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Analysis of Cluster based Self Organization Map (SOM) Algorithm in Various Color Spaces Models

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Abstract – Image segmentation means separation process that can divide the original image into smaller area with similar attributes. In this proposed system, input images are taken from the Berkley Image Segmentation Database (BSD) for color image segmentation. Various color space of images such as RGB, HSV and L*A*B* are used for the segmentation process. Due to effect of the color conversion function reduce the input images size is not flexible, Image J software is used to get the same size of images for different color space. The subjective and objective measured is applied to analyze the color images. Then the cluster based self-organization map (SOM) is applied to produce a low-dimensional input space of the training samples. SOM method develops the ratio of color images similarity and spatial relationship of objects within an image. In this system, the features of color similarity in the image is first segmented into cluster regions and the resulting regions are treated by computing the spatial distance between any two cluster regions and then the labeling process is made by SOM.

Keywords – Color Image Segmentation, SOM Algorithm, Image Processing, Color Space Model, ANN.

I. INTRODUCTION

Color image segmentation plays an important role in image processing and it consists of two critical issues. The first one is to define which color model to be used in segmentation process and the second one is defining the segmentation method. In the color space model contain color visualization, color specifying and color creation methods. Various types of color space model such as RGB, HSI, CMY, CMYK, YIQ, CIE L∗a∗b∗,etc., are applied for color segmentation, but none of them can control others kinds of colors images. Image segmentation is the operation of dividing a digital image into multiple segments. Each segment will contain different information to user according to the form of color, intensity or texture.

The aim of image segmentation is to simplify or alter the representation of an image into more relevant and not difficult to analyze. Image segmentation is a useful tool in many real system including industry, health care, astronomy and remote sensing, biomedical imaging, change detection, object detection and recognition. Clustering methods provide with a different view of the image segmentation by using different color spaces with same size of input images. SOM studies each inputs component and then classifies the input into the corresponding class. Most of them, K-Means clustering method is popularized approach that can be applied to solve low-level image segmentation projects. A successful clustering process depends on the many factors such as good similarity selection measure, feature type of an image, evaluation of the segmentation and prior knowledge available. The goal of clustering algorithm is to develop the partitioning decisions based on a user-defined initial set of clusters that is updated. The accuracy of color image segmentation relies on not only on the algorithm but also on the selection of color space model.

K means clustering algorithm includes placing the image pixel to the RGB color space and HSV color space [1]. HSV color space will be more suitable for rough color images in segmentation. In [3], there are three types of clustering methods applied on three different color images .However K-means clustering methods can take various segments depend on the cluster size.

In [4], described different clustering techniques such as K-Means, Fuzzy C-Means and Density Based are compared for their experimental results in segmentation of color

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images. The main goal of K-Means algorithm is to develop the clustering decisions for initial set of clusters defined by users. In Fuzzy C-means (FCM) clustering method permit one pixel includes two or more clusters. Density based image segmentation operate the spatial connectivity and the color similarity simultaneously in the segmentation process. By applying these three techniques, performance measure is executed for different images by calculating their accuracy. Self-Organizing Map (SOM) is an unsupervised artificial neural network technique that is used to produce a low dimensional representation of the input space [5]. SOM consists of two operations, the one is Training and the other is Mapping. Training creates the map from the input and Mapping clusters a new input vector. Self-organizing maps are capable of maintaining spatial information of the image and are therefore preferred whenever preserving the topological features is a priority in this paper. It is show that the proposed K-Means algorithm needs less time to get better segmentation results and there is no need to set any parameters in anymore.

In [6], Qixiang Ye and Wen Gao proposed a method by combining the spatial connectivity and color feature of the pixels. Since each pixel in an image has related spatial location and color value, color image segmentation can be made by grouping of these pixels into different groups of logical spatial connectivity and color. Density based clustering method is applied to find the spatial connectivity of the pixels, the benefit of this method is applied in data mining for finding spatial databases. The ratio of color pixels similarity is made by Munsell (HVC) color space in this system. The effectiveness of this method make sure color change in the segmented regions is better in terms of human perception.

In [2] Dina Khattab described automatic GrabCut technique for various color space in order to execute the different color space by comparing their performance results. Grabcut is considered as one of the semiautomatic image segmentation techniques because Grabcut needs user interaction in preprocessing step of segmentation process.

II. Color Image Segmentation

Clustering is the process of dividing the data points into similar classes or clusters. Therefore, colors in the same group are similar as possible and items in different groups or clusters are as different as possible. Clustering can be considered as data reducing form, that means a large number of data are converted into a small number of constitute data cluster. There are many types of similarity measures can be applied to define classes based on the data and the application. As a kind of unsupervised learning method, clustering is divided to be a hierarchical and partition.

