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Enhancement Of Image Segmentation Based On Modularity Optimization

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Abstract—Image segmentation is an emerging technique which separates a part of any object or image. Pattern Recognition and Image analysis are the initial steps of image segmentation. Image Analysis is one of the methods for the extraction of meaningful information from images. Oversegmentation is the major problem in image segmentation .in the problem of over segmenting an image into sizeable homogeneous region various techniques have been followed which seems to be time consuming and produces repetitive pattern.To overcome the oversegmentation problem an efficient fire fly algorithm is used.

Keywords : Digital Image Processing, Edge detection, Image Segmentation.

I. INTRODUCTION

A. IMAGE PROCESSING

Image processing is one of the methods for converting an image into digital form and performs some operations on it, to receive an enhanced image and to extract some useful information by it which intakes input from fig 1.1 as an image, like video frame or photograph and output could be an image or characteristics associated to that image. These methods will rapidly growing technologies today, by its applications for various aspects of a business, engineering, science and medical field. Image Processing creates a core research area in engineering and computer science disciplines.Image processing basically includes the following three steps:

Importing the image for optical scanner or digital photography.

- Analyzing or manipulating for the image that includes data compression and image enhancement and spotting patterns which are not possible for viewing by human eyes like satellite photographs.
- Output is the last stage which result may be an altered image or report, based on image analysis.

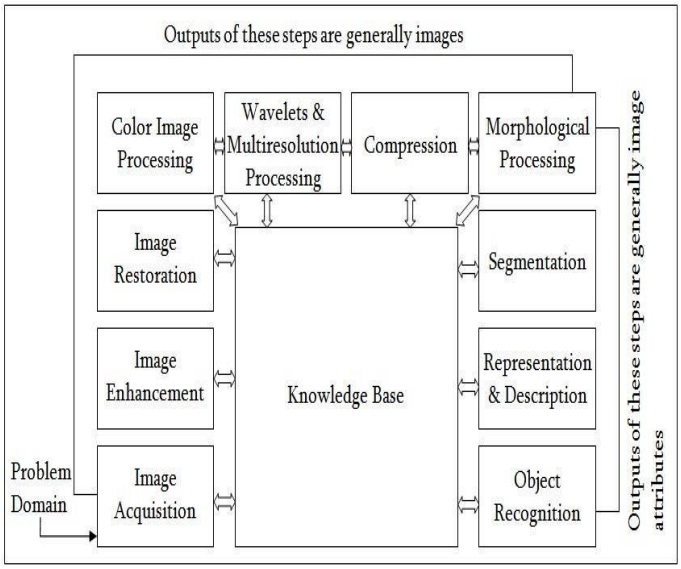

Fig 1.1 Image processing

B. USES OF IMAGE PROCESSING

Image processing is divided into 4 groups based on their uses. They are

1. Visualization
2. Image sharpening and restoration
3. Image retrieval

Image Recognition

II. IMAGE SEGMENTATION

Image segmentation is the process for partitioning a digital image to the multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify the change on representation for an image into something easier to analyze. Image segmentation is used for locating objects and boundaries (lines, curves, etc.) to the images. More precisely, image segmentation is the process for assigning a label for every pixel on an image such that pixels those label to share certain characteristics. The results of image segmentation are the set of segments, collectively covers the entire image on a set of contours extracted by the image. Each of the pixels on regions is similar for some of the characteristic or computed property on the feature like color, intensity, or texture.

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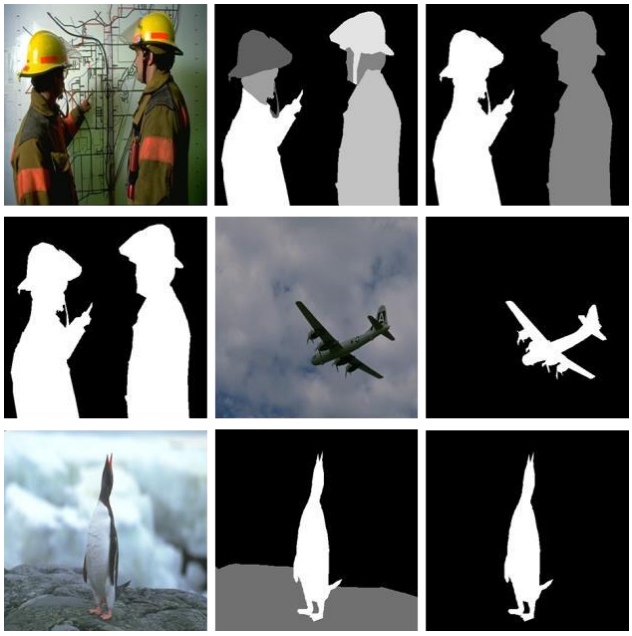

