RESEARCH PAPER | Engineering | Volume : 5 | Issue : 5 | May 2015 | ISSN - 2249-555X

Object Detection in Low Contrast Image

KEYWORDS

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ABSTRACT *Increase of scope in machine learning is always move around image processing. But processing whole image is very long-lasting task so segmentation of image into area of interest come into play, it reduces computational time as well as reduce the memory to store and reduces bandwidth in case of transmission of image features. If I say image is cluster of various object "having same pixel value" according to segmentation algorithm, we classify them in three parts: region based segmentation method, data clustering and edge based segmentation. In this paper we survey algorithms available for segmentation, their specialty and disadvantages.*

I. INTRODUCTION

Object detection has wide variety of application especially when we talk about machine learning and machine vision. I would like to prove an application of image segmentation from one example, suppose that I send one robot to moon to send images to ground station on earth. Sending whole image require large bandwidth and storing capabilities, to resolve this issue if we send only region of our interest from image it will save excess bandwidth as well as require less computational time. Other applications are like extracting features of object from image. So the image segmentation is defined as extracting region of interest from image [1]. Image segmentation algorithms are classified into three categories: edge based segmentation, data clustering and region based technique. Where region based technique is one of the oldest in segmentation techniques further classified into two parts: seeded growing segmentation and unseeded region growing. The common procedure in region based technique is to compare one pixel with neighboring pixels and cluster them in different regions depending upon their differences and threshold. Data clustering adopt clustering of same type of data around centroid and classify them on basis of similarity. Data clustering is widely used as image segmentation algorithms some of them are as: Hierarchical divisive algorithm, squared error algorithm, K-mean algorithm, and mean shift algorithm. Edge segmentation is based on edge of image. Some of edge detection are based on gradient operators and Hilbert transform some are Sobel operator, watershed algorithm, Prewitt algorithm etc. We talk about all the mentioned algorithms in remaining text.

II Region based Segmentation methods

In region based segmentation method we work on one assumption that the same region have same pixel value in image. That's why we compare pixel or set pixels with neighboring pixel and classify into cluster based on pixel similarity. The main types of algorithm under region based segmentation are: Seeded region growing, unseeded region growing, and the region splitting and Fast scanning algorithm.

II.1 Seeded region growing

Seeded region growing algorithm is one of simplest region based algorithm, in this we compare neighboring pixels of set of points, known as seed and determine whether the pixel classified into cluster of seed points or not [2]. The algorithm is as follows:

Step1: we start with n number of seed point clustered into n cluster say clusters with position

Step 2: Now we compare seed point position   with neighboring pixel, if less than threshold it would be classified into cluster.

Step 3 Iterate above step for all initial cluster. And compute mean of each clusters and set them as new seed.

Step 4: Iterate above step till all pixel of image not clustered.

The threshold usually given by user based intensity, gray level or color values.

The two main disadvantage are: initial seed and computation time. Different number of initial seed yields different segmentation of same image so reduces stability of image. Since it search all the pixel it take more time and reduces the time efficiency.

II.2 Unseeded region growing

It is derivative of seeded region growing technique proposed by Lin et al. [3]. In this instead of giving initial seed we generate seed automatically. So this method can perform fully automatic segmentation hence enhance the robustness of region based segmentation. The main disadvantage is computation efficiency.

II.3 Region Splitting and Merging

It main goal to distinguish the homogeneity of the image [4]. Its concept based on quad trees, which means each node of tress has four descendants and the root of tree corresponds to entire image.

Let define whole image as region R and define predicate P such =FALSE divide the region into quadrants. The again check for quadrant if it is false divide the sub quadrants and so on, until TRUE. After the splitting, we start merging two sub quadrants region and if TRUE.

The main disadvantage is that it may produce bulky seg-

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ments.

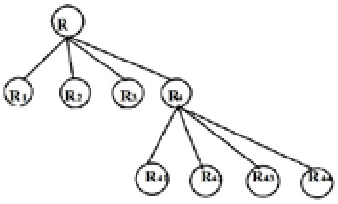

Fig 1

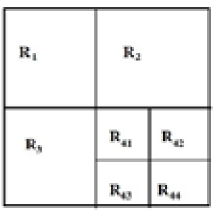

Fig 2

Fig1 the structure of quad tree where R represent the whole image

Fig2 corresponding partitioned image [3]

II.4 Unsupervised Segmentation of Color texture Regions in Image and Video (JSEG)

In 2001 Deng et al. present the method of unsupervised segmentation of color texture region in images and videos called JSEG [5]. The concept of JSEG is two divide segmentation into two portions, color quantization and spatial quantization. The color quantization quantizes color in image to several representatives' classes that can be distinguished as region in image.

