

A Review on Image Segmentation Techniques

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ABSTRACT: Segmenting an image into meaningful parts is a fundamental operation in image processing. Image segmentation is the action of splitting or dividing an image into numerous segments. Segmentation algorithm clubs a set of pixels with same features such as color, intensity, texture, disparity and motion and extracts the features of images. Image Segmentation played an essential role in Computer vision it is used for object tracking and to identify image boundaries. In this survey paper we discussed about various segmentation techniques that are used in the image analysis.

KEYWORDS: Digital image, Color, Intensity, Texture, Disparity, Motion, Object Tracking

I. INTRODUCTION

The image segmentation is one of the most efficient technique in the field of digital image processing technology. Image processing is an action to convert an image into digital form and perform some operations on it, in order to get a better image or to get some useful data from it. Image is duplication of object. An image consists of two dimensional function $f(x,y)$ where x and y are the two co-ordinates horizontally and vertically. The value of $f(x,y)$ at any point is gives the pixel value at that point of an image ranging between 0 and 255 [19]. For the segmentation we need to select the images. But the images should be either in form of black and white or colored. Color images are due to the grey level.

II. SEGMENTATION TECHNIQUES

Image segmentation is the process of dividing a digital image into multiple segments (sets of pixels, also known as super-pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. There are many segmentation techniques which are shown below [17]:

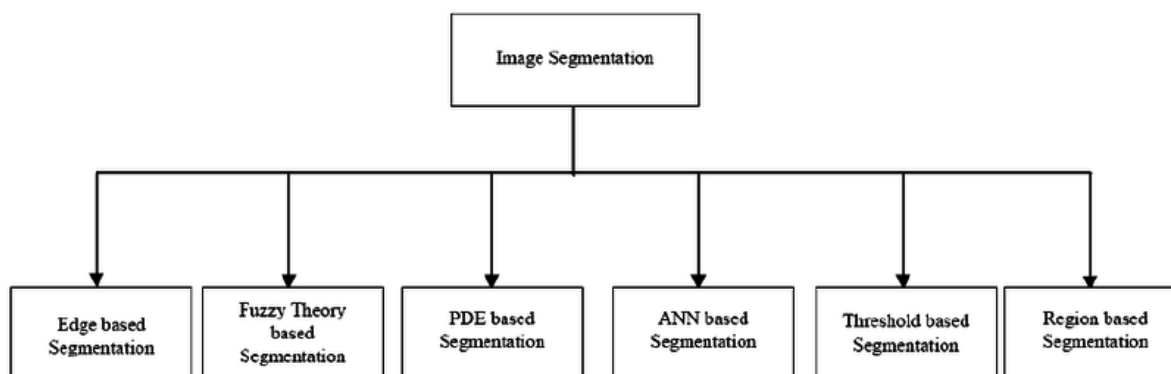


Fig-1: Segmentation Techniques

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2.1 Edge Based Segmentation Method

A connected pixel that is found on the boundary of the region is called an edge. So these pixels on an edge are known as edge points. An edge is extracted by computing the derivative of the image function. Some 4 types of edges are very easy to find. They are 1) Step-edge 2) Ramp-edge 3) Ridge-edge and 4) Ramp-edge and are shown as below [4]:

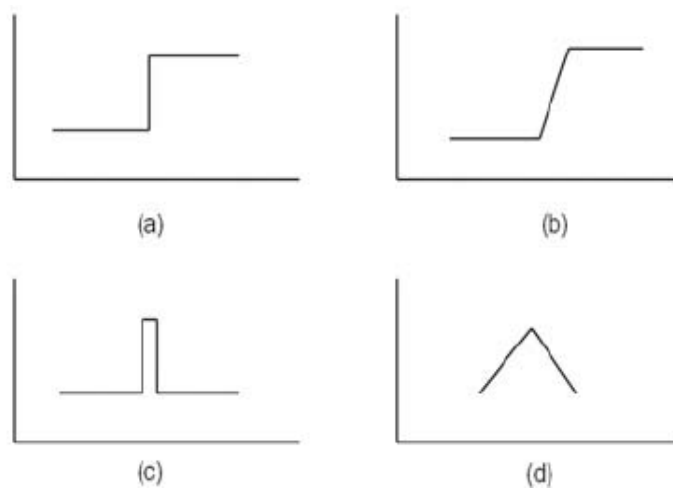


Fig-2: (a) Step-edge (b) Ramp-edge (c) Ridge-edge (d) Ramp-edge

Edges are recognized to identify the interruption in the image. Edges on the region are traced by identifying the pixel value and it is then compared with the nearby pixels.

