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A Exploratory Review on Soft Computing Segmentation Techniques

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Abstract: *Segmentation is a process to divides the images into its regions or objects that have similar features or characteristics. Segmentation has no single standard procedure and it is very difficult in non-trivial images. The extent, to which segmentation is carried out, depends on the problem specification. Segmentation algorithms are based on two properties of intensity values- discontinuity and similarity. First property is to partition an image based on the abrupt changes in the intensity and the second is to partition the image into regions that are similar according to a set of predefined criteria. In this paper some methods to detect the discontinuity and similarity of digital images will be discussed. The basic techniques for detecting the gray level discontinuities in a digital images and locating the objects and boundaries of images (points, lines and edges) have also been discussed. The other segmentation techniques like histogram thresholding, filtration, watershed, edge detection, region growing, region splitting and merging are based on the fact of classification with the usage of range functions that are applied to the intensity value of image pixels.*

Keywords: *Thresholding, Segmentation, Edge detection, Region growing, Region splitting and merging, watershed.*

I. Introduction

The goal of image segmentation is to cluster pixels into image regions, i.e. regions corresponding to individual surfaces, objects, or natural parts of objects. Segmentation is a testing field of picture investigation. Specifically, medical picture division has ended up essential with improvement of complex restorative imaging modalities which are fit for delivering a substantial amount of high-determination two-dimensional (2-D) and three-dimensionalbh (3-D) pictures. **Haralik R.H [6]** define the issue of picture division and there is an expansive number of systems depicted in the writing.

The first step in image analysis is segment the image. Segmentation divides an image into its cluster parts or objects. Extent of level to which this subdivision is carried out depends on the problem being viewed. To read the image correct and to identify the content of the image there is need to segment the object from the background and for this reason there are two techniques of segmentation i.e discontinuity detection technique and similarity detection technique. In the first technique, one approach is to partition an image based on abrupt changes in gray-level image and the second technique is based on the threshold, region growing and the Edge Detection method.Image segmentation technique used for :-

1. In automated inspection of electronic assemblies, presence or absence of specific objects can be determined by analyzing images.
2. Analyzing aerial photos to classify terrain into forests, water bodies etc.
3. Analyzing MRI and X-ray images in medicine for classify the body organs.

II. Segmentation Techniques

Various segmentation techniques are discussed below**:-**

1.Segmentation using discontinuities

Several techniques for detecting three basic gray level discontinuities in a digital image (points, lines and edges) are different types of filtration. The most common way to look for discontinuities is by spatial filtering methods.

a).Point detection idea is to isolate a point which has gray level significantly different from its background.

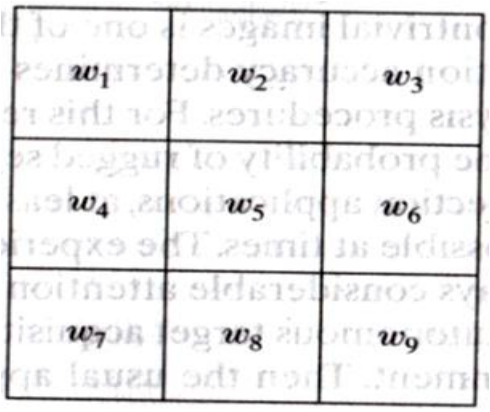

Figure.1

w1=w2=w3=w4=w6=w7=w8=w9 = -1, w5 = 8.
Response is R = w1z1+ w2z2 +……+ w9z9, where z is the gray level of the pixel.
Based on the response calculated from the above equation we can find out the points desired.

b).**Line detection** is next level of complexity to point detection and the lines could be vertical, horizontal or at +/- 45 degree angle. Responses are calculated for each of the mask above and based on the value we can detect if the lines and their orientation.

c)Edge detection The edge is a regarded as the boundary between two objects (two dissimilar regions) or perhaps a boundary between light and shadow falling on a single surface. To find the differences in pixel values between regions can be computed by considering gradients. The edges of an image hold much information in that image. The edges tell where objects are, their shape and size, and something about their texture. An edge is where the intensity of an image moves from a low value to a high value or vice versa. There are numerous applications for edge detection, which are often used for various special effects. Digital artists use it to create dazzling image outlines. The output of an edge detector can be added back to an original image to enhance the edges. Edge detection is often the first step in image segmentation. Image segmentation, a field of image analysis, is used to group pixels into regions to determine an image's composition. A common example of image segmentation is the "magic wand" tool in photo editing software. This tool allows the user to select a particular pixels in an image.
There is an infinite number of edge orientations to specify the widths and shapes of edges such that roof edge, line edge, step edge, ramp edge etc.

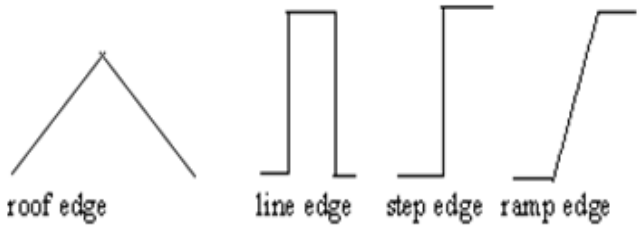

Figure 2 Different edge orientation

Some edges are straight while others are curved with varying radii. There are many edge detection techniques to go with all these edges, each having its own strengths. Some edge detectors may work well in one application and perform poorly in others. Sometimes it takes experimentation to determine what the best edge detection technique for an application is.

Edge detection is also used in image registration. Image registration aligns two images that may have been acquired at separate times or from different sensors.

