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Multi-Region Extraction Image Segmentation Based on Centroid Clustering Technique

[1] Praful B.Sambhare, [2] Pankaj Kawadkar

[1] Department Of Computer Sci. & Engg, PIES,Ratibad,Bhopal-462044 (M.P.)

[2] Department Of Computer Sci. & Engg, PIES,Ratibad,Bhopal-462044 (M.P.)

Abstract - In this paper we proposed the methodology that incorporates the Centroid-based clustering algorithm for the image segmentation. The image segmentation may be defined as the process of dividing the given image into different parts. Here we are taking image as the input and we are supposed to segment the given image on the basis of its high intensity region. The clustering algorithm also proved to be very efficient in the process of image segmentation. The clustering can be defined as the method of grouping the similar kind of objects from the input. The grouping can be on the basis of the attributes like color, shape, texture, size and other. The another technique used Multi-region extraction, using this approach foreground detect from image. But more difference between input image and Output image. So, we have implement Centroid-based clustering algorithm with Multi-region. The experiment shows that, the result of proposed method as compared to centroid-based clustering and Multi-region approach is best. This method has number of applications in medical imaging field, Digital Camera and etc.

Keywords **- Multiregion Extraction(MRE),Centroid-based Clustering, Foreground Detection, Content Based Image Retrieval.**

1. Introduction

Centroid based Image Segmentation is needed to improve segmentation results. Numbers of different segmentation techniques are available, but there is not even a one single method to be considered as a best method for different kind of images, only suitable for one specific type of images. The main purpose of centroid based segmentation method, dividing an image is to further analyse each of these objects present in the image to extract some high level information. segmentation has been, and still is, an important research field and many segmentation methods are available. Dynamic background is done by using image segmentation of video. Segmentation of video with dynamic background has been an important research topic in intelligent surveillance and human-machine interface technologies. For the segmentation need the Images. But the images are either in form of black and white or color. Color images are due to the grey level. As the grey level contrast changes the colour of colour image also changes.

In general, cluster analysis refers to a broad spectrum of methods which try to subdivide a data set X into c subsets (clusters) which are pairwise disjoint, all nonempty, and reproduce X. via union. The clusters then are termed a hard (i.e., nonfuzzy) c-partition of X. Many algorithms, each with its own mathematical clustering criterion for identifying "optimal" clusters, are discussed in the excellent monograph of Duda and Hart. A significant fact about this type of algorithm is the defect in the underlying axiomatic model that each point in X is unequivocally grouped with other members of "its" cluster, and thus bears no apparent similarity to other members of X. One such manner to characterize an individual point's similarity to all the clusters was introduced in 1965 by Zadeh.

Various definitions of a cluster can be formulated, depending on the objective of clustering. Generally, one may accept the view that a cluster is a group of objects that are more similar to one another than to members of other clusters. The term “similarity” should be understood as mathematical similarity, measured in some well-defined sense. In metric spaces, similarity is often defined by means of a distance norm. Distance can be measured among the data vectors them- selves, or as a distance from a data vector to some prototypical object (prototype) of the cluster. The prototypes are usually not known beforehand, and are sought by the clustering algorithms simultaneously with the partitioning of the data. The prototypes may be vectors of the same dimension as the data objects, but they can also be de-fined as “higher-level” geometrical objects, such as linear or nonlinear subspaces or functions. The overall segmentation performance is improved to compared with the regular region growing, and the improvement comes only from the integration of symmetry. The existence of symmetry can be measured as a binary (exists or not) or a continuous (variable) feature. One of the most widely used fuzzy clustering models is fuzzy c-means (FCM) . The FCM algorithm assigns

memberships to which are inversely related to the relative distance of to the point prototypes that are cluster centers in the FCM model. Suppose . If is equidistant from two prototypes, the membership of in each cluster will be the same , regardless of the absolute value of the distance of from the two centroids (as well as from the other points in the data). Cluster analysis is a method for clustering a data set into groups of similar individuals. It is a branch in multivari- ate analysis and an unsupervised learning in pattern recog- nition. The clustering applications in various areas such as taxonomy, medicine, geology, business, engineering sys- tems and image processing, etc., are well documented . In these clustering methods the hard c-means (or called k-means) are the most well-known conventional (hard) clustering methods which restrict each point of the data set to exactly one cluster.