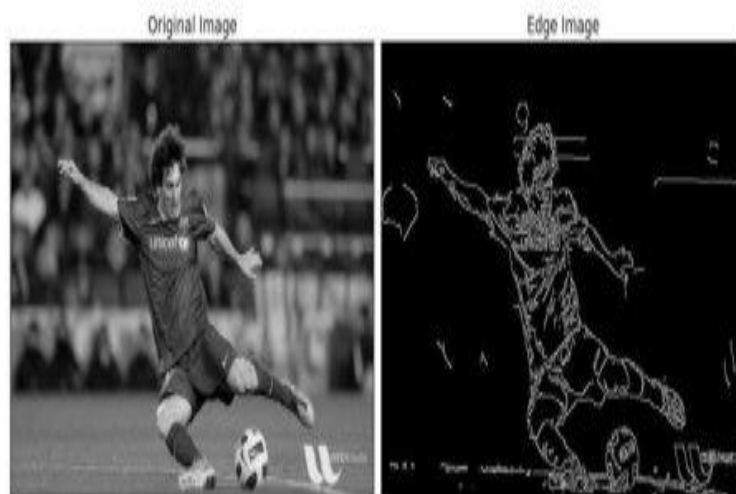


Fig-3: Segmented image using Edge Based Segmentation Technique

Edge detection involves many techniques. Those techniques are Roberts edge detection, Sobel Edge Detection, Gradient edge detection, Laplacian edge detection, LoG edge detection and Canny edge detection. The

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Laplacian operator is used with the second order derivative operator. The frequently used second order derivative operators are Laplacian of Gaussian operator and canny edge operator.

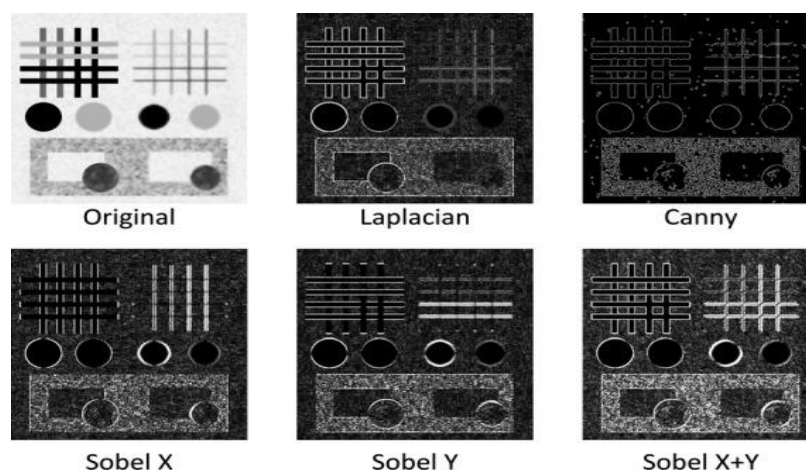


Fig-4: Segmented image using Edge Detection Techniques

2.2.Fuzzy Theory Based Segmentation

Fuzzy set theory and Fuzzy logic have been applied to overcome the uncertainty and ambiguity manifested in images [11]. Theory based segmentation technique assumes that the individual region in a given image follow a repetitive form of geometrical structure [12]. Fuzzy set theory and logic have been applied to handle the uncertainty manifested in images. Determination of fuzzy membership is not a trivial job. Feature selection algorithm provides better accuracy and suitable for noisy images [11]. Fuzzy clustering is a process of assigning these membership levels, and then using them to assign data elements to one or more clusters. One of the most widely used fuzzy clustering algorithms is the Fuzzy C-Means (FCM) Algorithm [14]. Fuzzy c-means has been a very important tool for image processing in clustering objects in an image [8]. They are fuzzy thresholding, fuzzy rule-based inferencing scheme, fuzzy c-mean clustering, and fuzzy integral-based decision making. A fuzzy integral based region merging algorithm for image segmentation, which combines both region and edge features of the image, is then used to merge regions recursively according to the criterion of the maximum fuzzy integral [16].

