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RESEARCH ARTICLE

Region Detection and Matching for Object Recognition

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Abstract— Detecting regions is important to provide semantically meaningful spatial cues in images. Matching establishes similarity between visual entities, which is crucial for recognition. My thesis starts by detecting regions in both local and object level. Then, I leverage color intensity cues of the detected regions to improve image matching for the ultimate goal of object recognition. More specifically, my thesis considers four key questions: 1) How can I extract distinctively-shaped local regions that also ensure repeatability for robust matching? 2) How can object-level shape inform bottom-up image segmentation? 3) How should the spatial layout imposed by segmented regions influence image matching for exemplar-based recognition? And 4) How can I exploit regions to improve the accuracy and speed of dense image matching? I propose an adaptive color quantization scheme to obtain a coarse image representation. The tiny regions are combined based on color information. The proposed energy transform function using extracted color map is used as a criterion for image segmentation. The motivation of the proposed method is to obtain the similar and significant objects in different images. I propose Kernel based fuzzy C-means Algorithm on color Quantized images using bacteria foraging Technique.

Keywords— Color Quantization, color map, Fuzzy c-means clustering algorithm, kernel based Fuzzy c-means clustering algorithm

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I. INTRODUCTION

The vision of objects is easy for the human because of the natural intelligence of segmenting, pattern matching and recognizing very complex objects. But for the machine, everything needs to be artificially induced and it is not so easy to recognize and identify objects. The task of segmenting objects within a scene is a prerequisite for most object recognition and classification systems. Once the relevant objects have been segmented and labeled, their relevant features can be extracted and used to classify, compare, cluster, or recognize the objects in question.

Dense correspondences will add richer information for segmentation and matching. Matching all the pixels between two images is a longstanding research problem in computer vision. Traditional dense matching problems—such as stereo or optical flow—deal with the "instance matching" scenario, in which the two input images contain different viewpoints of the same scene or object. More recently, researchers have pushed the boundaries of dense matching to estimate correspondences between images with *different* scenes or objects. There are two major challenges when matching generic images: image variation and computational cost. Compared to instances, different scenes and objects undergo much more severe variations in appearance, shape, and background clutter. These variations can easily confuse low level matching functions. At the same time, the search space is much larger, since generic image matching permits no clean geometric constraints.

So our goal is to leverage low-level geometric information to build a high-level object recognition system that is robust to geometric variations. A key idea behind our approach is to strike a balance between robustness to image variations on the one hand, and accurate localization of pixel correspondences on the other for matching. We want to propose model that simultaneously regularizes match consistency at multiple spatial extents—ranging from an entire image, to coarse grid cells, to every single pixel on RGB images.We Propose Color Quantization with KFCM Algorithm.

II. RELATED WORK

A. Color Image Quantization

All 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, NR 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.

Several heuristic techniques for color image quantization have been proposed in the literature. 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.

B. Clustering Technique

The 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. The Recent Clustering applied in color image quantization is the Fuzzy c-mean clustering algorithms 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

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

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

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

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

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

With color quantization, formula (4) is replace with

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

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.

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 an exemplar based object recognition in an images, we propose bacteria Foraging Technique.

But working on large scale RGB images CQ-FCM increases with the time .Thus we want more robust approach ,we propose CQ-KFCM technique.

III. OUR PROPOSED METHOD

Bacteria Foraging Optimization is a population oriented algorithm used to search optimal solution. In this research each Pixel of the image is considered as bacteria and the color of the pixel is considered as bacteria food. The aim of the proposed algorithm is to minimize the food sources i.e. to reduce the number of colors in the image. In this research, all the pixels initially have some color and the purpose of this research is to optimize the number of colors in the image. All the colors in the image are evaluated as the number of pixels having that color. This evaluation defines the health status of all the colors present in the image. Depending upon the health status of the colors, all the colors in the image are divided into two categories popular colors and unpopular colors. If the health status of the color is high i.e. the color is present on too many pixels then that color is considered as popular color and all other colors whose health status is poor are considered unpopular colors. All the pixels in the image are compared with every other pixel in the image to find the most similar color to be eliminated. Approximate unpopular colors to nearest value in color map we have made.

