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A REVIEW ON VARIOUS SEGMENTATION TECHNIQUES IN IMAGE PROCESSSING

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Abstract---Due to the advancement of computer technology image-processing techniques have become increasingly important in a wide variety of applications. Image segmentation plays a important role in image processing. Image segmentation refers to partition of an image into different regions that are similar and different in some characteristics like color, intensity or texture. Different algorithms and techniques have been developed for image segmentation. This paper investigates and compiles some of the technologies used for image segmentation. The various segmentation techniques like Edge Detection, Threshold, Region based, Feature Based Clustering and Neural Network Image Segmentation were discussed in this paper.

Key words: Segmentation, Neural Network, Thresholding, Image Processing

1. Introduction

An image is a visual representation of something and it contains a lot of useful information. Understanding the image and extracting information from the image in such a way that it will not affects the other feature of the image to accomplish some works is an important application in digital image technology. Image enhancement is the important step required to fulfill this requirement.1] After filtering the noise from the image, you can perform any operation on that image. [2]

Image segmentation is the first step in understanding the image processing. In practice, it is often not interested in all parts of the image, but only for some certain areas which have the same characteristics. Image segmentation is one of the important parts in image processing, computer vision and image recognition. It is based on certain criteria that divide an input image into a number of the same nature of the category in order to extract the area which people are interested in. For feature extraction and recognition of an image, image segmentation plays a vital role.

This paper provides a literature review on various image segmentation methods. The paper is organized as follow: Section II discusses about the image segmentation. Section III describes different types of image segmentation techniques and Section IV Concludes the overall study.

2. Image Segmentation

In digital image processing, image segmentation is a most commonly used technique and analysis to partition an image into multiple regions, often based on the characteristics of the pixels in the image [3] Image segmentation is the process of separating foreground from

background, or clustering regions of pixels based on similarities in color or shape. For example, a most common application of image segmentation in medical imaging is to detect and label pixels in an image of a 3D volume that represent a tumor in a patient's lung or other organs. Other practical application of image segmentation range from filtering of noisy images, medical applications, Locate objects in satellite images, Object detection and Recognition Tasks, Automatic traffic control systems and Video surveillance, etc. [4]-[5]

3. Segmentation Techniques

Most of the image segmentation algorithms are based on two basic properties of intensity values: discontinuity and similarity [6]. The first approach is to segment the image based on abrupt change in intensity, such as edged in the images. The second approach is based on some pre-defined criteria upon which images are partitioned.

Segmentation can be classified as:

A. Edge Detection Image Segmentation
B. Threshold Based Image Segmentation
C. Region Based Image Segmentation
D. Feature Based Clustering Image Segmentation
E. Neural Network Based Image Segmentation

A. Edge Detection

In image segmentation process, Edge detection is the basic step used to find the boundaries of objects within images. The edge detection is obtained by identifying the sharp changes or discontinuities in brightness. [7] It usually involves arranging points of discontinuity into curved line segments, or edges. The edge detection for image segmentation methods are Gray histogram and Gradient methods. [8]. Several operators are used by edge detection method, i.e., Classical edge detectors, zero crossing, Canny Edge detector, Sobel, Prewitt, Roberts Laplacian of Guassian(LoG)[9], and color edge detectors etc [10].

Zotin, Alexander, Konstantin Simonov, Mikhail Kurako, Yousif Hamad, Svetlana Kirillova.[11] proposed a Edge detection of MRI images based on fuzzy C means clustering. In this method, they used Balanced Contrast Enhancement technique (BCET) to improve the characteristics of medical images which involves noise removal functions. Then image segmentation techniques are carried out with the help of Fuzzy C means clustering method. Finally, Canny Edge Detection method is used to detect the edges of the image. Their technique yields better results in order to preserve more edge information with high accuracy.

S. Yuan, S. E. Venegas-Andraca, C. Zhu, Y. Wang, X. Mao and Y. Luo [12], Proposed a Fast Laplacian of Gaussian Edge Detection Algorithm for Quantum Images. They used Gaussian operator to find the discrete LoG mask. Then quantum image is filtered with the LoG mask and they used to find the zero crossing points to detect the edges and they analyzed the time complexity.

M. Nikolic, E. Tuba and M. Tuba [13] proposed a modified Canny Edge detection algorithm for ultrasound images. The ultrasound images are sensitive to noise and it is removed by modified median filter and then it is processed by canny edge detector to detect the edges of internal organs precisely compared to other methods.

Neha Yadav and Vikas Sindhu [14] Proposed a new edge detection technique which detects a acute and precise edges with the use of different filter namely STD, Median, Weiner, Gobar, Harmonic, Geometric filters etc.

B. Threshold Based

Thresholding is the most common method of image segmentation. Thresholding is a image segmentation technique to convert a multilevel image into a binary image i.e., it choose a proper threshold value to divide image pixels into several regions and separate objects from background. Different thresholding techniques proposed by different researchers are OSTU thresholding, P-tile method, Histogram dependent technique, Edge Maximization technique, Mean method, and visual technique.

Salem Saleh Al-amri [15] has applied Mean technique, Pile technique, HDT, and EMT technique on satellite images in order to find the best segmented image. From the above techniques, it is observed that Histogram Dependent Technique and Edge Maximization Technique are the best thresholding techniques.