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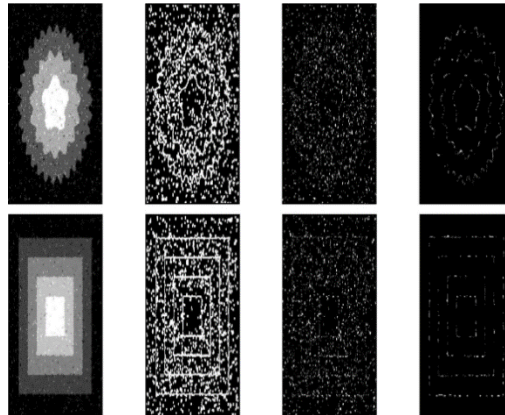


Fig-5: Fuzzy Theory Based Segmented image

2.3. PDE Based Segmentation

The partial differential equation based methods are the fast methods of segmentation. These are appropriate for time critical applications. There are basic two PDE methods: non-linear isotropic diffusion filter (used to enhance the edges) and convex non-quadratic variation restoration (used to remove noise). The results of the PDE method is blurred edges and boundaries that can be shifted by using close operators. The fourth order PDE method is used to reduce the noise from image and the second order PDE method is used to better detect the edges and boundaries [7].

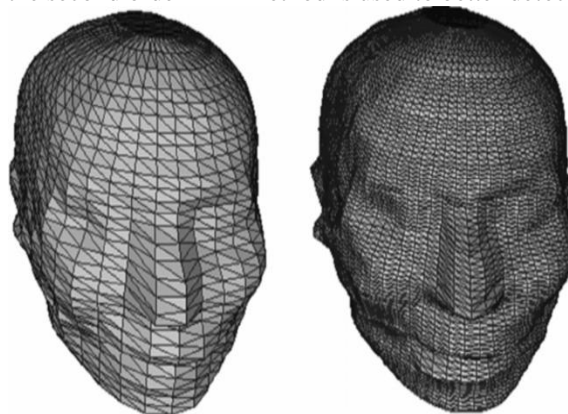


Fig-6:Multiresolutional-reconstruction-using-the-partial-differential-equation

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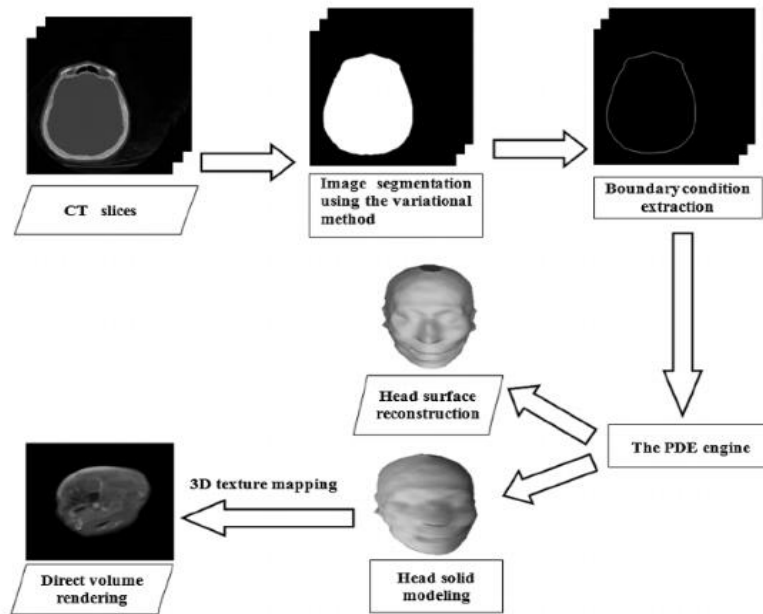


Fig-7: The flow chart of the Partial Differential Equation (PDE) method for head visualization with Computed Tomography (CT) data [15].

2.4. ANN Based Segmentation

An artificial neural network is often called a neural network or simply neural net. The artificial neural network based segmentation methods simulate the learning strategies of human brain for the purpose of decision making [2] [3]. This method is often used for segmenting medical images. Neural network based segmentation is totally different from conventional segmentation Algorithms [13]. The neural net was trained with set of training sample with aim to decide the connection between the nodes and weights between the nodes. Neural nets are broadly utilized to answer the crisis of image segmentation in medical stream. It is dependent on life imitation, particularly learning process of human brains, comprises a huge number of parallel nodes. Every node could carry out some fundamental computing. Learning process could be accomplished through moving the node connections and weights of connection [1]. The main disadvantage of this technique is that it utilize more time.