100	99	50	70	90	92
44	234	71	72	70	45
89	53	70	73	70	45
89	90	100	70	72	45
80	13	189	34	71	50
29	12	79	34	34	34
49	34	34	45	33	33
10	98	79	35	35	34

Fig 4

Let the above figure show the intensity level of an image in color quantization we define range of image pixel intensity to some special classes or same class of color as demonstrated in fig 5, for example pixel intensity 70-73 is defined as % and 90-92 intensity level is defined as *.

$	$	@	%	*	*
+	**	%	%	%	+
*	**	%	%	%	+
*	%	%	%	%	+
*	*	$	%	%	+
….	.	OO	-	-	-
@	-	-	+	-	-
---	--	OO	-	-	-

Fig 5

In spatial segmentation executes on class map (fig 5) of spatial distribution of color.

II.5 Fast scanning method [6].

In fast scanning method we scan image from the upper-left corner to lower-right corner and determine whether if we merge into existing cluster or not. Merge criterion is on the basis of threshold. This algorithm is illustrated by figures below.

255	253	252	150	147	154	152
248	84	85	81	88	158	156
250	246	79	90	83	186	195
77	80	82	88	79	81	191
81	86	120	121	127	124	125
35	85	126	118	223	240	247

Fig 6

Let the above figure shows the distribution of image pixel intensity in image and after fast scanning algorithm we clustered the image into different region as shown in fig 7. Taking threshold 45

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250	246	79	90	83	186	195
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81	86	120	121	127	124	125
35	85	126	118	223	240	247

Fig 7

As shown in figure 7 all pixel with less than threshold is clustered into one cluster. Algorithm is discussed below:

It is a simple concept and we list the steps of algorithm as below. We use C [m, n] (m = 1, 2… M, n = 1, 2, …, N) to denote the value of the pixel [m, n], use R[m, n] to denote the pixel [m, n] is classify into which region, use A(j) to denote the mean of pixels in the jth region, and use B(j) to denote the number of pixels in the jth region.

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Step 1: Classify the first pixel [1, 1] as Region 1. We set R [1, 1] = 1, A (1) = C [1, 1], B (1) = 1, m = 1,

n= 1, and j = 1.

Step 2: Then, set n = n+1 and scan the next pixel. If R [1, n−1] = j and

Case 1: |C [m, n] – A (j)| ≤ threshold, then set R [m, n] = j and set

A (j) = {A (j) B (j) + C [m, n]}/ (B (j+1) (1)

B (j) = B (j) +1, (2)

if threshold = 25, then |C [1, 2] − C [1, 1]| ≤ threshold, thus, the pixel [1, 2] is also classified into Region 1. If

Case 2: |C [m, n] − A (j)| > threshold then set R [m, n] = j+1, A (j+1) = C [m, n], B (j+1) = 1, and j = j+1.

Step 3: Repeat Step 2 until n = N.

Step 4: Then, set m = m+1, n = 1, and scan the first pixel in the next row. If R [m−1, 1] = iand

Case 1: |C [m, n] − A (i)| ≤ threshold, then set R [m, n] = iand

A (i) = {A (i) B (i) + C [m, n]}/ (B (i) +1) (4)

B (i) = B (i) +1. (5) If

Case 2: | C [m, n] – A (j)| > threshold, then set R [m, n] = j+1, A (j+1) = C [m, n], B (j+1) = 1, and j = j+1.

Step 5: Then, set n = n+1 and scan the next pixel. In this case, m ≠ 1 and n ≠ 1 and we should compare [m, n] with the upper region and the left region. Suppose that R [m−1, n] = iand R [m, n−1] = j.

Case 1: |C [m, n] – A (i)| ≤ threshold,

|C [m, n] – A (j)| > threshold.

In this case, we set R [m, n] = iand use (5) to adjust the values of A (i) and B (i).

Case 2: |C [m, n] – A (i)| > threshold,

|C [m, n] – A (j)| ≤ threshold. (8) In this case, we set R [m, n] = j and use (2) to adjust the values of A (j) and B (j).

