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Empirical Study of Cluster Based Image Segmentation For Natural Images

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Abstract — Image segmentation is the principle of segregation of digital contents of an image, generally correlated to the area of interest of a user. K – Means clustering method is expedient for implementation of image segmentation algorithm. However, the regular criterion for initial centroid selection in K – Means clustering can be made adaptive with the format or gray scale range of an image. Achievability of proposed method may be validated with the help of standard performance measures.

Keyword — Clustering, Image Segmentation, Gray Scale Range

1. INTRODUCTION

Now days, researchers focus on filtering certain parameters of an image, may be related to some features stated as a foreground and remaining splinters as background precisely. They generally resemble to the image in a specific and unique nature of the area [1] Image segmentation is a process of partitioning an image into sub areas which might have different characteristics. Image segmentation is an important step prior to Image analysis. One can obtain meaningful results using Image segmentation technique which can be used effectively for further image processing. Images can be interpreted as an array of pixels, arranged in rows and columns. Every pixel value reflects the shade of single point on image. As Natural images consist of more patterns which are in general produced by stochastic processes in nature, these images are usually classified as noisy (due to environmental effects). Somehow natural image segmentation is a perplexing task and it is one of the conventional problems in the field of computer vision as well as image processing [2][14][15] Image segmentation can be used to locate objects and boundaries in an image. There are many application of natural image segmentation such as Iris recognition, fingerprints recognition, medical imaging and so on [2][16][17]

2. RELATED WORK

Many researchers are working in the field of Image processing and their published work inevitably creates opportunities for others to contribute. Raman Maini, Himanshu Aggrawal [3] illustrates the method to perform edge detection which is a basic step in image analysis, but simultaneously it enlightens few issues related to the absence of true edges, false edge detection, generating thick or thin lines and the reason of occurrence of all such problems. Authors attend all associated issues and propose a solution for that. In gradient based detection algorithm has many drawback due to the sensitivity towards the noise, and the size of kernel filter and fixed coefficients. So, an edge detection technique providing the robust solution can be proposed, which is acceptable to the varying noise level, and helps to distinguish valid contents of the image, by comparing the performance of all operators. Further Authors conclude that the performance of canny operator is better compared to that of other operator, as canny operator works on adjustable parameters such as standard deviation (SD) for the Gaussian filter as well as threshold value. SD controls the size of Gaussian filter, when SD is greater than the size of Gaussian filter, more blurring effects are produced and when the SD is less than the size of Gaussian filter, the amount of blurring is confined, many problem can be resolved by adjusting certain parameters like SD [3] [14] [15]

A paper on Image segmentation using graph cut technique for outdoor scene images, authored by Purnashti Bhosale, Aniket Gokhale, Yogesh Motey [4], has proposed a method that focuses on improving the performance, graph cut method is compared with some other image segmentation techniques. Segmentation by graph cut method is done on the basis of Colors/ Shades and there texture information. One has to identify the foreground and background of an image by analyzing an image and then making background black while keeping

foreground as it is. This makes foreground clearly visible with respect to the background. It takes limited computations and produces better results compared to other segmentation technique [4] A paper on Automatic Segmentation of Vocal Tract MR Images by Zeynab Raeesy, Sylvia Rueda, Jayaram K. Udupa, and John Coleman [5] attends some important issues in biomedical field and analyzes hidden mechanism of human speech production system. MRI technique is frequently used but automatic segmentation of vocal track figure is challenging task in MRI for its implementation, because of dynamic nature of articulation, and the shape of vocal tract is changes according to the different sound. To resolve the problem of automatic segmentation in MRI technique author proposed a new method which is an automatic landmark tagging by recursive boundary subdivision method. This method is used for obtaining landmark on contour of vocal tract, and for recognition of the shape of vocal tract, oriented active shape model is used in MRI technique [5] The paper titled 'An Accurate Thresholding-based Segmentation Technique for Natural Images' authored by Sharifah Lailee Syed Abdullah, Hamirul Aini Hambali and Nursuriati Jamil proposes a thresholding based segmentation technique for providing good result for natural images [12] Sequence of steps for achieving their goal is suggested by author is

- Perform Otsu's method and take the threshold value.
- Transform the gray scale image into binary image.
- Check the color of interest if yes than modify the threshold value and get the segmented original image else inverse the image, than modify the threshold value and get the segmented original image [12]

