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Color image segmentation using k-means clustering algorithm

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ABSTRACT : Color image segmentation has been the hotspot for the researchers in the image processing field. Color image segmentation using the neural networks, k-means clustering algorithm has yielded fruitful results. An advantage resulting from the choice of color space representation could be taken to enhance the performance of segmentation processes. The amount of information contained in the segmented objects is adopted as a measure to determine the segmentation rule. The experimental results show that the segmented image results are deemed effective.

Keywords : Color image segmentation, color space, k-means clustering algorithm, neural networks.

I. INTRODUCTION

Colored images have attracted many of the researches for analysis and processing. Much of the progress made in the image processing field in the past years can be attributed to the research on colored images [1]-[7]. Colored images mainly represent the color information of each pixel composing them. Image processing can be said to increase the perception properties of an image, may it be noise removal, enhancement, segmentation, all these features are well attained by the image processing techniques. Image segmentation has been the most important precursors for image processing based applications and has a crucial impact on the overall performance of the developed systems [8]. Image segmentation consists of dividing the input image into several regions having similar pixel properties within a single region. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is mainly used to form a set of segments that collectively cover the entire image. People are only interested in certain parts of the image in the research and application of the image[18]. An advantage resulting from the choice of color space representation could be taken to enhance the performance of processes such as segmentation and feature matching because of the three fold increase in color signal dimension as compared to black and white images. Image segmentation techniques can be broadly divided into two categories dealing with the properties of intensity values, they are, namely: discontinuity and similarity. Using the discontinuity property we segment an image into regions having sufficient difference in terms of intensity values of each pixel from each other and from the background to allow boundary detection based on local discontinuities in intensity. On the other hand, using the similarity property we segment an image into regions having some similar properties defined according to a set of predefined criteria. Based on these two properties various image segmentation techniques have been developed such as edge based segmentation, region based segmentation and special theory based segmentation. The use of image segmentation techniques can be found in a very large number of applications such as medical diagnosis of cancer, survelliance, traffic control systems, face recognition [9]-[12].Among the development of segmentation techniques and their application in a variety of areas, it seems that a unified approach to the specific problem of color image segmentation has not been fully investigated [13]. In this proposed work, an attempt is made to study the effect of k-means clustering algorithm on color image segmentation. Several general purpose algorithms have been developed for image segmentation. Since there is no general solution to the image segmentation problem, these techniques have often been combined with domain knowledge in order to effectively solve an image segmentation problem for a problem domain [14][16].

II. NEURAL NETWORKS SEGMENTATION

Neural network based segmentation is a learning algorithm imitating the working pattern of neural networks. Artificial neural networks are made up of interconnecting artificial neurons. Artificial neural networks may either be used to gain an understanding of biological neural networks or for solving artificial intelligence problems.

Image segmentation is the basis of image analysis and understanding and a crucial part and an oldest and hardest problem of image processing. Clustering, a vital element of model identification field means distinguishing and classifying things that are provided with similar properties [15]. Clustering technique classifies the pixels with the same characteristics into one cluster, thus forming different clusters according to coherence between the pixels in a cluster. Clustering analysis assigns a set of observations into subsets called as cluster so that the observations in the same cluster are similar in some sense. It is a method of unsupervised learning and a common

technique for statistical data analysis used in many fields, including machine learning, pattern recognition, image analysis and bioinformatics.

III. SEGMENTATION ALOGRITHM DESCRIPTION

In this paper k-means clustering technique has been proposed that has been applied to solve low-level image segmentation tasks. K-means is one of the simplest unsupervised learning algorithm that solve the well known clustering problem[17]. This clustering is convergent and its aim is to optimize the partitioning decisions based on a user-defined initial set of clustering that is updated after each iteration. This procedure is computationally efficient and can be applied to multidimensional data. K -means is an iterative technique that is used to partition an image into k-clusters. The basic procedure is as follows:

1. Pick k cluster centers, either randomly or based on some heuristic.
2. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster center.
3. Re-compute the cluster center by averaging all of the pixels in the cluster.
4. Repeat steps 2 and 3 until convergence is attained.

IV. K-MEANS SEGMENTATION

Fig.1 shows the basic flow diagram for the computation procedure. The blocks are described next.

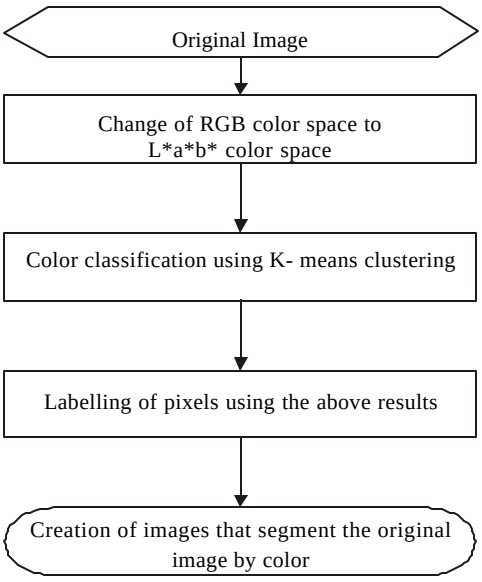


Fig. 1. Flow Diagram.

A. Original Image

B. Change of RGB color spaces to L*a*b* color space

An appropriate color space is essential to segment color images which form the basis for image processing technique. For research work, we have selected the L*a*b * color space which is a perceptually uniform orthogonal Cartesian coordinate system. The differences between two pixels in L* a* b* color space is the same with the sense of the human eyes visual system and this color space enables people to quantify these visual differences.

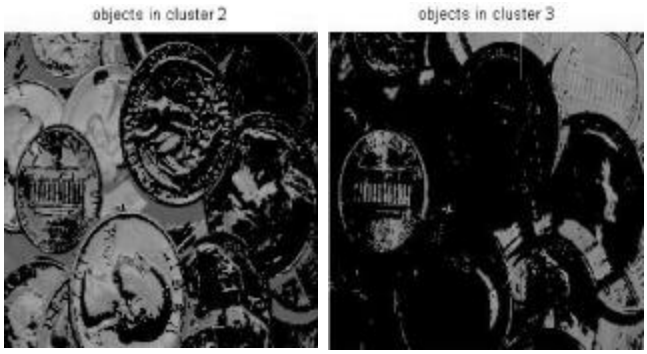
C. Color classification in L* a* b* color space using k-means clustering

Clustering is a way to separate groups of objects. K-means clustering treats each objects as having a location in space. It finds partitions such that objects within each cluster are as close to each other as possible. K- means requires that the number of clusters to be partitioned should be specified and also a distance metric to quantify how close two objects are to each other.

D. Labelling of pixels using the above results

For every object in one input image, k-means returns an index corresponding to a cluster.

E. RESULTS.



V. CONCLUSION

Image segmentation has been the basis of image processing, comprehension and model identification and a hot research subject of image processing technologies. This paper presents theoretical and pratical knowledge to image segmentation and clustering. The application scope of image segmentation is quite extensive. The experimental data include that our algorithm produces effective results. The choice of lab color space as the color space used in image segmentation is recommended.

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