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A Review for Object Recognition using Color Based Image Quantization Technique

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ABSTRACT

This paper deals with a review on various Color Quantization Techniques .The aim is to propose Exemplar-based object recognition which uses an adaptive color quantization scheme to obtain a coarse image representation. The tiny regions are combined based on color information. The Energy transform function using extracted color map is used as a criterion for image segmentation. The motivation for the proposed method is to obtain the similar and significant objects in different images using color quantization.

Key words-*Color Quantization, color map, Fuzzy c-means clustering algorithm, kernel-based Fuzzy c-means clustering algorithm*

1. INTRODUCTION

Color quantization is critical for displaying images with many colors on devices that can only display a limited number of colors, usually due to memory limitations, and enables efficient compression of certain types of images.

A color image quantization is a process that reduces the number of distinct colors used in an image, usually with the intention that the new image should be as visually similar as possible to the original image.

The process of color image quantization is often broken into four phases, Heckbert[2].

Phase 1 is sampling the original image for color statistics.

Phase 2 is choosing a color map based on those statistics.

Phase 3 is mapping the colors to their representative in the color map.

Phase 4 is Quantizing and drawing the new image.

Phase 4 is a trivial matter regardless of the quantization method. The other three phases however are more strongly connected. In particular the method used for phases 1 and 2 will determine the best method for accomplishing phase 3.

In general algorithms for color quantization can be broken into two categories: Uniform and Non-Uniform.

Uniform: Here the color space is broken into equal sized regions where the number of regions, N_R is less than or equal to K.

Non-Uniform: Here the manner in which the color space is divided is dependent on the distribution of colors in the image

2. RELATED WORK [3]

Several heuristic techniques for color image quantization have been proposed in the literature. Some of them are discussed below.

The median cut algorithm (MCA) divides the color space repeatedly along the median into rectangular boxes until the desired number of colors is obtained.

Popularity Algorithm builds the color map by finding the K most frequently appearing colors in the original image. Therefore the colors are stored in a histogram. The K most frequently occurring colors are extracted and they are made the entries in the color table. Now the true image can be quantized.

The variance-based algorithm (VBA) also divides the color space into rectangular boxes. However, in VBA the box with the largest mean squared error between the colors in the box and their mean is split.

The octree quantization algorithm repeatedly subdivides a cube into eight smaller cubes in a tree structure of degree eight. Then adjacent cubes with the least number of pixels are merged. This is repeated until the required number of colors is obtained.

M. G. Omran in his paper proposes Color image quantization based on PSO. The proposed approach is of the class of quantization techniques that performs clustering of the color space. The proposed algorithm randomly initializes each particle in the swarm to contain K centroids (i.e. color triplets). The K-means clustering algorithm is then applied to each particle at a user-specified probability to refine the chosen centroids. Each pixel is then assigned to the cluster with the closest centroid. The PSO is then applied to refine the centroids obtained from the K means algorithm.

The Recent Clustering applied in color image quantization is the c-mean clustering algorithms, which is a very time consuming approach. To reduce the computing load FCM algorithm based on color quantization is effective and fast to extract object from complicated Background but unable to have better curve Evolution.

3.FCM algorithm based on color Quantization Technique

The Fuzzy c-means clustering algorithm was first introduced by Dunn and later extended by Bezdek[11].Bezdek proved convergent property of clustering algorithm and hard C-means clustering algorithm. Here after, an objective-function-based fuzzy C-means clustering algorithm, has been extensively applied in such fields as medical diagnosis , target identification and image segmentation etc.The algorithm partition the data set $X=\{x_1,x_2,x_3,\ldots,x_n\}\varepsilon R^{pm}$ into c class with the result $U=\{u_{ik}\}\ \varepsilon R^{cn}$,where u_{ik} is the degree of membership of x_k belonging to ith the cluster. In this algorithm, every image pixel must be used for iterative calculation load is heavy. With color quantization, we used the representative color of each subset for FCM clustering, improving the running speed greatly. The data set in the quantized image is denoted as(Q,H), where

$Q=\{x_1,x_2,x_3,\ldots,x_q\}\varepsilon R^{pq}$,

$H=\{h(1),h(2),\ldots,h(q)\}$,

h(k) is the number of pixels in the k^{th} subset with the representative color x_k. The fuzzy c-means (FCM) clustering algorithm is an iterative clustering method that produces an optimal partition by minimizing the objective function.

$$J_m(U,V)=\sum_{k=1}^{n}\sum_{i=1}^{c}(u_{ik})^m d_{ik}^2(x_k,v_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

By color quantization, objective function become

$$J_m(U,V)=\sum_{k=1}^{q}\sum_{i=1}^{c}h(k)(u_{ik})^m d_{ik}^2(x_k,v_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where $U=\{u_{ik}\}$is define as

$$u_{ik}=\left[\sum_{j-1}^{c}\left(\frac{d_{ik}(x_k,v_i)}{d_{jk}(x_k,v_j)}\right)^{2/(m-1)}\right]^{-1},\ i=1\ldots..c\ \ k=1\ldots.q \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$v=\{v_1,v_2\ldots\ldots..v_c\}\in R^{pc}$ are c cluster centres computed with

$$v_i=\frac{\sum_{k=1}^{n}(u_{ik})^m x_k}{\sum_{k=1}^{n}(u_{ik})^m} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

With color quantization, formula (4) is replace with

$$v_i=\frac{\sum_{k=1}^{q}h(k)(u_{ik})^m x_k}{\sum_{k=1}^{n}h(k)(u_{ik})^m} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

From mentioned above, because q is much smaller than n, the calculation load of objective function ,membership and centres are reduced greatly and the whole running speed of FCM is thus much improved .After image pre-processing ,pixels are distributed more uniform and the data clustering ,could be performed directly in RGB space without affecting the clustering result. So, the proposed CQ-FCM could greatly improve the running speed without reducing quality of image segmentation.[6]

4. CONCLUSION

There are many different algorithms for color quantization. Which one is best is dependent on the requirements of the system it is to be used in. The uniform quantization algorithms offer a quick and dirty means but can result in very poor quality depending on image characteristics. The non-uniform algorithms offer better consistent results at the cost of increased memory and time complexities. To have a exemplar based object recognition in an images we propose Color image quantization with KFCM[5]. Color image quantization has been applied using bacteria foraging method. Bacteria Foraging Optimization Algorithm (BFOA), proposed by Passino, is a new comer to the family of nature inspired optimization algorithms. After obtaining color approximated image according to synthetic color map, kernel based FCM has been applied in order to carry out segmentaion process. The main motives of using the kernel methods consist in: (1) inducing a class of robust non-Euclidean distance measures for the original data space to derive new objective functions and thus clustering the non- Euclidean structures in data; (2) enhancing robustness of the original clustering algorithms to noise and outliers, and (3) still retaining computational simplicity. The algorithm is realized by modifying the objective function in the conventional fuzzy c-means (FCM) algorithm using a kernel induced distance instead of Euclidean distance in the FCM, and thus the corresponding algorithm is derived and called as the kernelized fuzzy c-means (KFCM) algorithm, which is more robust than FCM.

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