The K-Fuzzy c-means algorithms are under the group of squared error based clustering. The KFCM algorithms are an iterative technique which is used to split an image into k clusters. In statistics and machine learning, k means clustering is a method of cluster analysis which can to portions n observations into k cluster, in which each observation be in the right place to the cluster with the adjacent mean . 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.

Here, the kernel function K(x, c) is taken as the Gaussian radial basic function (GRBF) as follows:
K(x,c) =exp(- ǁx-c ǁ 2/□2) where '□'is the width parameter,
The Objective Function is

$$j_m(U,V) = 2\sum_{i=1}^{c}\sum_{k=1}^{n} u_{ik}^m[1-K(x_k,v_i)] \quad \text{.........7}$$

And
The fuzzy membership matrix u can be obtained from

$$u_{ik} = \frac{(1-K(x_k,v_i))^{-1/(m-1)}}{\sum_j^c (1-K(x_k,v_i))^{-1/(m-1)}} \quad \text{.....................8}$$

The cluster center v can be obtained from:

$$v_i = \frac{\sum_{k=1}^{N} u_{ik}^m K(x_k,v_i)\, x_k}{\sum_{k=1}^{N} u_{ik}^m K(x_k,v_i)} \quad \text{.........................9}$$

The proposed KFCM algorithm is almost identical to the FCM, except, Eq. (8) is used instead of Eq. (3) to update the centers. In step 4, Eq. (9) is used instead of Eq. (5) to update the memberships.

IV. DESIGN METHODOLOGY

The proposed Algorithm Required following Steps
Step 1) Generating synthetic RGB color map
Step 2) Applying gamma correction in order to adjust contrast of each intensity band
Step 3) Color image quantization using bacteria foraging method
Step 4) Segmentation of image using Kernel based fuzzy c-means clustering method
Step 5) Pattern template generation and thresholding for Matching