2. Literature Survey

The division of an image into meaningful structures, image segmentation, is often an essential step in image analysis. A great variety of segmentation methods have been proposed in the past decades. They can be categorized into,Threshold based segmentation: Histogram thresholding and slicing techniques are used to segment the image. This is the simplest method of image segmentation. Thresholding is used to create binary image based on intensity of the image. This method attempts to find an intensity called threshold. This technique to partition an input image into two or more pixel value by comparing with the predefined threshold value.Edge based segmentation: Here, detected edges in an image are assumed to represent object boundaries, and used to identify these objects.Region based segmentation: Here the process starts in the middle of an object and then grows outwards until it meets the object boundaries.Clustering techniques: Clustering methods attempt to group together patterns that are similar in some sense[1].

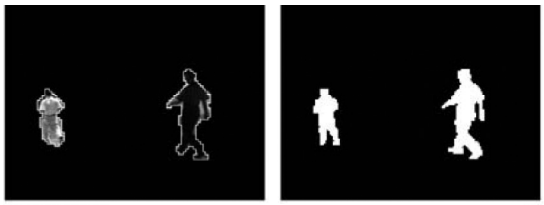
The fuzzy c-means (FCM) method is one of the best known fuzzy clustering methods. In FCM, the objective function is the trace of a within-cluster scatter matrix with spherical clusters obtained by minimizing the objective function with alternative optimization. Other clustering algorithms such as the Gustafson- Kessel (GK) clustering algorithm and Gath-Geva (GG) clustering algorithm were developed to detect non-spherical structural clusters, but these two algorithms fail to consider the relationships between cluster centers in the objective function[2].The Segmentation may prove helpful in recognition of the object , image compression, editing many more. The Segmentation process basically depends upon the quality of image which is to be processed [3]. This proves effective in the case of simple images due to very less variations in the pixels and required some preprocessing in case of complex image. The image segmentation process can be categorized into five categories such as Region Based Segmentation, Pixel based segmentation, Edge based segmentation, Edge and region Hy-brid segmentation, and clustering based segmentation[4]. This segmentation is mainly done of one of two basic properties of intensity values. The properties are discontinuity and similarity.

Similarity (homogeneity) in images is to partition an image into regions that are similar according to a set of predefined criteria in images. Homogeneity refers to the uniformity (similarity) of images. Discontinuity property can be stated as partition of an image is based upon sharp changes in intensity. The similarity of pixels mainly deals with the homogeneity of intensity in the image. Most of the existing segmentation methods rely on the segmentation of homogeneous images. The segmented images are visually different, homogenous and meaningful with respect to some properties. Methods for performing image segmentation vary depending on the application, imaging modality and some other applications. Selection of appropriate method to a segmentation problem is a difficult task[5].The key difficulty lies in dealing with the background pixels in the scene, which vary significantly with time[7,8].The unpredictability of the background pixels has a tremendous impact on the foreground detection accuracy. To solve this problem, a number of techniques have been developed, which can be classified into the following three types. The first type of techniques estimates the motion between two frames, such as the optical flow method [9] and block matching [10]. Most of these methods are computationally complex and cannot be applied to real-time programs. The second type, temporal differencing, uses the difference between two consecutive images to segment foreground and background pixels. However, successive frame differencing relies on continuous motion between frames, so it fails with static objects. Pixels of a moving object that have uniform regions will also be detected as background. The third type of approach subtracts and updates background models from input videos, and then utilizes. the difference information between the input image and its background. The algorithm can accurately detect the foreground pixels, even illumination changes.

In Processing of Images Based on Segmentation Models for Extracting Textured Component, The segmentation is carried out in two stages. In the first stage, colors in the image are quantized to several representative classes In the second stage, spatial segmentation is performed directly class-map.

It is difficult to handle a 24-bit color images with thousands of colors. Image are coarsely quantized without significantly degrading the color quality. Then, the quantized colors are assigned labels. A color class is the set of image pixels quantized to the same color. The image pixel colors are replaced by their corresponding color class labels and this image is called a class-map.

