filtration in spatial domain and other methods).

Color models provide a standard way to specify a particular color, by defining a 3D coordinate system, and a subspace that contains all constructible colors within a particular model. Any color that can be specified using a model will correspond to a single point within the subspace it defines. Each color model is oriented towards either specific hardware (RGB, CMY, YIQ), or image processing applications (HSI) [1-3].

1.1 The RGB Model

In the RGB model, an image consists of three independent image planes, one in each of the primary colors: red, green and blue. Specifying particular colors is by specifying the amount of each of the primary components present. Figure 1 shows the geometry of the RGB color model for specifying colors using a Cartesian coordinate system. The grayscale spectrum, i.e. those colors made from equal amounts of each primary, lies on the line joining the black and white vertices. [4-6].

The grayscale spectrum lies on the line joining the black and white vertices.
This is an *additive* model, i.e. the colors present in the light add to form new colors, and is appropriate for the mixing of colored light for example.
The RGB model is used for color monitors and most video cameras.

1.2 The HSI Model

As mentioned above, color may be specified by the three quantities hue, saturation and intensity.
The HSI model showing the HSI solid on the left, and the HSI triangle on the right, formed by taking a horizontal slice through the HSI solid at a particular intensity. Hue is measured from red, and saturation is given by distance from the axis. Colors on the surface of the solid are fully saturated, i.e. pure colors, and the grayscale spectrum is on the axis of the solid. For these colors, hue is undefined.
Conversion between the RGB model and the HSI model is quite complicated. The intensity is given by
Where the quantities R, G and B are the amounts of the red, green and blue components, normalized to the range [0,1]. The intensity is therefore just the average of the red, green and blue components. The saturation is given by [5-9]:
Where the min(R,G,B) term is really just indicating the amount of white present. If any of R, G or B is zero, there is no white and we have a pure color. [1].

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All methods of DIP described above can be applied directly only in gray scale images (color range [0… 255]).

II. SEGMENTATION

Image segmentation is a low-level image processing task that aims at partitioning an image into Homogeneous regions [13-15]. How region homogeneity is defined depends on the application. A great number of segmentation methods are available in the literature to segment images according to various criteria such as for example grey level, color, or texture. This task is hard and as we know very important, since the output of an image segmentation algorithm can be fed as input to higher-level processing tasks, such as model-based object recognition systems. Recently, Segmentation of a color image composed of different kinds of texture regions can be a hard problem, namely to compute for an exact texture fields and a decision of the optimum number of segmentation areas in an image when it contains similar and/or non-stationary texture fields. In this work, a method is described for evolving adaptive procedures for these problems. In many real world applications data clustering constitutes a fundamental issue whenever behavioral or feature domains can be mapped into topological domains. We formulate the segmentation problem upon such images as an optimization problem and adopt evolutionary strategy of Genetic Algorithms for the clustering of small regions in color feature space. The present approach uses k-Means unsupervised clustering methods into Genetic Algorithms, namely for guiding this last Evolutionary Algorithm in his search for finding the optimal or sub-optimal data partition, task that as we know, requires a non-trivial search because of its NP-complete nature. To solve this task, the appropriate genetic coding is also discussed, since this is a key aspect in the implementation. Our purpose is to demonstrate the efficiency of Genetic Algorithms to automatic and unsupervised texture segmentation. Some examples in Color Maps are presented and overall results discussed.

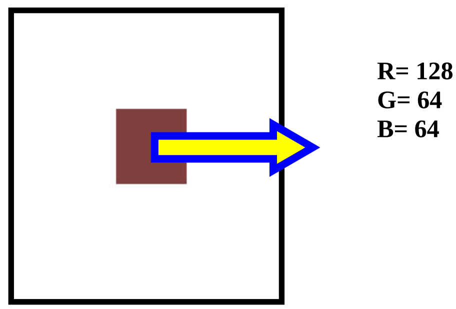
In the analysis of the objects in images it is essential that we can distinguish between the objects of interest and "the rest." This latter group is also referred to as the background. The techniques that are used to find the objects of interest are usually referred to as segmentation techniques - segmenting the foreground from background. In this section we will take the two of the most common techniques--threshold and edge finding-- and we will present techniques for improving the quality of the segmentation result. It is important to understand that:

- There is no universally applicable segmentation technique that will work for all images.
- No segmentation technique is perfect.

III. THE PROPOSED COLOR MODEL FOR DIGITAL IMAGE SEGMENTATION

The proposed color model [12] includes the following Stages of digital image processing:
1- Direct transforms (RGB to R'G'I conversion)
2- Image processing using only the intensity I.
3- Apply the method proposed in [10] to separate low and high frequencies in the black and white image.
4- Inverse transforms:
The proposed model needs (also as other models):

1- Evaluation Example
The following example proves the correctness of the proposed methodology of conversions:
Given the following pixel as shown below



To convert the above colored pixel to gray pixel: (all values are rounded):

$r_d = (r * 256) / (r + g + b)$

$g_d = (g * 256) / (r + g + b)$

$i = (r + g + b) / 3$

To convert the gray pixel to colored pixel: (all values are rounded).

$r1 = (3 * r_d * i) / 256$

$g1 = (3 * g_d * i) / 256$

$b1 = (3 * (256 - r_d - g_d) * i) / 256$

To manipulate the colored images, they must be converted to gray images so as to facilitate the manipulation process since it will be accomplished using one matrix of the image. While, using the colored image in the manipulation process needs to manipulate 3 different matrices of the image which are red, green and blue. Thus, the colored image is converted to gray for fast manipulation process.

By applying the previous rules:
1- Direct conversion:
$r_d = 128$ $g_d = 64$ $i = 85$
2- Inverse Conversion :
$r1 = 128$ $g1 = 64$ $b1 = 65$
Thus we obtain the same pixel values, which mean that the conversions were correct.
To segment the color image we propose the following algorithm which contains the following steps:
- Capture the color image.
- Get the Red, Green, and Blue components of the color image.

- Apply image reconstruction methodology to enhance and reconstruct the gray image.
- Use sobel method to get the edge gradient of the image.
- Perform threshold to get the binary edge maps.
- Retrieve the number of objects within the image and the image objects.

IV. METHODS AND EXPERIMENTAL RESULTS

The proposed model was implemented using matlab. Different color images were used.
Figures [2, 3, 4] show the original image, gray scale image and the segmented image using the proposed model.

Figure 2 show the original image

Figure 3 show the gray scale image

Figure 4 show the segmented image using the proposed model.

The proposed model was implemented using deferent types of color images.
The implementation results were compared with other results obtained by using other existing models.
Table 1 contains the experimental results and shows the enhancements, which can be achieved using the proposed model.

Table 1: Experimental results

Image	Actual number of the objects	Number of objects in unreconstructed image	Number of objects in reconstructed image
Peppers.png	97	105	97
Blobs.png	16	25	16
Hestain.png	15	26	15

The experimental results show that the effects of using the proposed model.
From the results shown in table1 we can see that part of the image is lost after reconstruction, this part may be noise it is occupied a high percent of the image size. This can be reduced and the numbers of objects are also reduced.

V. CONCLUSIONS

A new color model for digital image segmentation was proposed, the experimental results show the efficiency of using this model comparing with other existing models performing deferent types of image processing operations.
The error factor of the proposed model was computed and it is practically accepted.

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