A Literature Study of Image Segmentation Techniques for Images

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Abstract- **Digital Image processing techniques help in manipulation of the digital images by using computers. The general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display, information extraction. Image segmentation is a crucial step in image processing. In this paper we are studying Image segmentation techniques such as Segmentation based on Thresholding, Edge Detection, Color based binary Image segmentation, Particle swarm optimization are analyzed based on accuracy, sensitivity and specificity.**

Keywords- Image Segmentation, Thresholding, Edge Detection, Morphological Operations, Clustering.

I. INTRODUCTION

Image processing is a technique to enhance the input image to provide a clearer data. Digital image processing, where the digital images are processed using the computer. Digital images are composed of large number of elements called pixels, each pixel represents the image detail. Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. Image processing basically includes the following three steps:
a. Importing the image via image acquisition tools
b. Analyzing and manipulating the image;
c. Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers.
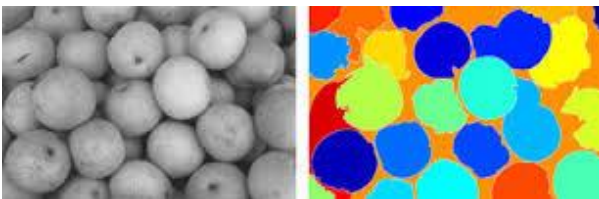

Figure 1: Example of Image Segmentation

Applications:
1. Intelligent Transport Systems – This technique can be used in Automatic number plate recognition and Traffic Signal recognition.
2. Remote Sensing - For this application, sensors capture the pictures of the earth's surface in remote sensing satellites or multi-spectral scanner which is mounted on an aircraft. These pictures are processed by transmitting it to the earth station. Techniques used to interpret the objects and regions are used in flood control, city planning, resource mobilization, agricultural production monitoring, etc.
3. Moving object tracking – This application enables to measure motion parameters and acquire visual record of the moving object. The different types of approach to track an object are Motion based tracking and Recognition based tracking.

II. IMAGE SEGMENTATION METHODS

Image Segmentation is the process of dividing colour or gray level images into different regions or segments as per the area of interest. Segmentation is used for object recognition, boundary estimation, image compression, image editing. The main objective of image segmentation is to divide the image for further image analysis and arrange pixels into high level representation for further analysis. Multiple segmentation algorithms are exits, choice of particular segmentation technique is depend upon for which application it is useful and type of image which is being processed for extracting information from the image.

A. Segmentation based on Thresholding

Image segmentation based on Thresholding is quite simple than other segmentation methods. Here single value is selected as threshold and used to segment the image mostly into foreground and background segments. Value taken as Thresholding is T and image is I, for any pixels I(x, y) intensity value greater than T replace that pixel intensity value by 1 otherwise replace it by 0. There are two methods namely global Thresholding and local Thresholding When there is intensity distribution between the foreground pixel intensity value and background pixel intensity value which are very distinct from each other then global Thresholding method is used. Otsu method is one of the common methods of global Thresholding. In Multilevel Thresholding by using Otsu method multiple threshold values are used to segment the input image.

B. Segmentation based on Edge Detection

Edge detection method is used to solve image segmentation by detecting the edges or pixels between different regions that have sudden transition in intensity values are extracted and linked to form closed object boundaries. The result is in a binary image. Edge detection having three steps namely Filtering, Enhancement and Detection. Most commonly used edge detection methods are Canny, Sobel, Prewitt, Robert these all are first derivative operators. When there is sudden change in intensity value near edge and there is little noise in image then gradient based method works well. This method involves roll together gradient operators with the image. High value of the gradient magnitude is possible place of rapid transition between two different regions. These are edge pixels, they have to be linked to form closed boundaries of the regions. Common edge detection operators used in gradient based method are Sobel operator, canny operator, Laplace operator, Laplacian of Gaussian (LOG) operator, canny is most promising one, but takes more time as compared to Sobel operator. Morphological operations are also used to extract the shape of images. It is mostly apply on binary images Dilation and erosion are one of the morphological operations. In dilation operation edges of objects in binary image are becoming broad or thick. In erosion operation edges of objects in binary image shrinks or thins.

C. Region based Segmentation

Segmentation method based on region is relatively easy as compare to edge detection method and more effective to noise. In edge detection method image is segmented based on changes in intensity near edges at great rate and in region based methods, image is partition into regions that are similar according to a set of predefined condition or seed point. Region based segmentation include two methods Region growing, region Splitting and Merging.

1) Region Growing

In region growing method, pixels are grouped into different region based on predefined condition or initial seed point. In region growing method first select a seed particle from input image, and then Select set of the criteria to find out similar seed based on color or intensity value and after that set stopping rule. Region is growing as per the similar properties between the seed pixel and neighboring pixels. When no more pixels that match the predefined criteria region growing stops.