Fig 1.2 Image Segmentation

Image segmentation is the process which subdivides the image to its constituent parts or objects. The level by which these subdivision are carried out depending upon the problem that solved, i.e., the segmentation should stops on the objects that interest on an application which have been isolated e.g., on autonomous air-to-ground target acquisition, that lies to identify vehicles on a road, the first steps are to segment the road from the image and then for segmenting the contents on the road down to potential vehicles. Image thresholding techniques are used for image segmentation.

III. IMAGE SEGMENTATION TECHNIQUES

Many image segmentation techniques are developed by researchers and scientists, which is most important and widely used on image segmentation techniques. Latest research work on image segmentation techniques are highlighted, discussed and evaluated below.

A. Threshold Based Image Segmentation

Histogram thresholding is used for segmenting on image; that is certain applied on pre-processing and post-processing techniques which requires to the threshold segmentation [17]. Major Thresholding techniques proposed by the different researchers are Mean method, P-tile method, Histogram dependent technique, Edge Maximization technique, and visual technique. In this section, several new approaches for the last five years resulted on threshold based image segmentation are being discussed.

SalemSalehAl-amri [18] has applied Mean technique, Pile technique, HDT, and EMT technique on three satellite images in order to select the best segmented image from all above techniques. Experiments and comparative analysis of techniques have shown that HDT (Histogram Dependent Technique) and EMT (Edge Maximization Technique)are the best thresholding techniques which out perform al other thresholding techniques.

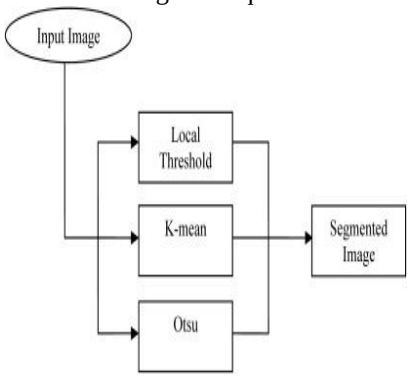

Figure 2.1 Block diagram for threshold technique

KaipingWeI[19] have found that current image segmentation techniques are time consuming and require lot of computational cost in order to perform image segmentation. It is a big problem for real time applications.

They proposed a new threshold based segmentation method using Particle Swarm Optimization (PSO) and 2-d Otsu algorithm (TOPSO).TOPSO algorithm used PSO technique to search an optimal threshold for the segmentation process .Figure 2.1 shows a clear view of Otsu process. They implement the proposed hybrid method on Matlab7.0. Results shown that TOPSO algorithm takes25timeslesstimeas compare to traditional Otsu algorithm. It is good for real time applications.

B. Region Based Image Segmentation

Region based segmentation is simple as compared to other methods and also noise resistant. It divides an image into different regions based on pre-defined criteria, i.e., color, intensity, or object. Region based segmentation methods are categorized into three main categories, i.e., region growing, region splitting, and region merging [20]. In this section several new approaches regarding Region based image segmentation is discussed from last five years.

