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Comparative study of Different Image Segmentation Techniques applied on Outdoor Scene Images

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***Abstract*—** The novel proposes a comparative study of different image segmentation techniques applied on outdoor scene image. Basically Segmentation is the first stage in any attempt to analyse or interpret an image automatically. Some kind of segmentation techniques will be found in many application involving the recognition, detection, and measurement of objects in images. This paper aims to recognize and differentiate the objects present in different outdoor scene images using various segmentation techniques. And also compares the result of different segmentation techniques which will prove which segmentation technique efficiently differentiates the objects present in the images accurately. Hence recognizes the background. Finally the results obtained are compared with the standard database i. e Berkeley database.

Keywords: *Image segmentation, Thresholding techniques, Clustering Technique, Graph cut methods.*

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I. INTRODUCTION

The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Segmentation is the process that partitions the image pixels into non-overlapping regions such as Each region is homogeneous (i.e., uniform in terms of the pixel attributes such as intensity, colours, ranges, textures etc.) and connected. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image Segmentation acts as bridges between low-level image processing and high-level image processing. Some types of segmentation technique will be found in the applications involving the recognition, detection, and measurement of objects in the images. Basically Segmentation subdivides an image into its particular regions or objects. That is, it partitions an image into distinct regions that are meant to correlate strongly with objects or features of interest in the image. Segmentation can also be considered as a process of grouping together pixels that have similar attributes. Image segmentation algorithms generally are based on one of two basic properties of intensity values that are discontinuity and similarity. Discontinuity approaches partitioning an image based on abrupt changes in intensity. Similarity approaches partitioning an image based on regions that are similar according to a set of predefined criteria. Techniques based on discontinuity attempts to partition the image by detecting abrupt changes in gray level i.e. Point, line, and edge detectors. Techniques based on similarity attempt to create the uniform regions by grouping together connected pixels that satisfy predefined similarity criteria. Therefore, the results of segmentation may depend critically on these criteria and on the definition of connectivity. The approaches based on discontinuity and similarity mirror one another in the sense that completion of a boundary is equivalent to breaking one region into two.

II. THRESHOLDING TECHNIQUES

Thresholding is one of the simplest image segmentation algorithms. It can be useful in differentiating the objects in an image. By selecting a proper and adequate threshold value T, the gray level images can be converted into binary images. The binary image contains all the essential information about the position and shape of the objects of our interest (foreground). It is advantageous to obtain first a binary image as it reduces the complexity of the data and simplifies the process of background and foreground recognition. The common way to convert a gray-scale image to binary image is to select a single threshold value (T). Then all the gray level values below T will be classified as black colour, and those above T will be classified as white colour.

A common method used to select threshold value is by analysing the histograms of the type of images that one wants to segment. In ideal case the histogram presents only two dominant modes and a clear valley. In this case the value of T is selected as the valley point between the two modes. Histograms are more complex, with many peaks and not clear valleys in some cases, and are not always easy to select the threshold value. So there are various methods to select the threshold values. One of them is automatic thresholding. It is the simplest way of thresholding. In this the threshold value for each image is selected automatically by the system is called an automatic threshold scheme. It requires the knowledge about the intensity characteristics of the objects, size of the objects, fractions of the image occupied by the objects and the number of different types of objects appearing in the input image. Then automatic thresholding is possible. The method which can be used for selecting the threshold value is by taking mean value of the pixels as the

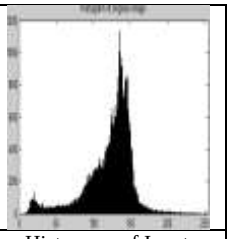
threshold value. It is being rarely used as it works well only in the cases where the half of the image is background and half of the image is foreground.

There are two types of thresholding techniques described in this paper Global thresholding and Local thresholding techniques [12]. In global thresholding technique one threshold (T) value is required. The regions having pixels value less than this threshold value will be considered as background and the regions having pixels value more than this threshold value will be foreground. The result obtained by using global thresholding technique is as shown in fig (d).

The results of global thresholding technique is satisfactory for some images where there is not much variation in the pixels value of the image .In local thresholding technique more than one threshold values are required. It is also known adaptive thresholding. Adaptive thresholding typically takes a gray scale or colour image and outputs a binary image representing the segmentation of the particular image. For each pixel of the image the threshold has to be calculated. Some methods for the selection of threshold are explained above. The results obtained by using local thresholding technique are as shown in fig (e).