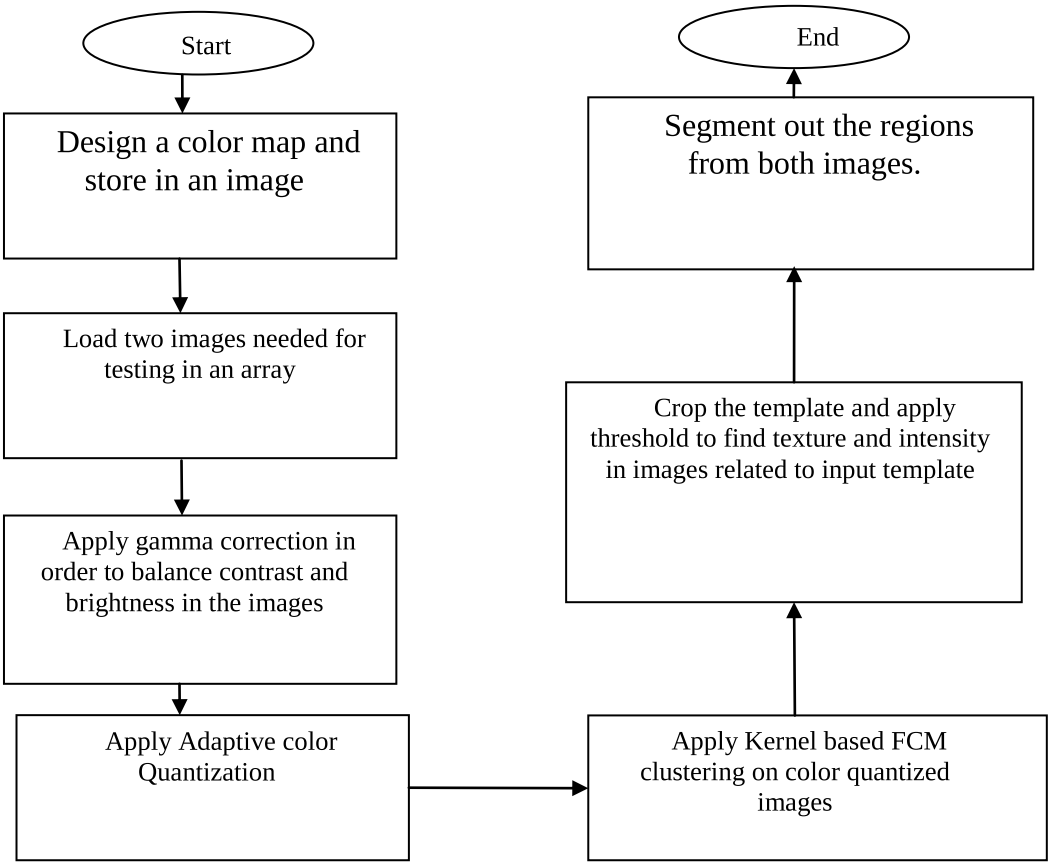

Fig. 1 A Flow Chart

V. EXPERIMENTAL SETUP

Proposed algorithm has been applied on different datasets collected from World Wide Web. In order to verify our algorithm we have implemented it on variety of Images. Few out of total images used for the experimental results have been shown below. Images have been chosen with different lightning conditions, objects, shapes and using different locations of the camera from the objects.

