

Current Image Segmentation Techniques-A Review

Manraj, Amitpal Singh

*Department of Computer Science & Engineering, Guru Nanak Dev University RC GSP
Gurdaspur, Punjab, India*

Abstract— Image segmentation is the most critical part in digital image processing. Image segmentation is a process of dividing an image into different sets of pixels. Segmentation is required to extract the region of interest from the image. There are various techniques of image segmentation and each has their own particular preferences and reason. In this paper, distinct image segmentation algorithms with their prospects are explored

Keywords— Image segmentation, edge detection, thresholding, K-means, neural network.

I. INTRODUCTION

Images are basically utilized in field of computer science for extracting meaningful information. Image processing has a vast range of applications in every field. In medical, it is used identification of diseases through MR images. It is used for identifying the number plates of the vehicles moving on roads. Image Segmentation is a procedure of separating an image into distinctive parts. This serves to improve or change the general presentation of a picture into such information which is more important and simpler for a framework to dissect. Reason for separating a picture is to further break down each of these subparts or sub-pictures so that some advanced information can be extracted. In some cases picture de-noising is carried out before segmentation to improve the picture and enhance the quality of the process [2]. This paper is categorized into four sections. Part II gives brief description of image segmentation. Part III describes the image segmentation techniques that are currently used. Crux is explained in part IV. Part V demonstrates the future extent of this paper.

II. IMAGE SEGMENTATION

Image segmentation alludes to the procedure of segmenting a digital image into N number of parts. The images are portioned on the premise of set of pixels or pixels in the region that are comparable on the premise of some homogeneity criteria, for example, texture, color, intensity [2]. Image segmentation separates an image $f(x, y)$ into disconnect, continuous and nonempty subsets, from these subsets larger amount data can be effectively separated. Application of image segmentation includes medical image processing, satellite images, object identification and recognition, criminal investigation, quality assurance in factories, facial recognition, airport security system etc. [3][4]. Because of the significance of the image segmentation, vast number of algorithms have been proposed yet the choice of the algorithm absolutely relies

on the sort of image and the type of the issues or problems [2].

III. EXISTING IMAGE SEGMENTATION TECHNIQUES

A great exploration is carried out in the field of image segmentation procedures. At present there are large numbers of algorithms, each doing the segmentation but not in the same way as another. There is no specific algorithm that is appropriate for a wide range of images. Algorithm created for a particular class of images may not generally apply to images of another class [2] [5]. Image segmentation techniques are based upon two approaches: 1) Detection of discontinuities and 2) Detection of similarities.

- 1) Discontinuities based: In this class, segmentation of images is done on the premise of unexpected changes in the intensities of grey level of an image. Here attention is given to the identification of lines, edges and isolated points. Detection of discontinuities includes algorithms like edge detection.
- 2) Similarities based: Segmentation is done on the premise of similitudes in intensities or grey levels of a picture. Our attention here is to identify similar points, edges and lines. Detection of similarities include algorithms like region based segmentation methods and thresholding. In this approach image is partitioned according to the similarity between the regions and some predefined criterion.

A. Threshold Method

Image segmentation by utilizing thresholding is truly straightforward however capable methodology for segmenting images based upon image-space region i.e. qualities of the picture [7]. This technique is generally utilized for pictures having light object on dark background or the other way around. Thresholding algorithm will pick a proper threshold value T to divide picture's pixels into a various classes and separate objects from the background. Any pixel (x, y) for which $f(x, y) \geq T$ is thought to be frontal area or foreground while any pixel (x, y) having value $f(x, y) < T$ is thought to be background. There are two sorts of thresholding strategy that are in existence:

1. Global Thresholding:

Global thresholding strategy is utilized when the intensity distribution between the objects of background and foreground are extremely different. At the point when the distinction between background and foreground items is extremely large, a solitary value of threshold can essentially

be utilized to differentiate both objects. Hence, in this kind of thresholding, the estimation of threshold T depends exclusively on the property of the pixel and the gray level value of the picture. Some most basic utilized worldwide thresholding strategies are Otsu, entropy based thresholding, and so forth [10].

2. Local thresholding

This technique segments a picture into a various sub regions and after that pick different threshold values for every sub area separately. Hence, threshold relies upon both $f(x, y)$ and $p(x, y)$. Some commonly utilized Local thresholding methods are 2-D entropy-based thresholding, histogram transformation thresholding, straightforward factual thresholding, and so on [7].