SOM apply competitive learning that varies from other artificial neural networks. This algorithm use neighborhood function to maintain the topological properties of input space that factor cause differ from other error-correction learning. Being a typical partitioned clustering method, K-Means method assign each points to the cluster with the nearest center.

2.1 Color Space Model

Color space moedl is used to define the color ability of a digital device or file in image processing. An RGB color space can be simply interpreted as “all possible colors” which can be made from three colors for red, green and blue. The HSV color space is used when selecting colors for paint or ink because HSV better represents how people relate to colors than does the RGB color space. Selecting an HSV color begins with picking one of the available hues, which adjusting the shade and brightness value.

The aim of L*A*B* color is to estimate nearly human vision. L component closely matches human perception of lightness. It can be made by modifying the balance of color corrections between a and b components in order to do more accurate. Moreover, by altering the lightness contrast using the L component. The system use Image J tools combine with color conversion plugin for color space conversion like that RGB to HSV and RGB to LAB.

This tool designed with an open architecture that provides extensibility via Java plugins. User-written plugins make easier to solve most of the analysis problem or image processing. It supports standard image processing functions such as contrast manipulation, sharpening, smoothing, edge detection and median filtering. It can display, edit, analyze, process, save and print 8-bit, 16-bit and 32-bit images. It can read many image formats including TIFF, GIF, JPEG, PNG, DICOM, BMP, PGM, FITS and so on.

III. Proposed System Architecture

This proposed system is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Self-Organizing Map (SOM) for color clustering which is applies in color image segmentation process. Learning SOM algorithm for training with neural network structure and feature of prototype vector is proposed for color image segmentation. In this experiment, the effectiveness of low clustering methods involving RGB, HSV, L*a*b color spaces for different real color image is obtained.

In the Self-Organizing Maps (SOM) algorithm, competitive learning are used as special classes of artificial neural networks. SOM is applied when the class memberships of input data is not known. Due the effect of unsupervised learning, the system require small amount of features of input data and there is no human intervention is needed during the learning. To activate or fire, the output neurons of the network play among themselves in competitive learning. Therefore, the results shows with only one output neuron, or one neuron per group, are on at any one time.

The winning neuron is defined after the competitive is winning. Spatial neighborhood location is defined by this

winner neuron. The neighboring node of the winning neuron reduce the value of their individual discriminates is called the excited neurons. These neurons make suitable adjustments associated with the connection weights through input pattern. SOM learning processes give the result with smallest learning progress for the weight adjustment. Only the weight vectors of winner and its neighbor units are update.

3.1. SOM Learning Algorithm Steps

The following steps are running in SOM learning algorithm.

Step 1: Randomly position weight vector in the data space.

Step 2: Choose one data point, either randomly rotates the dataset in sequence

Step 3: Search the neuron that is nearest to the selected data point. This neuron is called the Best Matching Unit (BMU).

Step 4: Place the BMU near to that data point. Learning rate determined the distance placed by the BMU, which distance decreases after each iteration.

Step 5: Move the BMU's neighbors closer to that data point as well, with farther away neighbors moving less. Neighbors are defined using a radius around the BMU, and the value for this radius decreases after each iteration.

Step 6: Update the learning rate and BMU radius, before repeating Steps 2 to 5. Iterate these steps unit position of neurons have been stabilized.

IV. EXPERIMENTAL RESULTS

Making analysis for this system uses images from the Berkeley Segmentation Dataset (BSDS). There are 3 test images with RGB color space, which are shown as below in Figure 1.

Figure 1. Original image of test images

There are 3 test images with HSB color space, which are shown as below in Figure 2.

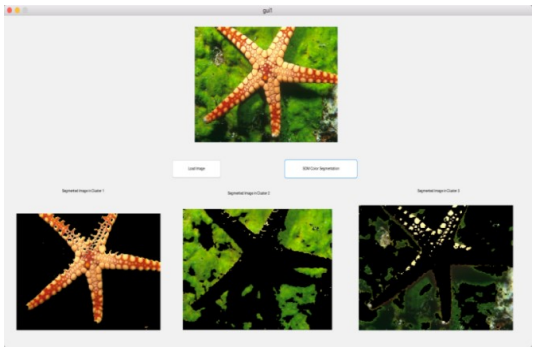
Figure 2. Test images with HSB color space

There are 3 test images with LAB color space, which are shown as below in Figure 3.