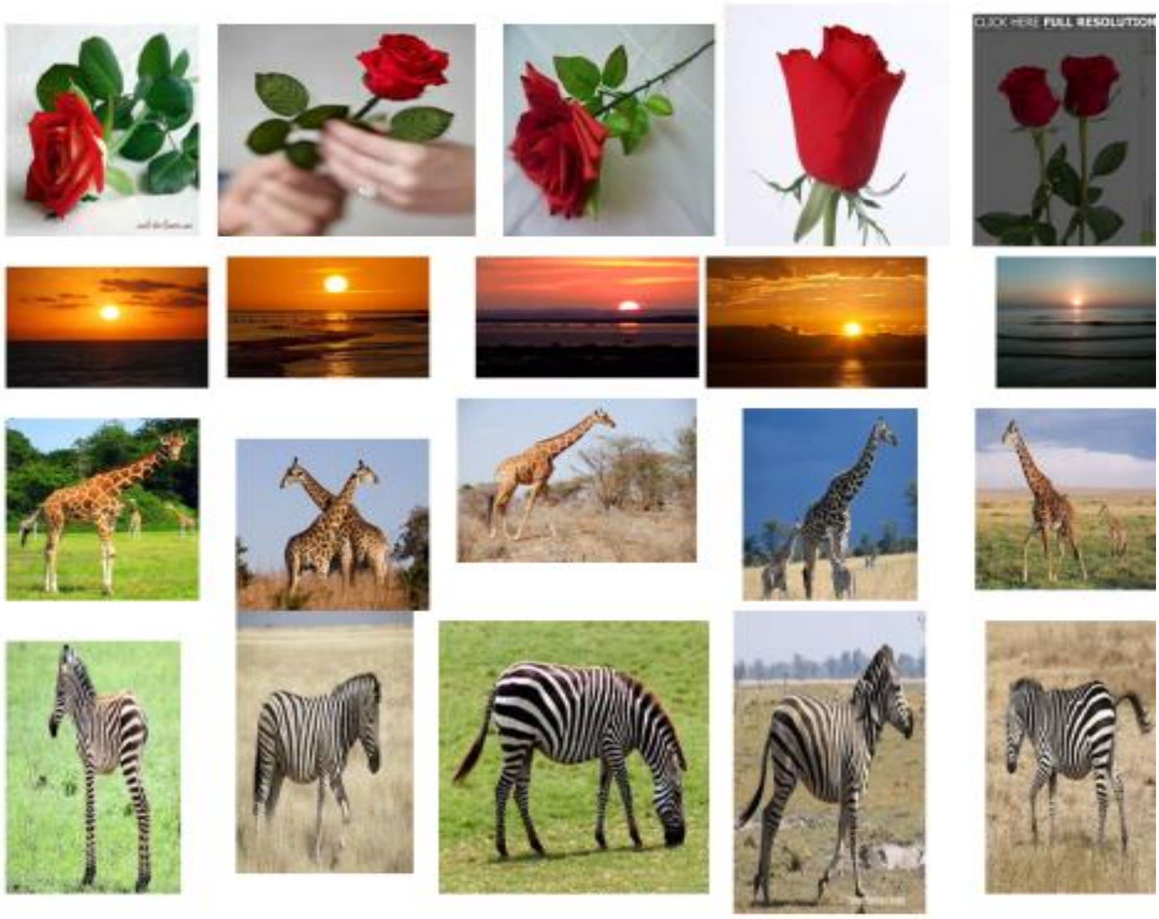

Fig. 2 A Sample of Images from Database

INPUT IMAGES OUTPUT IMAGES

Image1 Image2 Image1 Image2

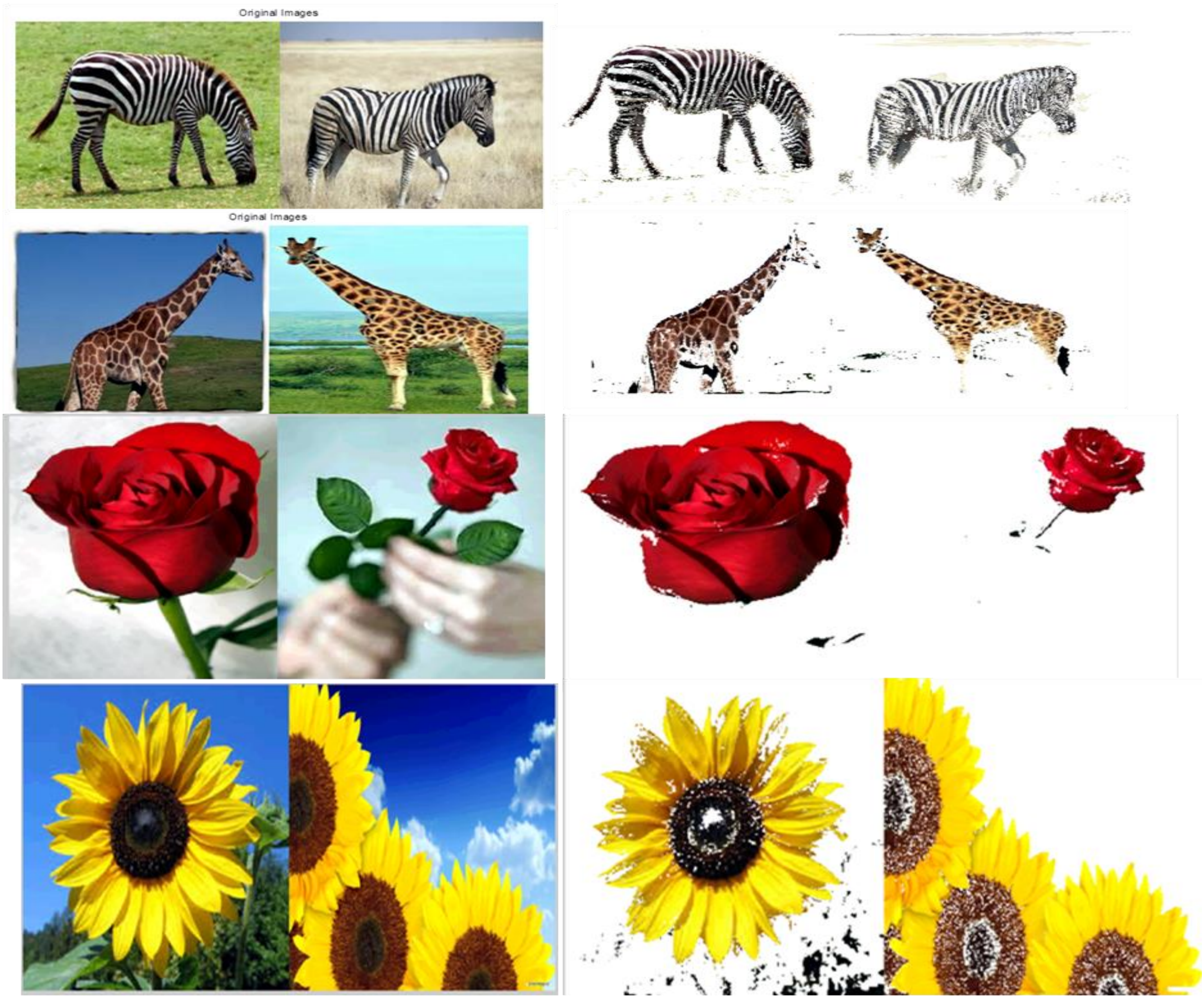

Fig. 3 Results a) Input Images image1 and image2 are two images we selected for region detection and matching.
b) Output Images image1 and image2 are two images we get after applying CQ-FCM.

Table I Comparison Table between CQ-FCM and CQ-KFCM

Figure/Technique	**CQ-FCM**			**CQ-KFCM**		
	Time(seconds)	**ROI1(%)**	**ROI2(%)**	**Time(seconds)**	**ROI1(%)**	**ROI2(%)**
Figure 3.1	105.2356	25.8011	21.1978	11.9632	25.8211	21.5278
Figure 3.2	87.4552	21.1022	5.3233	11.7259	17.8256	7.5767
Figure 3.3	66.3534	38.2944	6.8567	12.0184	41.2644	7.2089
Figure 3.4	70.0691	32.5611	53.9978	12.0167	42.9511	49.9856

In Table I we have Time: It is the time taken to implement the Fuzzy algorithm on Color Quantized Images.ROI (Region of Interest), It is a form of annotation, often associated with categorical or quantitative information (here it is for mean intensity), expressed as text or in structured form. ROI is a selected subset of samples within a dataset identified for object boundaries.ROI1 is for first Image and ROI2 is for second Image.

It has been found that if we increase the size of input images, it produces better results in segmentation but take more time for calculations. We have tried FCM algorithm but that takes too long for the segmentation process. The KFCM is fast and effective than FCM as it produces better segmentation because of induced kernel parameter for making clusters instead of Euclidian distance.

VI. CONCLUSIONS AND FUTURE SCOPE

We have presented an efficient Region Detection & Matching technique using the color quantization method with Kernel Based Fuzzy C-Means Algorithm of RGB images. In our work, we have chosen RGB images for object recognition. In first we make a synthetic colormap from combination of chosen primary colors and then loaded images have been quantized using bacteria foraging technique. The reason for doing this was to reduce the colors in the images for better segmentation. After that, whole quantized image pixels have been divided into kernel based fuzzy clusters by using KFCM. After that a patch has been generated for the chosen portion of an object and clusters have been filtered out which has same color as template patch. The proposed algorithm is implemented in MATLAB 2012b. The experimental results give satisfactory results and are more pleasing and comfortable. This is a Recognition Technique based on color, intensity and texture oriented. So in future, It can be tried to add other features in our algorithm like shape, size etc. of the objects for advance classification of Objects. The proposed technique can be further extended to test its performance on images corrupted with different kinds of noise. Performance can be evaluated by using some other parameters.

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