Magdalene C. Unajan Magdalene C. Unajan, Member, IAENG, Bobby D. Gerardo, Ruji P. Medina [16] presented a modified Otsu-based Image Segmentation Algorithm to enhance the performance of the Otsu method. They calculated optimum threshold value by using standard deviation. The results show that the computational cost is low and is more immune to noise compared to previous methods.

C. Region Based Image Segmentation

Region Based Segmentation are relatively simple and more immune to noise compared to edge detection method [17]. In region-based methods, partition an image into regions that are similar according to a set of predefined criteria. Region based segmentation methods are divided into three main parts, i.e., region growing, region splitting, and region merging [18]. Region growing is a region-based sequential technique in neighboring pixels are scanned and added into larger regions based on predefined seed pixels, growing criteria and stop conditions.

Region splitting is to divide the image into a set of disjoint regions which are coherent within themselves. A region merging process is used after each split which compares the adjacent regions and merges them if necessary.

Seemawazarkar, Bettahally N. Keshavamurthy, Ahsan Hussain [19] introduced a method of region-based segmentation of images using soft KNN algorithm. They incorporated soft classification techniques with k-nearest neighbour algorithm to detect the ambiguous region of the image. For experiments, they collected the images from social networks. This method performs much better than traditional k-nearest neighbour approach.

Karoui [20] proposed a new unsupervised image segmentation method using level set methods and texture statistics. This method includes an automatic feature selection step used to readjust the weights attached to each feature in the curve evolution equation that drives the segmentation. This method improves the computational efficiency.

Nguyen MongHien Edge, Nguyen ThanhBinh, and Ngo QuocViet[21] proposed a edge detection based on Fuzzy C Means in medical image processing system. To improve the quality of MRI image, they proposed Semi Translation Invariant Contourlet Transform (STICT) and then fuzzy K means clustering is used to segment the images. They used Canny Edge detection techniques to detect the edges of the image accurately. This method yields accurate results compared to other methods.

Chidadala J., Maganty S.N., Prakash N [22] proposed automatic seeded point selection region growing algorithm along with clustering technique to solve MRI image segmentation problems. First, the image is preprocessed by the median filter and then segmented by automatic seeded point region growing algorithm. After the segmentation process, the image is classified by a support vector machine (SVM).

D. Image segmentation based on clustering

Clustering is a powerful technique in image segmentation. There are several clustering methods such as k means, adaptive k means, fuzzy c means (FCM) and improved fuzzy c mean algorithm (IFCM). *K*-Means clustering algorithm is an unsupervised algorithm used to segment the wanted area from the background. It clusters, or divides the given data into K-clusters.

PengfeiShan[23] proposed an image segmentation method based on K-mean algorithm. To extract the features, they used a grey gradient maximum entropy method and uses K-mean method to classify the images.

Juntao Wang and XiaolongSu[24] proposed improved K-means Clustering Algorithm with the use of noise data filter so that the impact of noise data on K –Means algorithm is decreased effectively and clustering results will be more accurate.

Xin Zheng [25] proposed a method Adaptive K-means Algorithm for image segmentation which results an accurate segmentation value and is very simple method.

N.A. Mohamed; M.N. Ahmed [26] describes the application of fuzzy set theory in medical applications. They proposed Markov random field (MRF), a new method which is less sensitive to noise and a fully automatic technique to obtain image clusters.

Nguyen MongHien, Nguyen Thanh Binhand Ngo Quoc [27] presented a new approach to MRI edge Detection. They used the Semi Translation Invariant Contour let Transform (STICT) to improve quality of the original MRI and Fuzzy C Means (FCM) clustering method is applied for the image segmentation. After that to detect the fine edges, Canny edge detection algorithm is used. Experiment results shows that it yields better results compared to other methods.

E. Neural Network Based Image Segmentation

Neural networks are an interconnected collection of nodes called neuron. Every neuron takes one piece of the input data, typically one pixel of the image, and applies a simple computation, called an activation function to generate a result. Each neuron has a numerical weight that affects its result. That result is fed to additional neural layers until at the end of the process the neural network generates a prediction for each input or pixel.

Leena Silvoster M and Govindan V.K[28] Conventional Neural Network (CNN) is a method used to segment images and to extract the features directly from pixel images with minimum preprocessing.

In Artificial Neural Network (ANN), each neuron is corresponding to the pixel of an image. An Image is mapped to the neural network. An Image in the form of neural network is trained using training samples, and then connection between neurons, i.e., pixels is found and then the new images are segmented from the trained image [29].

M. M. Mehdy [30] proposed Two ANN model for the early detection of breast cancer. (i) First, applying classifier directly to the region of interest (ROI) image data. (ii)Second, understanding the situation from the features extracted from the pre-processed image signals.

P. Mohamed Shakeel and S.Baskar [31] implemented a new method of FFANN to enhance the cardiac image segmentation . With this method, it is able to detect the edges and to define the texture boundary accurately. Experiment results shows that effective learning capacity of FFANN and time consuming for image segmentation is less compared to other methods.

4. CONCLUSION

Image segmentation has become an auspicious future and it mainly focus on the contemporary research in many fields like object recognition and detection, medical images, and satellite images. For different images, we can't able to adapt the same method to segment the images because; the image segmentation depends on different characteristics like homogeneity, color, texture, etc. Still many researches going on in image segmentation to get better results with high accuracy. In this paper, an overview of image segmentation and various techniques used for image segmentation were discussed. Further, different papers suggested many points about segmentation techniques were discussed. This work will give an idea for the researchers to develop new segmentation models.

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