The simplest and quickest edge detectors determine the maximum value from a series of pixel subtractions. The homogeneity operator subtracts each 8 surrounding pixels from the center pixel of a 3 x 3 window. The output of the operator is the maximum of the absolute value of each difference. Similar to the homogeneity operator is the difference edge detector. It operates more quickly because it requires four subtractions per pixel as opposed to the eight needed by the homogeneity operator. The subtractions are upper left – lower right, middle left – middle right, lower left – upper right, and top middle – bottom middle.

2. Segmentation using Thresholding

Thresholding is based on the assumption that the histogram has two dominant modes, for example light objects and an dark background. In this method to extract the objects from the image is needs to select a threshold value such that it separates the two modes.

$$F(x,y)= T$$

Depending on the kind of problem to be solved there are multilevel thresholding. **A. D Brink[8]** Define the region of thresholding, there is two type of thresholding global thresholding and local thresholding. **Global threshoding** is considered as a function for the entire image and local thresholding involves only a certain region. In addition to the above mentioned techniques, if the thresholding function T depends on the spatial co-ordinates then it is known as the dynamic or adaptive thresholding.

a) Basic global thresholding technique:

In this technique the entire image is scanned by pixel after pixel and some pixels labeled as object or the background, depending on whether the gray level is greater or lesser than the thresholding function T. The success depends on how well the histogram is constructed. It can be fulfilled in controlled environments, and can also find the applications primarily in the industrial inspection area. **R.C Gonzalez [7]** present an algorithm for global thresholding that can be summarized in a few steps.

1) Select an initial estimate for T.
2) Segment the image using T. This will produce two groups of pixels. G1 consisting of all pixels with gray level values >T and G2 consisting of pixels with values <=T.
3) Compute the average gray level values mean1 and mean2 for the pixels in regions G1 and G2.
4) Compute a new threshold value T= (1/2)(mean1 +mean2).
5) Repeat steps 2 through 4 until difference in T in successive iterations is smaller than a predefined parameter T0.

b) Basic adaptive thresholding technique:

In this technique the images having uneven illumination make it difficult to segment using the histogram, in this case **Ioannis M. Stephanakis [12]** divide the image in many sub images and then come up with different threshold to segment each sub image. The key issues are how to divide the image into sub images and utilize a different threshold to segment each sub image.

3). Region based segmentation

The main objective of segmentation is to divide the image into different regions and region based segmentation techniques are used to determining the region of images directly. The segmentation must be complete and every pixel must be in region it indicates that the region is disjoint.

Formulation of the regions:

An entire image is divided into sub regions and they must be in accordance to some rules such as

1. Union of sub regions is the region
2. All are connected in some predefined sense.
3. No to be same, disjoint
4. Properties must be satisfied by the pixels in a segmented region P (Ri) =true if all pixels have same gray level.
5. Two sub regions should have different sense of predicate.

a) Segmentation by region splitting and merging*:* The basic idea of splitting is, as the name implies, to break the image into many disjoint regions which are coherent within themselves. Take into consideration the entire image and then group the pixels in a region if they satisfy some kind of similarity constraint. This is like a divide and conquers method. Merging is a process used when after the split the adjacent regions merge if necessary. **D. Chaudhuri [11]** developed an algorithms of this nature are called split and merge algorithms.

b) Segmentation by region growing: This is a simple region based approach which is also classified as a pixel based image segmentation and it involves the selection of initial seed point in which examine neighboring pixels of initial seed point and determines whether the pixel neighbors should be added to the region or not. This approach is the opposite of split and merges said by **Thanos Athanasiadis[10]**.

1. An initial set of small area are iteratively merged based on similarity of constraints.
2. Start by choosing an arbitrary pixel and compared with the neighboring pixel.
3. Region is grown from the seed pixel by adding in neighboring pixels that are similar, increasing the size of the region.

4. 4 When the growth of one region stops we simply choose another seed pixel which does not yet belong to any region and start again.
5. 5 This whole process is continued until all pixels belong to some region.
6. 6 A bottom up method.

4. Segmentation by Morphological watersheds:

This method combines the positive aspects of many of the methods discussed earlier. The basic idea to embody the objects in "watersheds" is given by **Alan P. Mangan [9**].The concept of watersheds is the idea of visualizing an image in 3D to spatial versus gray levels. So all points in such a topology are either belonging to regional minimum all with certain to a single minimum, equal to two points where more than one minimum. A particular region is called watershed if a region minimum satisfying certain conditions.

III. Conclusion

In this paper, the study reviews the research on various research methodologies applied for image segmentation in soft computing specially for the medical images. And the new study aims to provide a simple guidance to the researcher who want to carry out their research on the image segmentation very accurately.In future the efforts for the proposal of genetic segmentation filter will be done , the GA is a stochastic global search method that mimics the metaphor of natural biological evolution. GA operates on a population of potential solution applying the principle of survival of fittest to produce better and better approximation of solution. At each generation, a new set of approximation is created by process of selecting individuals according to their level of fitness in the problem domain and breeding them using operators borrowed from natural genetics. The genetic algorithm solves optimization problems by mimicking the principles of biological evolution, repeatedly modifying a population of individual points using rules modeled on gene combinations in biological reproduction. Due to its random nature, the genetic algorithm improves your chances of finding a global solution. It enables you to solve unconstrained, bound constrained and general optimization problems, and it does not require the functions to be differentiable or continuous.

This research will provide the guidance to the researcher and doctors to exract the particular tumor area from the medical images by using the biography based neural clustering with genetic algorithm.

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