Usually, each image region contains pixels from a small subset of the color classes and each class is distributed in a few image regions[1]. The FCM algorithm and the clustering algorithm are compared using the following criteria for the cluster center locations: the mean square error (MSE) of the centers $(\mathrm{MSE} = \sqrt{\|\hat{v} - v_t\|^2}$, where $\hat{v}$ is the computed center and v_t the true center), the objective function values (OFV), and the number of iterations (NI). The computed results are listed in Table 1 for various values of β. [2].
A Multi-scale approach was developed using three kinds of meshes. The border length of the first two models was 6 pixels. The top-right corner of the first model was labelled (0, 0). This point was labeled (3, 3) in the second model, so that, with a border length size of 6 pixels, the elements would be staggered in the two models. The first model was then called the "even model" and the second model was the "odd model". The third model was also an "even model" with a border length of 3 pixels. Two convergent contours were first obtained using the first two models .The two results are combined as high-resolution contours. Finally, the pixels inside this contour were set as foreground pixels. Figure (2a) shows the detected foreground [11].



(a) (b)

Fig:1 (a) Foreground detection result using a fixed energy threshold (b) Ground truth foreground map

3. Proposed Methodology

Many clustering strategies have been used, such as the crisp clustering scheme and the Centroid-based clustering scheme, each of which has its own special characteristics. Among the Centroid-based clustering methods, this algorithm is the most popular method used in image segmentation because it has robust characteristics for ambiguity and can retain more information than hard segmentation methods. Clustering algorithms are used for segmenting Digital images however noise are introduced into images during image acquisition, due to switching, sensor temperature. The multi-resolution technique is one of the most important techniques for image segmentation. Wavelet transformation is a pixel-based method and is widely used for multi-resolution segmentation approaches, but it suffers the deficiency of modeling the macro-texture pattern of a given image. In Multi-region Segmentation, within each segmentation region, from the piecewise constant model, and a smoothness, boundary preserving regularization term. To extract data from multiple regions in image by using Multi-Region extraction technique.

3.1 Selection of centroid based region

Proposed method works on the sequence of following steps:

1. Apply Centroid-based clustering.
2. Apply Multi-Region Extraction.
3. Apply Centroid-based clustering with MRE.
4. Stop

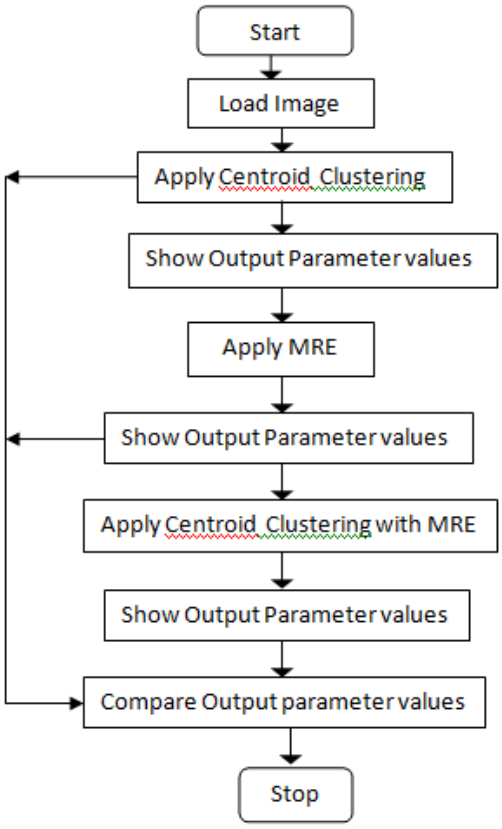


Fig.2 Data Extraction form Image

Fig.3(a) Original Image (b) Multi-Regions Extracted Image

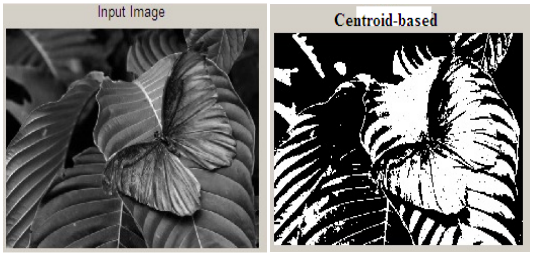


Fig.4(a) Original Image (b) Centroid-based Segmented Image

Multi-region Extraction (MRE) to preserve efficiency, improve reliability but it has some limitations to produce satisfactory result. So, to combines a features of Centroid-based clustering algorithm with Multi-region extraction (MRE) to achieve satisfactory result. The proposed algorithm called as "Multi-region Extraction Image Segmentation Based On Centroid-based Clustering Technique".