2) Region Splitting and Merging

Instead of choosing seed points, divide an image into a set of unconnected regions and then merge the regions to satisfy the conditions of image segmentation. First image is split into small regions till regions with mandatory degree of homogeneity are formed. The splitting of the phase has an impact on the overall segmentation of the image. This results in over segmentation of the image. And then merging step is followed. Disadvantage of region splitting and merging techniques is complex and take a lot of time.

D. Segmentation based on Clustering

There are two types of learning task unsupervised learning task and supervised learning task, clustering is unsupervised task, there is no need of training set required to cluster the input data here data is pixels of input images. Clustering is done on the basis of similarity criteria defined between pixels. The pixels are grouped into clusters in such manner that intra cluster similarity is maximum and inter cluster similarity is minimum. K-means clustering and fuzzy clustering these two methods are basically used to cluster the input image

1) Hard Clustering

K-means clustering is used as hard clustering. In hard clustering sharp boundaries are assumed between clusters. Same pixel is not found in two clusters at a time In k-means clustering initial cluster center are randomly choose and make sure that these cluster centers are far away from each other and then by using any distance measuring method calculate distance between each pixel value with each cluster center and assign that pixel to that cluster having less distance between pixel value and cluster center. Once whole image is scanned then repeat same procedure and recalculate cluster center values by calculating mean value of all pixel values present in that cluster. Until no more change in cluster center values this procedure is repeated. Finally image is getting clustered into different clusters

E. Color based Binary Image Segmentation

In color based binary image segmentation the brightness of the input color images are removed by adjusting the thresholding values. Then the color image is converted to binary image and the edge detection is applied. The color inversion is done to identify the defected parts. Finally the binary image is converted to color image and the defected parts are easily identified.

F. Particle Swarm Optimization

PSO is a computational method that optimizes a problem by iteratively improving a candidate solution with a proper quality measurement. PSO optimizes a problem by having a group of solutions and moving these particles around the search-space by simple mathematical formulae. Each particle's movement is influenced by its local best known position, but it is guided towards the best known positions in the search space which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions.

G. Parameters of Image Segmentation

Accuracy: Determines the efficiency of the system
Accuracy= ((True Positive + True Negative)/ (True Positive + True Negative + False Positive + False Negative))*100
Specificity: Fraction of Negative samples predicted as a Positive class
Specificity= True Negative/ (True Negative + False Positive)*100
Sensitivity: Fraction of Positive samples predicted correctly by the model
Sensitivity= True Positive/ (True Positive + False Negative)*100

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III.   MANIFESTATION SYSTEM

The aim is to develop segmentation methods for Colored imaging applications.. To fulfill the problem and maintain the accuracy, we need to follow the following objectives:

1. To analyze and differentiate image using Color Based Image Segmentation Techniques.
2. To Implement the Improved Algorithm in Simulation Tool.
3. To improve accuracy by choose right type of filters in algorithm.
4. To Implement designed algorithm.
5. To generate the outputs using performance parameters such as PSNR.
6 To Generate Graphs.

IV. INTENDED SYSTEM

1. To understand general problem of detecting linear structure.
2. To analyze techniques of image segmentation.
3. Study the techniques for improving segmentation and Color based Image Grouping.
4. Identify the problems in existing techniques and Methods.
5. Design an efficient technique to improve color and Pixels based Image Segmentation.
6. Develop the algorithm in any programming language to demonstrate the real scenario.
7. Analyze the results.

V. COMPARATIVE STUDY OF VARIOUS SEGMENTATION TECHNIQUES

In this section briefly outlines the pros, cons and segmentation effects of Threshold based, Edge based, Region based, Cluster based and Color based segmentation techniques. The merits and demerits of various segmentation based image compression techniques are analyzed in detail. In our future work we will plan to get the best technique for detecting edges in a quite as simple enhanced way for detecting segments

Segmentation Techniques	Pros	Cons
Threshold	Segment the image from background effectively	Sensitivity and Specificity is low
Edge based	Detect strong & weak edges	Very Noisy
Region based	Provides unique image with clear edges	Requires may iterations.
Color based	Indicate the edges, boundaries and texture information	Requires more number of clustering

VI. CONCLUSION

In this paper we have discussed the useful methods of Threshold based, Edge based, Region based, Cluster based and Color based methods of image segmentation. This comparison study is helpful for individual researchers to do research in the area of image segmentation. Throughout this study of the various techniques, we conclude that the image segmentation is the crucial part of the image processing model.

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