2.5. Threshold Based Segmentation

Thresholding technique is used to convert a multilevel or a grey scale image into a binary image with the help of histogram of the image [5]. Thresholding refers to an amount or a level. To apply Thresholding a preset threshold value T is used to compare the intensities of the pixels at the peaks, if the pixel are dark it growing darker or white it become whiter.

$$T=T[x,y,P(x,y),f(x,y)]$$

Where x and y are the pixels, P(x, y), f(x, y) are the points of gray level image. If T depends on f(x, y) then it is known as Global thresholding and if it depends upon, P(x,y),f(x,y) it is called Local thresholding and if it depends on x,y, P(x,y),f(x,y) is known as Adaptive thresholding[10]. Threshold techniques can be categorized into two classes:

1. Global Threshold
2. Local or adaptive thresholdingThreshold

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Thresholding is a method of transforming a grayscale input image to a bi-level image by using an optimal threshold. The technique which follows the simplest property that pixels in a region can share its concentration. So, a normal way to segment such regions is through thresholding, the separation of light and dark regions [18].

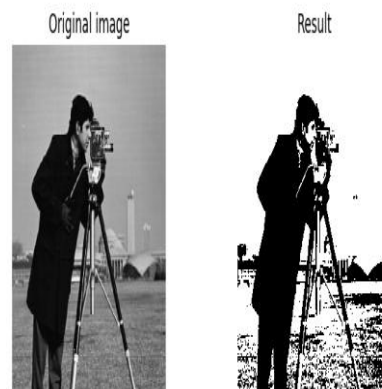


Fig-8: Segmented image using Threshold Based Segmentation

2.6. Region Based Segmentation [20]

R indicates region of image and is stated as a connected homogenous subset of an image with respect to some criterion like texture or gray level. Image regions are cluster of connected pixels with analogous belongings. In this approach, every pixel is assigned to specific area or an object. Region based segmentation method consists of three functions region growing, region merging and region splitting.

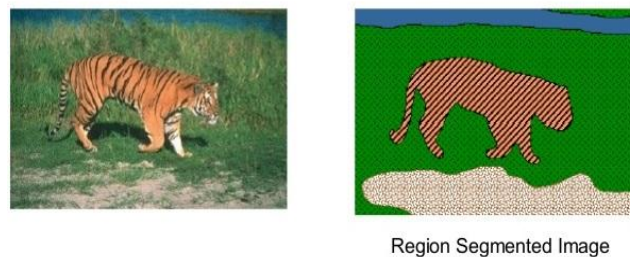


Fig-9: Segmented image using Region Based Segmentation.

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Segmentation Technique	Description	Merits	Demerits
Edge based segmentation	It is based on discontinuity of detection and locates the point with more or less abrupt changes in grey level.	It is very useful for the image which contains better contrast between objects.	1. It is not suitable for wrong detected and too many edges. 2. It is not a trivial job to produce a closed curve.
Fuzzy theory based segmentation	Fuzzy set theory and logic have been applied to handle the uncertainty manifested in images.	1. Feature selection algorithm provides better accuracy and suitable for noisy images. 2. It can be used detect the automatic changes in the images.	1. Interaction is longer and complex. 2. Determination of fuzzy membership is not a trivial job.
PDE based segmentation	It is based on working of differential equation.	It is fastest method, best for time critical applications.	It is more computational complexity.
ANN based segmentation	1. It uses the neural network consist of nodes. 2. Using neural network to perform classification or clustering	1. No need to write complicated programs and easily detect errors. 2. Provides better result for face detection.	Training process consumes more time and it required over training.
Threshold based segmentation	It is based on histogram peaks of the image to find particular threshold values.	It does not need any prior information of the image, simplest method.	It is highly dependent on peaks, spatial details are not considered.
Region based segmentation	Groups pixels into homogeneous regions including region growing, region splitting and region merging.	Work well when the region homogeneity criteria are easily defines and more immune to noise.	It is an expensive method regarding both time and memory.

Table-1: Comparison of Various Segmentation Techniques

III. CONCLUSION

This survey paper explains several image segmentation techniques briefly including their advantages and disadvantages. ANN based segmentation technique will provide a better result for face detection. Comparing with other methods PDE is the fastest method and best for time critical applications. The image segmentation techniques that mentioned in this survey paper are used in many technologies including face recognition and pattern recognition.

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