Karoui[21]proposed a new unsupervised image segmentation method using levels methods and texture statistics. They claim that their method is different from other methods since it doesn't assume independent variable, and it doesn't restrict to first order grey features. The implementation includes feature selection step to re- adjust the weights of each feature to get the segmentation. In experiments, filter response histogram is used to calculate the number of distributions ;hard wavelet is used to compute the energy of image wavelet of each band. PDE is used tor e-initialize the level sets. Results have shown for a image with block diagram in figure 2.2

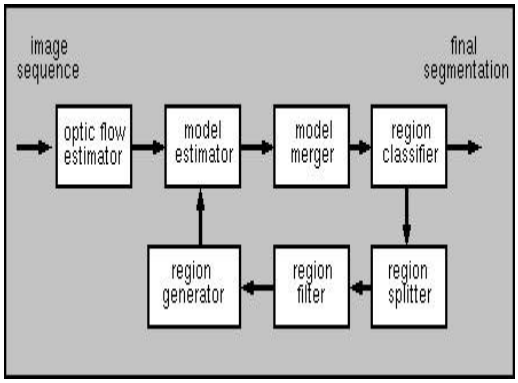

Figure 2.2 Region based image segmentation

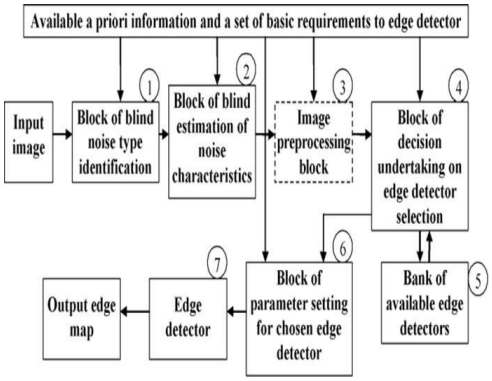

Figure 2.3 Block diagram for edge detector

Yong-meiZhou[22]has introduced new region-based image segmentation technique with the help of mean-shift clustering algorithm. Firstly, their method extract color, texture, and location features of each pixel of an image, secondly, make the clusters on the basis of those features using mean-shift clustering approach, label the each region, and finally make segments of image on the basis of these labels.TheyusedMatlab7.0toimplement their algorithm .Experiment shows that their method present better results in term of speed and segmentation.

CivahirCigla[23] presented a new graph theoretic color image segmentation method, and tries to improve the normalized cut image segmentation method. They used image with weightedun-directedgraph, whereas nodes represent the regions,and weights between nodes represent the intensity match of neighboring regions. Their modified normalized cut method has solved the problem of over segmentation in which extra regions are created for image .Experiments are conducted on images of cow, mosaics, and multi-resolution NC image and results compared with NCIS algorithm on the basis of

MSE criteria. The results shown that proposed method improve the NCIS algorithm.

C. Edge Based Image Segmentation

Edge detection is a basic step for image segmentation process [24].It divides an image into object and its background. Edge detection divides the image by observing the change in intensity or pixels of an image. Gray histogram and Gradient are two main methods for edge detection for image segmentation [25].Several operators are used by edge detection method,i.e., Classical edge detectors ,zero crossing, Laplacian of Gaussian (Log)[26],and color edge detectors etc[27].In this section several new approaches regarding Edge detection based image segmentation is discussed from last ten years and explained with clear structure in fig 2.3

YuXiaohan [28]proposed a new image segmentation technique based on region growing and edge detection methods.Their hybrid method helps the segmentation process to avoid from errors when both techniques used in a separate manner.Region growing is used to find the edge pixels in the image,while2ndorder derivative is used for edge detection .Experiments are conducted on 3D MRI image data.Gaussian technique is used for smoothing after edge detection .Results have shown that their technique is better in order to preserve more edge information.

Wesolkowsk[29]-[30]have used the Markov Random Fields for edge and region based hybrid color image segmentation. Firstly,line process is implemented using edge detection algorithm.Vector angle measure is used as a distance measure between pixels in order to detect edges.The main problem with their technique is that it is a pixel neighbor model and has the same drawbacks of region growing method. A parameter estimation technique is used to evaluate.

Ying-Tung Hsiao[31]proposed a new image segmentation technique by combining morphological operator with region growing technique. Firstly they used morphological closed operation to enhance the image and then perform edge detection using dilation residue edge detector .After it they deploy growing seeds and perform the region growing process for image segmentation, after it ,region merging and edge detection is performed on the images.They perform experiments on table tennis, girl and MRI image.Snake boundary condition method[32] is used to get better edge detection results.All experiments are conducted in VisualC++.