B. Segmentation based on edge detection

Edge detection is essential in image processing. Edge detection helps in segmentation of objects. It represents boundaries of an object [5] [6]. Edge detection algorithms find points which shows sudden change in brightness and distinction in intensities of an image. These objects are then connected together to structure closed object boundaries [6]. There is a wide range of approaches to perform edge detection. The two most utilized methods are specified here:

1) Gray Histogram Technique

In this strategy, segmentation relies on estrangement of foreground from background by choosing a threshold value T . The problem emerges while choosing the threshold values because gray threshold alike or uneven due to existence of noise. The background and curves of an image are substituted with two conic Gaussian curves whose intersection is selected as value of T .

2) Gradient Based Method

The first derivative for image $f(x, y)$ is called a gradient and also there is a sudden change in the intensity in the parts closed to edges. Points with sudden or abrupt change in intensities of two regions have larger value of gradient. These points are known as edge pixels and can be connected together to structure closed boundaries. Laplacian of Gaussian (LOG) operator, sobel operator, Laplace operator, and canny edge operator are utilized in gradient methods. Generally canny edge operator is utilized, yet it takes additional time as compared to sobel operator. Practically, an edge detection algorithm needs a balanced process of detecting accurate edges and reduction of noise. In-case the level of precision is too high, various extra and fake edges will be detected due to noise. Further if we reduce the level of noise in a great measure [7], the preciseness of edges may be reduced and some useful edges will not be detected. Hence, edge detection algorithms are normally applicable for the noise free and simple images [8].

C. Region based Segmentation Methods

When compared with segmentation based upon edge detection, the strategies based on regions are straightforward and are more resistant to noise. As opposed to edge based segmentation strategies that segment images according to sudden changes in the intensities of

neighboring pixel, region based segmentation divides an image into regions that are comparable as indicated by a predefined criteria [10]. This technique of segmentation includes:

1) Region Growing

This technique categorizes pixels in a whole image into sub parts or huge areas based upon the predefined criterion. The fundamental thought is to gather an accumulation of pixels with comparable properties for formation of a region [10]. This method can be processed into four stages:

- (i) Select a gathering of seed particles in picture.
- (ii) Select an arrangement of criteria for deciding comparative seeds based on properties, for example, grey level intensity or color and after that set up a halting guideline.
- (iii) Spread the region by joining to every seed those neighboring pixels which have predefined properties like the seed pixel.
- (iv) Stop the region development when there are no more pixels that match the measure for consideration in that region.

2) Region Splitting and Merging

According to past specified procedures, region develops by selecting an arrangement of seed points. On the other hand, in this procedure, the image is subdivided into a set of random detached regions and unites or breaks the regions as per the state of the tree in which every node has precisely four branches [10]. This incorporates the following steps:

- a) Initiate the splitting of region into four branches.
- b) Unite or merge any region when no more part is conceivable. Stop when there is no possibility of merging.

D. Theory based Segmentation

This sort of image segmentation technique incorporates the derivatives from distinctive fields and is vital for image segmentation. They incorporate clustering based algorithms, wavelet based algorithm, neural network algorithms, and genetic algorithms, etc. [10].

1) Clustering Techniques

Clustering is a learning assignment that is unsupervised. In this technique, one needs to recognize a finite arrangement of classifications known as clusters to categorize pixels [11]. A comparability criterion is established between the pixels and afterward comparable pixels are gathered together to develop clusters. Similitude criteria incorporate traits of an image, for example, texture, color, size and so on. The nature of a cluster relies upon both the nature of comparability criteria utilized and how it is executed. Clustering strategies are categorizes as fuzzy clustering, k-means clustering, hard clustering and so on.

a) Hard Clustering

A pixel can just belong to a solitary cluster and there exists a sharp border line between clusters. K-means clustering algorithm is a standout method amongst the most famous and decently utilized hard clustering algorithm [11]. It is a clustering strategy which groups n pixels of a picture into K clusters, where $K < n$ and K is a positive whole

number. Firstly, the centroids of the predefined groups are introduced. Groups are framed on the premise of some likeness features like grey level intensity of pixels and separation of pixel intensities. The methodology is as per the following:

- (i) Choose number of clusters K randomly.
- (ii) Randomly pick K pixels of diverse intensities as Centroids.
- (iii) Centroids are figuring out by computing mean of pixel values in a particular region. Place Centroids far from one another as could be expected under the circumstances.
- (iv) Compare a pixel with each Centroid and relegate pixel to the nearest Centroid to structure a cluster. At the point when all the pixels have been doled out, the initial clustering has been finished.
- (v) Recalculate the mean of every group or cluster and again compute the location of Centroids in K clusters.
- (vi) Until the Centroids stop moving, repeat steps (iv) and (v).

b) Fuzzy clustering

Fuzzy clustering can be utilized as a part of circumstances when there is no a characterized limit or boundaries between distinctive objects in a picture. It partitions the input pixels into bunches or clusters on the premise of some similitude foundation. Similitude foundation can be separation, intensity, connectivity and so forth. This algorithm incorporates Gaussian Mixture Decomposition (GMD), Fuzzy C Means algorithm (FCM), Fuzzy C varieties (FCV), Gustafson-Kessel (GK) and so on.