Original Images Fig (a)

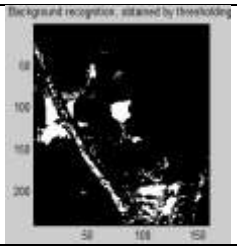
Gray Scale Images Fig (b)



Histogram of Input Images Fig(c)

III. CLUSTERING TECHNIQUES

Cluster is a collection of objects which are "similar" between them and are "dissimilar" to the objects belonging to other clusters.. Clustering problems arise in many applications, such as knowledge discovery [9], data mining and, data compression and vector quantization [10], and pattern recognition and pattern classification [11]. Clustering can be classified into four types, Overlapping Clustering, Exclusive Clustering , Hierarchical Clustering and Probabilistic Clustering. In first case the overlapping clustering, clusters the data using fuzzy sets, so that each point belongs to two or more clusters with different degrees of membership. In such cases, data will be associated to an appropriate membership value. The second type, the data's is grouped in an exclusive way, so that if a certain pixel belongs to a definite cluster then it could not be included in another cluster. The hierarchical Clustering algorithm is based on the union between the two nearest clusters. The last type of clustering algorithm uses a completely probabilistic approach. The four most used algorithms are K-means, Hierarchical clustering, Fuzzy C-means, Mixture of Gaussians. Each of these algorithms belongs to one of the clustering types as above. Such as K-means is an exclusive clustering algorithm, Hierarchical clustering is obvious Fuzzy C-means is an overlapping clustering algorithm and lastly Mixture of Gaussian is a probabilistic clustering algorithm. Clustering based on k-means is closely related to a number of other clustering and location problems. This paper describes K-mean clustering technique of segmentation.



Global Threshold Fig (d)

Local Threshold Fig (e)

A.K-mean Clustering

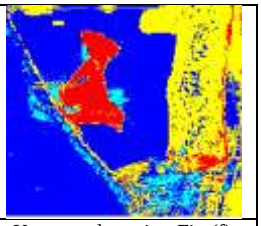
It is an unsupervised clustering algorithm. Here "K" stands for number of clusters. K-means algorithm is iterative in nature. In K-mean algorithm data vectors are grouped into predefined number of clusters [1] [2]. There is a need to specify K in advance.

The K-mean algorithm works in the following way first decide a value for *K*, the number of clusters. Then initialize the *K* cluster centres' (randomly, if necessary). Decide the class memberships of the *N* objects by assigning them to the nearest cluster centres. Then re-estimate the *K* cluster centres, by considering the memberships found above are correct. Repeat these steps until none of the *N* objects changes membership in the last iteration. The weakness of K-mean is, it is applicable only when mean is defined. The results obtained using K-mean clustering method is shown in fig (f). In that it can be seen that the clusters of the nearer value pixels are formed. For given ranges of pixel values a particular colour is given. In this k-mean clustering six ranges are defined of pixel values and six different colours are given to these groups of pixels.

IV. GRAPH CUT BASED ON COLOR METHOD

An image segmentation problem can be interpreted as partitioning the image elements (pixels) into different categories. Graph cut is the popular technique for interactive image segmentation. The task of interactive image segmentation has attracted the attention in recent years [8], [4], [5], [6]. A Cut of a graph is a partition of the vertices in the graph into two disjoint subsets. Taking a graph with an image, one can solve the segmentation problem using graph cuts techniques in graph theory. In this paper graph cut method based on textures information is implemented [3]. The graph cut method can be applied on both gray scale images and colour images as well. Implementation of graph cut method on gray scale image is simple and easy so it is broadly used. The resultant image obtained after applying graph cut method contains boundaries separating the objects based on texture information [7].

Original Images Fig (a)



K-mean clustering Fig (f)

Original Images	PSNR	Entropy	Quality factor
	69.0056	6.8124	0.0084

Table 1

In this paper the boundaries obtained in resultant image are used on colour image and on the bases of colour it is decided that the region is a part of background or foreground like if the colour of the region is green then the probability is more that it is the part of background also the size of the region is an important feature to determine whether it is background or foreground as the background will be larger than the foreground. Now after determining this for each region one can take decisions to combine the background regions of the image and thus can separate the foreground from the background. Fig (g) shows the result of graph cut method which groups the similar value pixels and draws the boundary around it. Whereas fig (h) shows the result of graph cut method based on colour information which highlights the foreground and darkens the background of the input images.

Graph Cut Method Fig (g)

Graph cut based on colour Fig (h)

V. CONCLUSION

This paper presents a survey of different segmentation techniques on outdoor scene images and tried to differentiate the background and foreground of the images. The different segmentation techniques discussed are Thresholding technique: Global and Local thresholding, Clustering technique: K-mean clustering and Graph cut method and graph cut based on colour. By comparing the results obtained by the various techniques it is concluded that the results obtained by graph cut method and graph cut based on colour are more correct and accurate which clearly separates the background and foreground of the images and highlights the foreground as shown in Fig (h).The advantage of graph cut method is it can be directly applied on colour images and can separate the background and foreground of the images. Further the results are compared to the standard data base i.e. Berkeley database. The comparison table is as shown above which proves the results obtained using Graph cut based on colour information are very close to accuracy and is the automatic segmentation technique where as the results in Berkeley database are obtained by ground truth which is nothing but done manually.

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