AmjadZaim[33]has found that segmentation of prostate boundaries from ultra sound images is a challenging task for surgical procedures. They proposed a new edge based segmentation technique for prostate ultrasound image. Phase symmetry is used to perform the edge detection on the ultrasound images. Median filter is used to reduce the noise. Edge extraction and edge linking is used to produces the final edge based segmentation image. The main advantage is that their method doesn't require any human intervention. Results of contour produced by their method are compared with manually segmented contours, and accuracy of87%is found.

D. Fuzzy Theory Based Image Segmentation

Fuzzy set theory is used in order to analyze images, and provide accurate information from any image. Fuzzification function can be used to remove noise from image as well[34].Agray-scale image can be easily transformed into a fuzzy image by using a fuzzification function. Different morphological operations can be combined with fuzzy method to get better results [35]. Fuzzy k-Means andFuzzyC-means (FCM)are widely used methods in image processing [36]. In this section several new approaches of image segmentation using Fuzzy theory is presented

GourChandraKarmakar [37]introduced a new fuzzy rule based image segmentation technique which can integrate the spatial relationship of the pixels.Three types of membership functions are used,i.e.,Membership function for Region pixel distribution ,to measure the closeness of the region, and to find the spatial relationship among pixels.There is no need to define parameters in their technique ,like FCM algorithm.Fuzzy rules uses above three membership functions and fuzzy IF-THEN rule structure to perform segmentation of an image .FCM and proposed technique implemented on Matlab5.3.1onX-ray image and human vocal tract image .Results have shown that GFRI Soutper form FCM and isolate the object from background AmolS.Pednekar[38] proposed a new image segmentation technique based on fuzzy connectedness using dynamic weights. Author has found that traditional segmentation schemes can't solve the problems of fuzzy medical images.They introduce DyW algorithm which dynamically adjusts the linear weights in fuzzy connectedness. The seed DyW algorithm is applied successfully to the images of different modalities, whereas multiple seed is applied to infrared face segmentation. It is found that DyW image segmentation algorithm gives99%more accuracy as compare too their techniques.

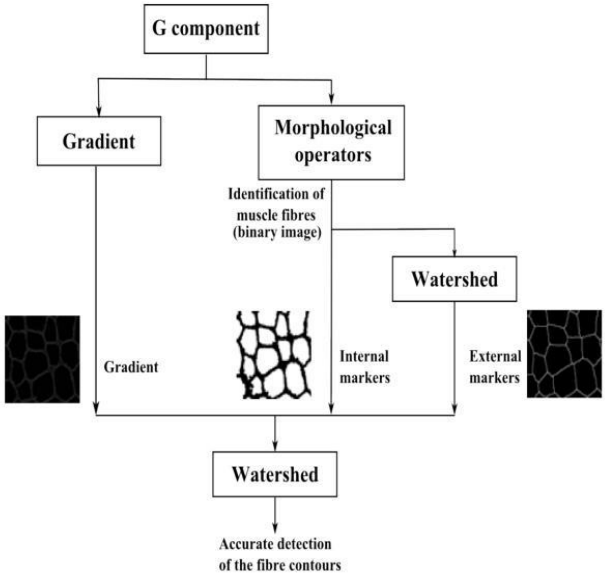

Figure 2.4 Block diagram of fuzzy based segmentation

AmolS.Pednekar[38] proposed a new image segmentation technique based on fuzzy connectedness using dynamic weights. Author has found that traditional segmentation schemes can't solve the problems of fuzzy medical images.They introduce DyW algorithm which dynamically adjusts the linear weights in fuzzy connectedness. The seed DyW algorithm is applied successfully to the images of different modalities, whereas multiple seed is applied to infrared face segmentation.It is found that DyW image segmentation algorithm gives99%more accuracy as compare too their techniques.

LiuYaju[39]has proposed a new fuzzy color image segmentation algorithm based on feature divergence and fuzzy dis-similarity.

Their algorithm claims to improve segmentation quality. Their algorithm extracts sub- images feature eagen-vector using watershed technique is shown in fig 2.4 . Firstly,color image is transform into gray level image, histogram is created in second step,cluster are created in next step, FCM is applied to each cluster, then they applied erosion, dilation ,and region growing on resultant image After it, the segmented region image is produced at the end .Image Is taken with complex background, i.e., photographic images .Results have shown that fuzzy approaches generate better result.

