AUTOMATIC MULTILEVEL THRESHOLDING OF DIGITAL IMAGES

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Abstract- The segmentation has been appliedin several areas, especially where it is necessary use tools for feature extraction and to get the needed object from the rest of the image for analyzing a particular object. There are several segmentation methods for segmenting medical images , but it is difficult to find a method that can be adapt and better for different type of medical images. For better segmentation multilevel thresholding is applied and to adapt for different type of images histogram based segmentation is performed. Multilevel thresholding is a process that segments a gray-level image into several distinct regions. The technique was applied to segment the cell core and potential rejection of tissue in myocardial images of biopsies from cardiac transplant.

Keywords: Segmentation,Multilevel thresholding, Myocardial biopsy.

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I.INTRODUCTION

The influence and impact of digital images on modern society is tremendous, and image processing is now a critical component in science and technology. The rapid progress in computerized medical image reconstruction, and the associated developments in analysis methods and computer-aided diagnosis, has propelled medical imaging into one of the most important sub-fields in scientific imaging. In computer vision, segmentation refers to the process of partitioning a digital image into

multiple regions (sets of 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. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).

During segmentation, an image is preprocessed, which can involve restoration, enhancement, or Simply representation of the data. Certain features are extracted to segment the image into its key components. The segmented image is routed to a Classifier or an image-understanding system. The image classification process maps different regions or segments into one of several objects. Each object is identified by a label. The image understanding system then determines the relationships between different objects in a scene to provide a complete scene description. Powerful segmentation techniques are currently available however, each technique is ad hoc. The creation of hybrid techniques seems to be a future research area that is promising with respect to current Navy digital mapping applications. Medical image segmentation refers to the segmentation of known anatomic structures from medical images. Structures of interest include organs or parts thereof, such as cardiac ventricles or kidneys, abnormalities such as tumors and cysts, as well as other structures such as bones, vessels, brain structures etc. The overall objective of such methods is referred to as computer-aided diagnosis they are used for assisting doctors in evaluating medical imagery or in recognizing abnormal findings in a medical image.

II.METHODOLOGY:

Several general-purpose algorithms and techniques have been developed for image segmentation. Since there is no general solution to the image segmentation problem, Thresholding approaches, Region Growing approaches, Clustering techniques often have to be combined with domain knowledge in order to effectively solve an image segmentation problem for a problem domain.

CLUSTERING METHODS

K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster [2]. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early group age is done. At this point we need to re-calculate k new centroids as bar centers of the clusters resulting from the previous step.

After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop we may notice that the k centroids change their location step by step until no more changes are done. In other words centroids do not move any more. Finally, this algorithm aims at minimizing an objective function, in this case a squared error function.

Using K Means clustering we can segment Angiographic images. The goal is to propose an algorithm that can be better for large datasets and to find initial centroids. K-Means Clustering is an iterative technique that is used to partition an image into *K* clusters.

REGION GROWING METHODS

In Region growing technique, segment an image pixels that are belong to an object into regions. Segmentation is performed based on some predefined criteria. Two pixels can be grouped together if they have the same intensity characteristics or if they are close to each other. It is assumed that pixels that are closed to each other and have similar intensity values are likely to belong to the same object. The simplest form of the segmentation can be achieved through threshold and component labeling. Another method is to find region boundaries using edge detection. Region growing is a procedure that groups pixels or subregions into larger regions.

The simplest of these approaches is pixel aggregation, which starts with a set of "seed" points and from these grows regions by appending to each seed points those neighboring pixels that have similar properties (such as gray level, texture, color, shape).Region growing based techniques are better than the edge-based techniques in noisy images where edges are difficult to detect.

OTSU'S METHOD

Otsu's thresholding chooses the threshold to minimize the
intraclass variance of the threshold black and white pixels. Otsu's Thresholding Method based on a very simple idea Find the threshold that minimizes the weighted within-class variance. This turns out to be the same as maximizing the between-class variance[4]. Operates directly on the gray level histogram so it's fast (once the histogram is computed).

Assumptions for OTSU's method

- Histogram (and the image) are bimodal.
- No use of spatial coherence,nor any other notion of object structure.
- Assumes stationary statistics, but can be modified to be locally adaptive.

Now, we could actually stop here. All we need to do is just run through the full range of *t* values [1,256] and pick the value that minimizes. But the relationship between the within-class and between-class variances can be exploited to generate a recursion relation that permits a much faster calculation. For any given threshold, the total variance is the sum of the within-class variances (weighted) and the between class variance, which is the sum of weighted squared distances between the class means and the grand mean.