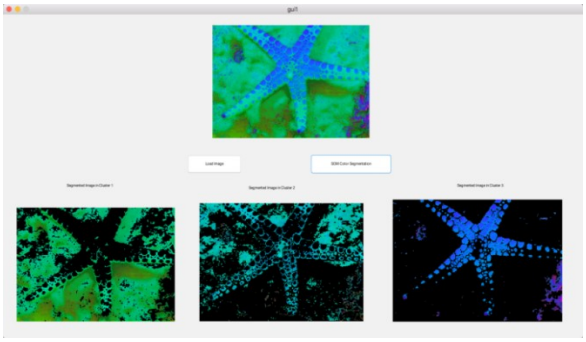
Figure 3. Test images with LAB color space

In this proposed system three type of input data images are used for implementation process. The same size of input image is used as 481 × 321and the number of cluster is 3.

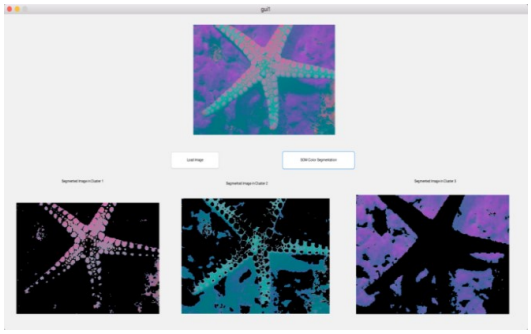
In figure 4 shows the experimental result for 101.jpg of RGB, HSV and LAB images with SOM algorithm. In figure 5 shows the result for 102. Jpg of RGB, HSV and LAB color image with SOM algorithm. And then figure 6 show the result for 103.jpg image as RGB, HSV and LAB color image with SOM algorithm. The comparative result of these is shown in figure 7.



101.RGB Image Result



101 HSV Image Result



101LAB Image Result

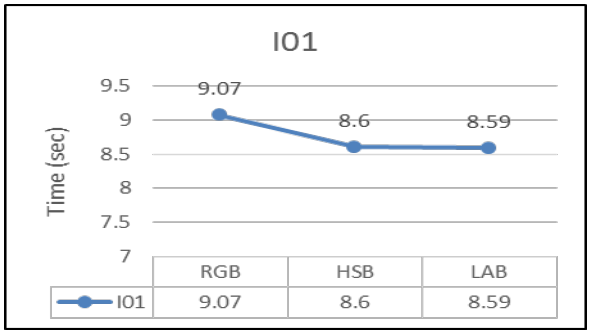
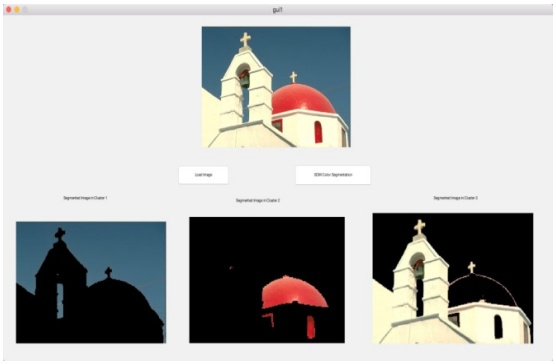
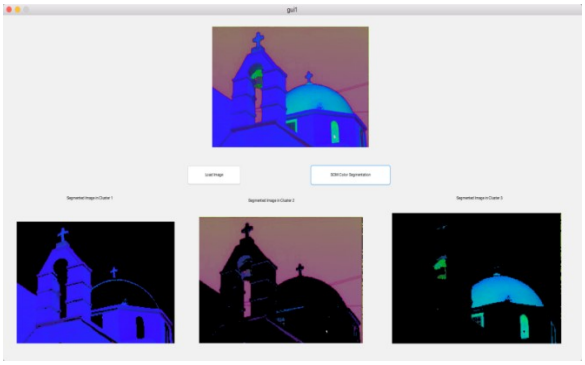


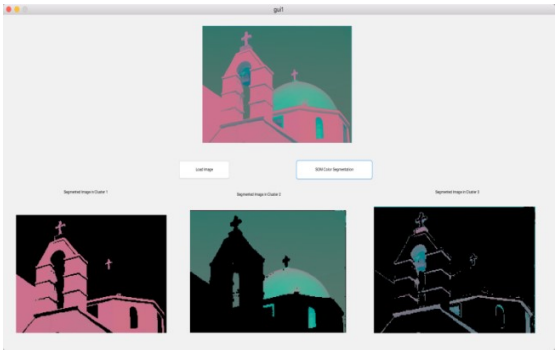
Figure 4. Experimental result for 101.jpg images with SOM algorithm