Case 3: |C [m, n] – A (i)| > threshold,

|C [m, n] – A (j)| > threshold.(9)

In this case, we set R [m, n] = j, A (j+1) = C [m, n], B (j+1) = 1, and j = j+1.

Case4: |C [m, n] − A (i)| ≤ threshold,

|C [m, n] − A (j)| ≤ threshold. (10) When i= j, we just set R [m, n] = iand use (5) to adjust the values of A(i) and B (i). However, when i≠ j, we must merge Region iwith Region j. In this case, we set R [m, n] = i, but we should reset all the pixels [m0, n0] that satisfy R [m0, n0] = j as R [m0, n0] = i(11)

at the same time. Moreover,

A(i) = {A(i)B(i) +A(j)B(j) +C[m, n]}/(B(i)+B(j)+1), (12)

B (i) = B (i) +B (j) +1, (13)

B (j) = 0. (14)

Step 6: Repeat Step 4 and Step 5 until all the pixels in the image have been scanned.

Step 7: If B (i) <Δ, we delete Region iand assign the pixels in Region ito the adjacent regions. Sometimes, the isolated dots (due to details or noise) of an image may cause over-segmentation. This step can avoid the problem.

(Step 8): Sort the regions according to B (i), i.e., number of pixels within them.

The main disadvantage of this method is it fails in low contrast images and take more time when we apply to video.

The advantages are concluded below:

1. The pixel of each cluster are connected and have similar value.

2. The computational time is faster than both region growing algorithm and region splitting and merging algorithms.

3. The segmentation result exactly match the shape of real object.

III.DATA Clustering:

Data clustering [7] is one of the most used algorithm in image segmentation. The main concept of data clustering is to use centroid to represent each cluster and base on similarity with centroid of cluster to classify.

III.1 K- mean clustering [8]

Since k-mean clustering is widely used in image processing, the algorithm is as follows:

Step1: first we decide how many cluster is to be finally classified and set as a number N. Now randomly select N patterns from whole data bases as the N centroid of N clusters.

Step2: classify each pattern to closet cluster centroid. The closest usually represent the pixel of similarity.

Step3: repeat the cluster centroids and then there are N centroids on N cluster.

Step4: Repeat iteration 2 and 3 until convergence criterion in not met.

Main disadvantages is result is sensitive to initial selection of centroid.

IV Edge based segmentation [9]

It is gradient operator generally based on edge detection. Some popular algorithms are Sobel, watershed algorithm, Prewitt etc.

Edge detection techniques transform images to edge images. Edges are the sign of lack of continuity, and ending.

Volume : 5 | Issue : 5 | May 2015 | ISSN - 2249-555X

IV.1Steps in Edge detection:

Step 1: Filtering:Images are often corrupted by noise.

There is a trade-off between edge strength and noise reduction. More filtering to reduce noise results in a loss of edge strength.

Step 2: Enhancement: To facilitate the detection of edges, it is essential to determine changes in intensity in the neighborhood of a point. Enhancement emphasizes pixels where there is a significant change in local intensity values and is performed by computing gradient magnitude.

Step3: Detection: There are nonzero value for the gradient at many points in an image, and not all of these points are edges for an application. Thus some method like thresholding should be used to determine which points are edge points.

IV.2 Edge Detection Methods:

The Roberts Detection: The Roberts Cross operator performs 2D spatial gradient measurement of the image which is simple and quick. It highlights the edges. Its input and output is a grayscale image. Pixel values at each point in output represent the estimated absolute magnitude of the spatial gradient of the input image at that point.

+1	0
0	-1

Gx

0	+1
-1	0

Gy

Fig 8

The Prewitt Detection: The Perwitt operator is limited to 8 possible orientations. This gradient based edge detector is estimated in the 3x3 neighborhood for 8 directions. All 8 convolution masks are calculated then the one with largest module is selected.

-1	+1	+1
-1	-2	+1
-1	+1	+1

0°

+1	+1	+1
-1	-2	+1
-1	-1	+1

45°

Fig 9

The Sobel Detection: Sobel operator performs a 2D spatial gradient measurement on an image and emphasizes the edges. The operator consists of a pair of 3x3 convolution kernels. One kernel is simply the other rotated by 90 degree.

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Fig 10: Sobel mask

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