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DENOISING BASED ON VARIOUS SEGMENTATION METHODS

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Abstract

Denoising is one of the important pre processing steps in image processing. The main aim of this paper is to denoise the image based on various segmentation methods. Some of the segmentation methods used in this paper is pixel based methods, edge based methods and region based methods. Thresholding, histogram based thresholding, k means clustering methods are explained under pixel based methods. Gradient based edge detection, laplacian based edge detection and canny edge detection are explained under edge detection methods. Region growing and region splitting & merging segmentation methods are explained under region based segmentation. We are concluding the paper with best method of segmentation for denoising. This paper gives advantages and disadvantages of various segmentation methods.

Keywords Laplacian, gradient, canny edge detection, k means cluster, thresholding.

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1. Introduction

Segmentation means partition of image into meaningful regions based on color, texture, depth, grey level etc. Segmentation is one of the important steps in image processing. It is used in various applications like face recognition, to identify diseases like tumour (medical imaging) etc, to locate objects in satellite pictures like crops, water, traffic control systems etc.

2. Segmentation methods

a. Pixel based models

i. Thresholding

It is the simplest and most often used method in segmentation. For any particular threshold value, if the pixel grey value is similar or closer to threshold value then it belongs to category 1. Otherwise it belongs to category 2. For each category of pixels, it will have similar grey level values, texture etc.

Histogram based thresholding:

We will allocate each pixel to its cluster or its neighbouring cluster by comparing the value to its threshold. If it is linear discrimination, then it belong histogram based thresholding. Or else if it belongs to quadratic discrimination ten it is solved by k-means clustering.

Algorithm

Step 1: assign a value as threshold, t.

Step 2: Two categories are calculated. First, calculate the proportion (p1), mean (μ1) and variance (σ1) are calculated for value less than or equal to t. Once again calculate proportion (p2), mean (μ2) and variance (σ2) are calculated for value greater than t.

Step 3: Recalculate t.

Step 4: Repeat step 2 and 3 until t converges to a stable value.

ii. K means clustering

It is partitioning method that divides a collection of objects into K groups based on least square method.

Algorithm

Step 1: calculate the mean of each cluster

Step 2: Find the nearest cluster for each point in the cluster. Calculate the distance of each point from each cluster from the corresponding cluster mean.

Step 3: Repeat above two steps till sum of squared within group errors cannot be lowered.

Once the image has been segmented using the K-Means algorithm, the clustering can be improved by assuming that neighboring pixels have a high probability of falling into the same cluster. Thus, even if a pixel has been wrongly clustered, it can be corrected by looking at the neighboring pixels.[1]

b. Edge based models

Edge detection refers to locate and to identify sharp discontinuities in an image.[2] usually edge based segmentation doesnot suit for noise removal. Identification of edges in noisy image is very difficult, because noise and edges are having high frequency content. Reduction of noise will cause the image into blurred one, so we can't find the edges clearly.

i. Gradient based Edge detection

This method will find the first derivative of the image by calculating the minimum and maximum values to detect edges. Some of the gradient based edge detection are sobel operator, Roberts cross operator, prewitt operator etc. Robert-cross operator is used to calculate gradient vector by diagonal direction. In Robert cross algorithm the horizontal and vertical edges bring out individually and then they put together for the resulting edge detection.[3] Prewitt operator is used to find edges of images in horizontal and vertical direction.

ii. Laplacian based edge detection

This method will find the second derivative of the image by calculating the zero crossings values to detect edges.

iii. Canny edge detection method.

It is also called as optimal edge detector because it has low error rate. It can be efficiently implemented by using the first derivative of Gaussian function. It also finds the horizontal and vertical direction of first order derivative of Gaussian functions. First it applies the Gaussian filter to smoothen the image and applies through convolution masks. It uses one horizontal

convolution mask and one vertical convolution mask. The major limitation of this method is it uses only two convolution mask and fails to identify the edges clearly.

c. Region based models

i. Region growing

The way of extracting and representing information from an image is to group pixels together into regions of similarity.[4] region growing method is divided into two methods. They are a) seeded growing region b) unseeded growing region.

In seeded growing region method, it will take group of seeds as input with the image. Each and every pixel in the image is assigned to a region until the difference between the pixels is smaller one. Then the region will grow. If the distance is bigger, then it is placed in different region. The segmentation of such images is important because it reduces the transmission overhead by reducing the number of regions in the image.[5]

Region-based segmentation method also requires theuse of appropriate thresholding techniques.[6] In unseeded region growing method, there won't be any explicit seeds. But it works like seeded region growing method. But it is different that if the minimum δ is less than the predefined threshold T then it is added to the respective region.

ii. Region splitting & merging

It is also called as quadtree segmentation. The entire image is considered as single region. Then in the first split the region will be divided into four regions. If all the four regions are homogeneous then, they are merged as connected components. A combination of region splitting and merging result in a method with the advantages of both approaches. [7]

3. Experimental results and discussions

4. Conclusions

Thresholding is the simple to implement but difficult to set a threshold and sensitive to noise. K means clustering creates tighter clusters but did not work well. Sobel operator is very simple and detects edges easily. It is inaccurate and very sensitive in noise images whereas canny edge detection detects edges easily in noisy image but it consumes time. Region based segmentation works well in noisy environment. After all observations, the region based segmentation works well for noisy images compared to other methods.

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