Fig.1 is taken as a input image which is a myocardial images obtained with biopsies of a Transplanted heart patient. In the studied images we used three methods to diagnose the matching of cell core or tissue of a transplanted heart patient. For comparison of the segmented regions, beyond the strategy of maximum entropy, we compared the results with those provided by the Otsu's method.

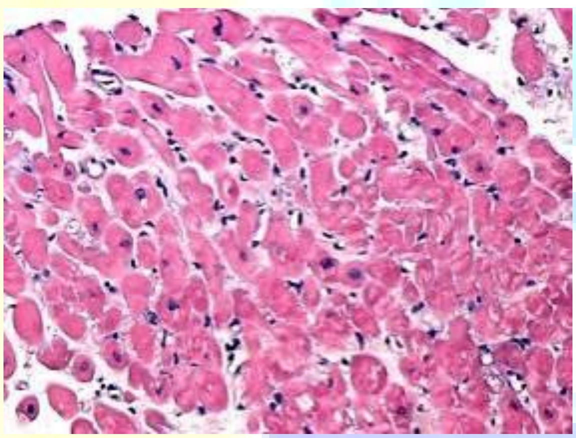

FIG: 1 Myocardial images obtained with biopsies of a transplanted heart patient.

Segmenting the input cardiac for diagnosing the mismatch of tissue in heart transplant patient using clustering method. The cardiac image which is shown in Fig 1is segmented using k means clustering method number of clusters is the user defined parameter for this image which is selected k=4.Fig.2 From the segmented image ,cell core of the cardiac is not clear because tissues and blood vessels too present in this segmented image so this method of segmentation for biopsy cardiac image is not suitable. The ouput dependents on the parameter k which is user defined will change so the ouput is not stable.

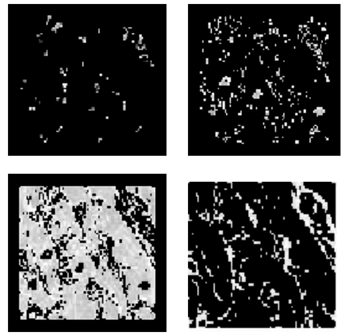

FIG: 2 Segmentation using k-means clustering

Fig 3 is a segmented cardiac image using region growing method from which we can visualize the cell core which is not clearly viewed for diagnosing the mismatching of tissues. When comparing other method this is stable method which is one of the advantage of using this method for segmentation. Here cell core , tissue and vessels are segmented so it not clear for visualizing the mismatch of the cell core because entire image is not in same intensity .

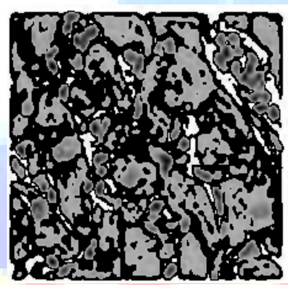

FIG:3 Segmentation using Region growing method

using otsu's method threshold value of the cardiac image is calculated setting that as threshold value biopsy cardiac image is segmented which is shown in fig 4. From the segmented image we cannot clearly diagnosing the mismatch of the tissue or cell core because the threshold value is dependent upon the user. This method show different segmented image for different value of threshold.

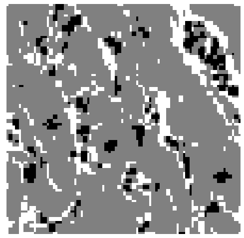

FIG: 4 Segmentation using OTSU's method

III. SEGMENTATION ALGORITHM

The proposed algorithm is based on a model of automatic multilevel thresholding and considers techniques of group histogram quantization, analysis of the histogram slope percentage and calculation of maximum entropy to define the threshold.

A. Histogram Quantification

To evaluate the histogram in specific groups, the user should set the size of the group. If the given value is 1 then the process analyzes pixel by pixel. For values greater than 1, the value used in the process of iteration of the algorithm is the value that was defined by the user.

B. Valleys Analysis

The identification of the histogram valleys is very important, because in these valleys the thresholds are concentrated, and therefore the division of classes. The algorithm identifies automatically these valleys using the transition of the histogram values signals, which is done in the following way:

- First you compare the first group's value, which was determined in the histogram segmentation, with this group's last value. If the first is lower it means that the histogram values are increasing and the signal is positive.

On the other hand, the histogram values are decreasing and the signal is negative.

- The next step is to identify the sign of the next group, every time there is a transition from a negative to positive, a valley is identified.