3. K-MEANS CLUSTERING ALGORITHM

K-means clustering is the most popular partition based clustering. It is extensively used for cluster analysis too. It has greater efficiency and scalability when we are dealing with large datasets.it also has many deficits like in it we have to initialize number of cluster k, initial cluster is randomly selected [7][8]

Algorithm

- Predefine the number of cluster k, and also pick initial centroid randomly.
- The squared Euclidean distance will be calculated from each seed to each cluster is computed, and each seed is assigned to the closest cluster.
- For every cluster, the centroid is computed and each seed value is now replaced by the respective cluster centroid [9] [8]
- Euclidean distance from a seed to each cluster is calculated, and the object is allotted to the cluster with the smallest Euclidean distance [13]
- This process will be continuing until object is in same cluster at every iteration [8] [9] [10] [11]

4. PROPOSED ALGORITHM

The regular criterion for initial centroid selection in K – Means clustering can be made adaptive with the format or gray scale range of an image.

Steps for clustering:

Step 1. Image acquisition from the Database.

Step 2. Represent Image into matrix form stating to pixel values

Step 3. Compute the value of gray level co-occurrence matrix

Step 4. Consider nonzero diagonal elements of co-occurrence matrix.

Step 5. With the help of Otsu's method find the threshold and limit the number of nonzero elements present on diagonal of co-occurrence matrix.

Step 6. The modified number of nonzero elements on diagonal of co-occurrence matrix represent the number of clusters that can be formed for the given image

Step 7. Divide the range of image pixels into sub gray scale ranges equal to the number of clusters to be formed for the given image.

Step 8. Find the centroid for each gray scale range.

$$Mean = \frac{\text{sum of pixel value}}{\text{total pixels}}$$

Step 9. Perform clustering; negotiable to the centroid for each gray scale range.

Step 10. Obtain results and calculate Performance Measures for different image segments.

5. RESULTS AND DISCUSSION

Below the host image and image segments obtained after the execution of proposed algorithm are shown;

Fig. 1.Orignal Image

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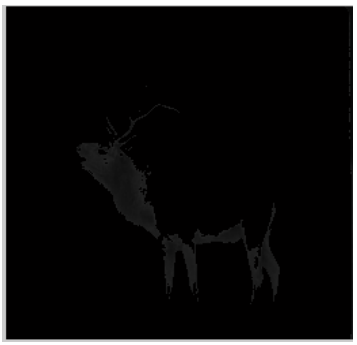
Fig.2. Cluster 1


Fig.3. Cluster 2

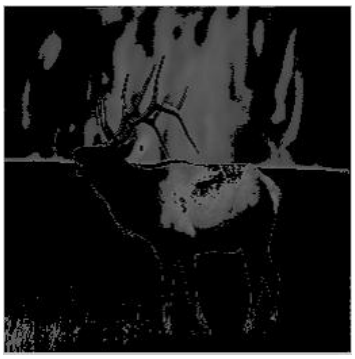
Fig.4. Cluster 3


Fig.5. Cluster 4


Fig.6. Cluster 5


Fig.7. Cluster 6


Fig.8. Cluster 7

Comparison of execution time

Number of cluster	Execution Time(By Proposed algorithm)	Execution Time(By Existing algorithm)
3	0.8417	1.8124
4	0.9484	2.3015
5	0.9417	2.3771
6	1.0918	2.7654
7	1.2049	2.8041
8	2.2324	3.5889

Comparison of Entropy

Input Image	Cluster	Entropy(By Proposed algorithm)	Entropy(By Existing algorithm)
Image	1	0.6104	0.4729
	2	3.0216	1.9212
	3	2.3357	2.2616
	4	1.2952	1.2442
	5	1.9607	0.8023
	6	1.6082	1.4097
	7	0.0532	0.0312

6. Conclusion

We conclude that with proposed method one can minimize the randomization in initial centroid selection, attending less variation in certain performance measures with respect to image segments. Image segmentation technique undoubtedly helps in object detection and recognition and is useful in biomedical imaging, Content based image retrieval, remote sensing etc. The work carried during research creates an opportunity for region based Biomedical Imaging and Image processing

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