A number of clustering techniques are available to make the image segmentation more efficient and effective. The clustering methods are using are relevance feedback, log based clustering, hierarchical clustering, graph based clustering, Retrieval-dictionary based and filter based clustering and many more.

Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters).Cluster analysis as such is not an automatic task, but an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and failure. It will often be necessary to modify data preprocessing and model parameters until the result achieves the desired properties. The evaluation of the Centroid clustering with Multi-region with respect to the quality of provided segmentation and efficiency of the algorithm. Our aim is to show that, the proposed method is comparable in quality with other widely adopted low level segmentation techniques. The proposed method is compare existing two method (i.e Centroid based clustering and Multi-Region) based on some parameters values.

The parameters values are Time, Minimized Mean Squared Error, PSNR. The below Table 1 shows performance of our method based on some parameter. This result shows that the performance of clustering technique with MRE is better than other two technique.

Table1: Performance of Proposed Method

Image	1	2	3
CentroidCluster (Time)	41.44	20.84	47.78
MRE (Time)	07.61	00.38	00.38
Cluster with MRE (Time)	37.04	23.73	39.51
CentroidCluster (MMSE)	07.87	02.3	02.87
MRE (MMSE)	2098.9	1407.24	7861.85
Cluster with MRE (MMSE)	05.42	03.18	04.58
CentroidCluster (PSNR)	15.89	12.64	11.03
MRE (PSNR)	18.31	14.84	-29.78
Cluster with MRE (PSNR)	18.93	14.78	14.42

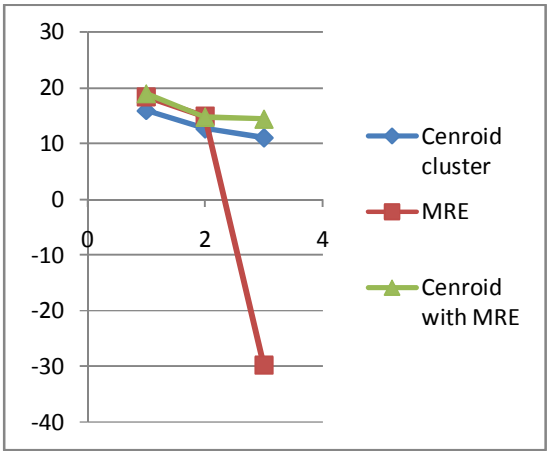


Fig. 5 performance of proposed method versus other two methods

4. Conclusion

In this paper we presented different segmentation techniques used in the various fields as Content based image retrieval, medical imaging, object detection and recognition task. It is very important and useful to segment images into clusters as to improve the quality of images . The propose method provide better segmentation accuracy by separating high density areas from image using saliency map. The purpose of multiregional clustering algorithm (MRC) is to improve efficiency. The segmentation methods mostly used in Medical applications, Digital camera, magnetic resonance, computed tomography (CT), Detection of accuracy such as unman aerial vehicle landing mark and flights, also verify this point, real-time target recognition, Face detection, Human tracking and Identification and Image Pattern Detection, Human tracking and Identification and Image Pattern Detection.

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Mr.Praful B.Sambhare received B.E in Computer Science & Engineering From S.S.E.S College of Engineering & Technology, Akola; in 2009 and pursuing M.Tech.in Computer Science & Engineering From Patel Institute of Engineering & Science, Ratibad, Bhopal.

Prof.Pankaj Kawadkar received M.Tech.in Computer Science & Engineering in 2010. He is now working as a Head of Department (CSE) in Patel Institute of Engineering & Science, Ratibad, Bhopal.

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