Once you found the first valley, you pass to the next step, the analysis of the percentage of slope.

BLOCK DIAGRAM

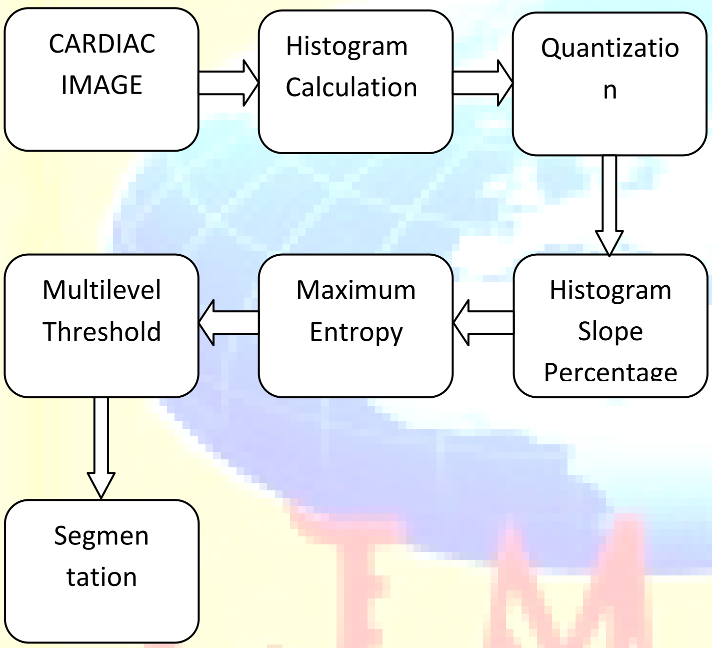

FIG: 5 Block diagram of multilevel thresholding

C. Analysis of the slope percentage

The determination of thresholds based on an analysis of vouchers may include differences in cases where there is a distribution of values in the histogram, without valleys or valleys insignificant, with little variance. For the type of image analyzed, we identified that an effective threshold would be near to the base of a group that has a considerable percentage of slope. This minimum percentage of slope is set by the user, who may adjust according to the type of image. This approach involves calculating the slope achieved by the difference of the average of the last three values of the group with the first three. If this difference is greater than the parameter set, the scanning of the slope percentage is interrupted and go to the step of identifying the threshold. If the difference is smaller, the histogram scan continues until the difference of means is greater.

D. Threshold identification using maximum entropy

Having established a group with valley, the

threshold identification is calculated by determining the maximum entropy, which is achieved from probabilistic calculations. In this context, we consider an image as a result of a random process, where the probability pi

corresponds to the probability of a pixel of the image taking a value of intensity i (i = 1, .., n) . The gray level with the highest entropy is

identified as a threshold. After identifying the threshold, we return to the stage of analysis of the valleys until the entire histogram has been processed.

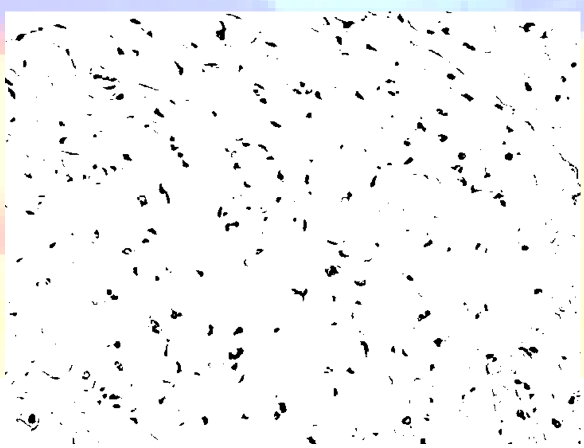

FIG:6 Segmented image using automatic multilevel thresholding

Applications of multilevel thresholding:

Segments the cell core and rejection of tissue in myocardial images of biopsies from cardiac transplant.

IV.CONCLUSION

According to used method, it was possible to find the image thresholds, and therefore, segmenting them, presenting satisfactory results. Through comparisons of the techniques, that all techniques show better results, with irrelevant differences. Compared with the method shown in , for the studied images, the proposed technique will show better results because it allows the adjustment of parameters such as group size and slope percentage of the histogram, factors that influence the threshold values. These characteristics are significant aspects of the developed technique, and allow the application to other image types, since the input parameters are adjustable to the studied case. This versatility and quality of results make the developed technique a considerable alternative to be applied during the stage of feature extraction in artificial vision systems.

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