This algorithm [12] is most acknowledged since it can protect considerably more data than different methodologies. In this strategy, a dataset is gathered into N groups with each information point in the dataset having a place with each cluster to a certain degree.

2) Neural Network-based segmentation

In this technique, image is firstly mapped into a neural network. Here every neuron depicts a pixel [3] [7]. To determine the weights and connection between nodes, the neural network is trained with training sets. At that point the new pictures are portioned with trained neural system. Neural network segmentation incorporates two critical steps:

- (i) Feature extraction- The input data of neural network is determined in this step. Important features from images are extracted for segmentation process.
- (ii) Image segmentation- Segmentation of an image is done in this step by using the extracted features from images.

Three essential qualities of neural network based segmentation:

- (i) High strength makes it resistant to noise.
- (ii) In-case, if the data is deviated from normal circumstances the results of image segmentation is improved.
- (iii) Suitable for real time applications due to parallel and fast computing.

E. Model Based Segmentation

The human eyes can perceive objects even if they are not clearly noticeable. All the algorithms described above use only local information. For this situation, we oblige particular learning about the geometrical state of the item, which can then be contrasted or compared with the local information to reproduce the objects. This strategy is relevant just in the case when we know the precise shape of the objects comprised in an image.

IV. CONCLUSIONS

In this paper, various image segmentation techniques are described. Image segmentation has an auspicious future and has applications in every field. After decades of exploration, there is still no all-around acknowledged image segmentation algorithm. Image segmentation is influenced by lots of variables, for example, sort of image, intensity, color, etc. Hence there is no single method that is pertinent on a wide range of pictures and nature of issues. Due to all above elements, image segmentation is still a huge pending issue in the domain of image processing. In our future work, we are exploring these algorithms and applying them to perform binarization of ancient and historical degraded images to extract meaningful information that can be valuable for our economy.

REFERENCES

- [1] S.K Somasundaram, P.Alli, "A Review on Recent Research and Implementation Methodologies on Medical Image Segmentation", Journal of Computer Science 8(1): 170-174, 2012.
- [2] Image Segmentation Techniques Rajeshwar Dass, Priyanka, Swapna Devi IJECT Vol. 3, Issue 1, Jan. -March 2012
- [3] Pal, N. R. And Pal, S. K., 1993. A review on image Segmentation techniques. Pattern Recognition, 26(9), Pp. 1274 - 1294.
- [4] Zhang, Y. J., 1997. Evaluation and comparison of Different segmentation algorithms. Pattern Recognition Letters, 18(10). Pp. 963-974.
- [5] Edge Detection Techniques Evaluations and Comparisons. Ehsan Applied Mathematical Sciences, Vol. 2, 2008, no. 31, 1507 - 1520.
- [6] Evaluating The Effectiveness Of Region Growing And Edge Detection Segmentation Algorithms. Ahmed R. Khalifa 2010
- [7] W. X. Kang, Q. Q. Yang, R. R. Liang, "The Comparative Research on Image Segmentation Algorithms", IEEE Conference on ETCS, pp. 703-707, 2009.
- [8] S. S. Varshney, N. Rajpal, R. Purwar, "Comparative Study of Image Segmentation Techniques and Object Matching using Segmentation", Proceeding of International Conference on Methods and Models in Computer Science, pp. 1-6, 2009.
- [9] Baidya Nath Saha, Nilanjan Ray, Russell Greiner, Albert Murtha, Hong Zhang, "Quick Detection of Brain Tumors and Edemas: A Bounding Box Method Using Symmetry", Computerized Medical Imaging and Graphics, ISSN 08956111. 2012, pp. 95-107.
- [10] Segmentation Techniques For Image Analysis IJAERS/Vol. I/ Issue II/January-March, 2012
- [11] V. K. Dehariya, S. K. Shrivastava, R. C. Jain, "Clustering of Image Data Set Using K-Means and Fuzzy K-Means Algorithms", International conference on CICN, pp. 386-391, 2010.
- [12] S. Naz, H. Majeed, H. Irshad, "Image Segmentation using Fuzzy Clustering: A Survey", International Conference on ICET, pp.181-186, 2010.
- [13] Efficient Implementation of Local Adaptive Thresholding Techniques Using Integral Images Faisal Shafait, Daniel Keysers, Thomas M. Breuel.