102 RGB Image Result



102 HSV Image Result



102 LAB Image Result

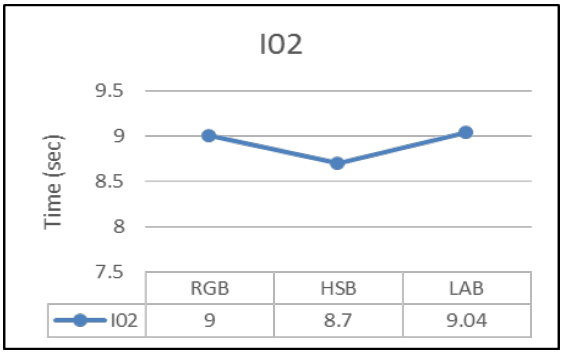
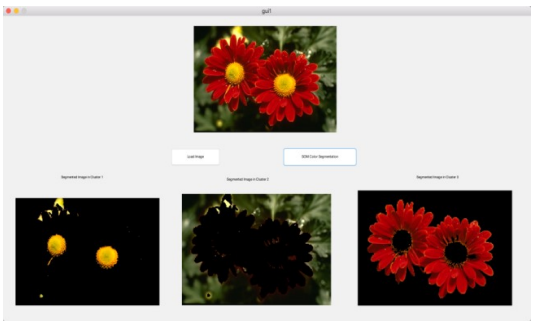
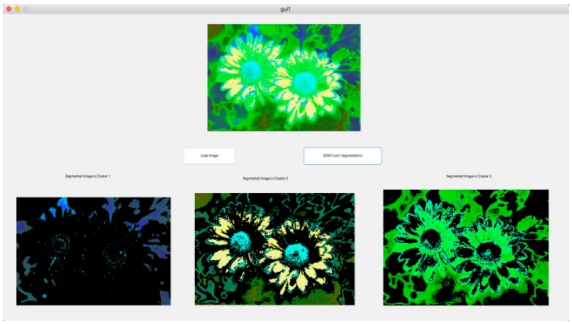


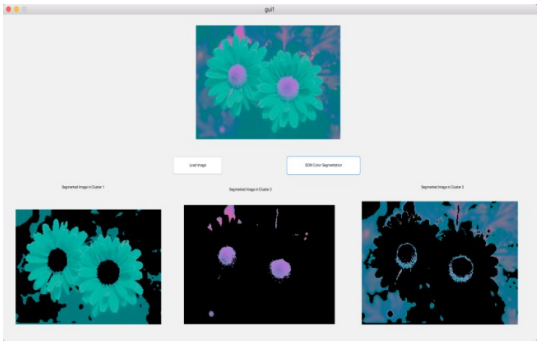
Figure 5. Experimental result for 102.jpg images with SOM algorithm



103 RGB Image Result



103 HSV Image Result



103 LAB Result Image

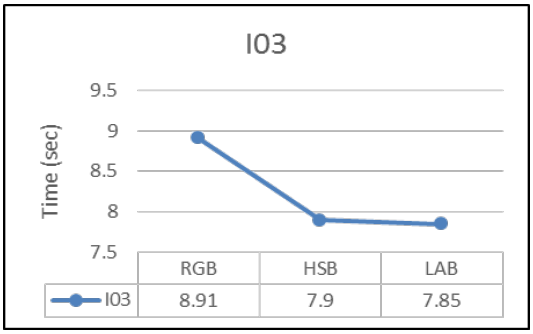


Figure 6. Experimental result for 103.jpg images with SOM algorithm

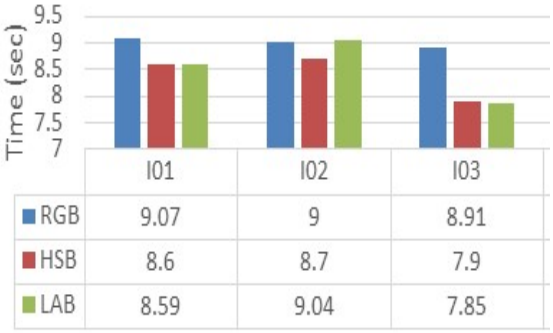


Figure 7. Compare results for various images

In this proposed system, the same number of iteration and same size is applied for the result of image segmentation and time for this process is same for all three color spaces. The results of segmented object regions are the same as human vision in the evaluation process. Therefore the proposed system is feasible for color image segmentation. This system gives three clusters as feasible solution which may be useful in image retrieval. The number of iteration of SOM algorithm also affects the outcome and processing time of the neural network. In this experiment the number of iteration in SOM is assigned to 90 and that can give better clustering result.

V. CONCLUSIONS

Color image segmentation separates the corresponding image into similar color and hence gives meaningful output of objects in the image. A self-organizing map (SOM) organized with a network of neurons and these neurons modify the structure of a dataset by permitting huge amount of datasets and recognize possible clusters. An SOM process the shape of a dataset by moving its neuron near to the selected data points repeatedly. Clear neurons groups may be throwback underlying clusters in the data. SOMs are good for continuous variable datasets and should be checked repeatedly for consistency. The experimental results show

the evaluation of segmentation of color images with three color space model in this system. The segmentation results depend on not only color space bout also using algorithm. The proposed compare the performance of different segmentation techniques for various color space with color images.

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