E. ANN Based Image Segmentation

In Artificial Neural Network, every neuron is corresponding to the pixel of an image .Image is mapped to the neural network. Image in the form of neural network is trained using training samples,and then connection between neurons,i.e.,pixels is found.Then new images are segmented from the trained image [40].Some of the mostly used neural networks for image segmentation are Hopfield ,BPNN,FFNN,MLFF,MLP, SOM,and PCNN. Segmentation of image using neural network is performed in two steps,i.e. ,pixel classification and edge detection [41].In this section several new approaches of ANN used for image segmentation is discussed from lastf ive years.

XuejieZhang[42] proposed a new Fast learning Artificial Neural Network (FLANN) based color image segmentation approach for R-G-BS-V(i.e.,RGB and HSV)cluster space.In first step,noise is removed using 3*3 averaging filter to reduce the disparity in color distribution. In second step ,pixels are converted to RGBSV space using HSV conversions.FLANN clustering is performed to produce a cluster result of image. Next, pixels with same color are being separated. Segment number is assigned to each segment of image. Effect of tolerance and neighborhood size is observed. Results have shown that proposed algorithm produced perfect segments for colors in the image.

FarhadMohamad Kazemi[43]proposed a fastC- means based training of Fuzzy Hop field Neural network [44]in order to apply it into image segmentation. Objective function is used based on2-fFuzzyHNN.This objective function found the average distance between image pixels and cluster's centroids.According to author, Fuzzy HNN provides better

segmentation as compare to other methods. Firstly,they make clusters from given data ,then perform normalization, i.e. grey level images, calculate centroids, then compute distances, find new centroids, and computer new new membership function value using fuzzy C-means [45].The results have shown that FHNN provides a faster speed as compare.

F. PDE Based Image Segmentation

PDE(Partial Differential Equations)equations or PDE models are used widely in image processing, and specifically in image segmentation. They uses active contour model for segmentation purpose .Active Contour model or Snakes transform the segmentation problem into PDE .Some famous methods of PDE used for image segmentation are Snakes ,Level-Set,and Mumfordshah method[46].In this section, several new approaches for image segmentation based on PDE are discussed.

GloriaBueno[47]presents a new method of segmentation of anatomical structure in medical images. Adaptive PDE models,i.e.,fuzzy PDE Contour model, and PDE geometrical Contour model with FuzzyC- Means classification is used for segmentation ofimages. Adaptive PDEmodels helped to find the region of interest. 3DbrainMRI Image is used as a dataset. Fuzzy PDE model has segment the MRI brain image using Fuzzy Clustering approach.The model has out performed‘Snakes’model and reduce some of drawbacks of Snakes model.

Feature extraction schemes in[48]-[49]are capable to handling geometrical complexity, rate of change,and orientation of image .New PDE based segmentation scheme is also presented that increase contrast criteria of texture information. PDEs are used for modeling the segmentation scheme.

Watershed method [50] is extended by using PDE models. They compare their proposed scheme with watershed segmentation method, and it is found that coupling of textural information, and modeling using PDEs leads the image segmentation to high quality process and outperforms the watershed segmentation algorithm.

IV. CONCLUSION

In this review of image segmentation , the overview of various segmentation methodologies applied for image processing is explained briefly.A number of relevant algorithms have been proposed in recent years for avoiding oversegmentation like mean shift algorithm, watershed segmentation algorithm, graph partition algorithm etc.All these algorithms have the sensitive problem of noise and easily leads to oversegmentation. The proposed method uses the agglomerative algorithm based on modularity optimization .Different from the existing algorithms based on modularity, we identify the differences between community detection and image segmentation, start from superpixels, and propose a new texture feature from low-level cues to capture the regularities for the visually coherent object and encode it into the similarity matrix; moreover, the similarity among regions of pixels is constructed in an adaptive manner to avoid oversegmentation. Compared with other existing segmentation algorithms, our proposed algorithm can automatically detect the number of regions/segments in an image, produces sizeable regions with coherent regularities preserved, and achieves better semantic level segmentation to some extent.

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