International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 03 – Issue 02 || February 2018 || PP. 14-18

Segmentation of Historical Inage using Median Threshold Value Approach

Arnab Acharyya[1], Sumit Samanta[2], Partha Halder[3]
[1]*Elitte College of Engineering, Department of Computer Science & Engineering, Karnamadhabpur, Ghola, Sodepur, Kolkata-113, West Bengal, India*
[2]*Elitte College of Engineering, Department of Computer Science & Engineering, Karnamadhabpur, Ghola, Sodepur, Kolkata-113, West Bengal, India*
[3]*Technique Polytechnic Institute, Department of Computer Science & Technology, Panchrokhi, Sugandhya, Hooghly-712102, West Bengal, India*

Abstract: Images are considered as one of the most important medium of conveying information, in the field of computer vision, by understanding images the information extracted from them can be used for other tasks. Image segmentation is the process of partitioning a digital image into multiple segments. Image de-noising is done before the segmentation to avoid the selection of falsely object for segmentation to segment the image into multiple parts without loss of information. The goal of segmentation is to change the representation of an image into more meaningful and easier to analyze. Image segmentation is basically used to locate the objects and boundaries (lines, curves, etc.) in images. Segmentation technique can be classified into different types namely, Region Based, Edge Based, Threshold Based etc. As a segmentation technique, Otsu's method is widely used in pattern recognition, document bainarization and pattern recognition. Otsu's method searches for a threshold that minimizes the intra-class variances of the segmented image and can achieve good results when the histogram of the original image has two distinct peaks, one belongs to the background, and the other belongs to the foreground.

Keywords: image segmentation, thresholding, median value, historical image

1. Introduction

Segmentation partitions an image into distinct regions containing each pixel with similar attributes. To be meaningful and useful for image analysis and interpretation, the regions should strongly relate to depicted objects or features of interest. Meaningful segmentation is the first step from low-level image processing transforming a grayscale or color image into one or more other images to high-level image description in terms of features, objects, and scenes. The success of image analysis depends on reliability of segmentation, but an accurate partitioning of an image is generally a very challenging problem[5].

2. Basic Concept of Image Segmentation

Segmentation techniques are either contextual or non-contextual[2]. The latter take no account of spatial relationships between features in an image and group pixels together on the basis of some global attribute, e.g. grey level or color. Contextual techniques additionally exploit these relationships, e.g. group together pixels with similar grey levels and close spatial locations.

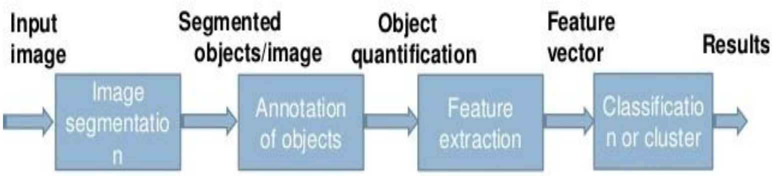

Figure 1: Image Analysis Pipeline

3. Pixel Connectivity

Pixel connectivity is defined in terms of pixel neighbourhoods. A normal rectangular sampling pattern producing a finite arithmetic lattice $\{(x,y): x = 0, 1, ..., X-1; y = 0, 1, ..., Y-1\}$ supporting digital images allows us to define two types of neighbourhood surrounding a pixel. A 4-neighbourhood $\{(x-1,y), (x,y+1), (x+1,y), (x,y-1)\}$ contains only the pixels above, below, to the left and to the right of the central pixel (x,y). An 8-neighbourhood adds to the 4-neighbourhood four diagonal neighbours: $\{(x-1,y-1),(x-1,y), (x-1,y+1), (x,y+1), (x+1,y+1), (x+1,y), (x+1,y-1), (x,y-1)\}$.

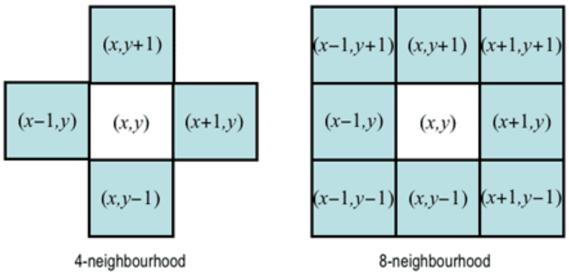

Figure 2: Pixel neighborhood

A 4-connected path from a pixel p_1 to another pixel p_n is defined as the sequence of pixels $\{p_1, p_2, ..., p_n\}$ such that p_{i+1} is a 4-neighbour of p_i for all $i = 1, ..., n-1$. The path is 8-connected if p_{i+1} is an 8-neighbour of p_i. A set of pixels is a 4-connected region if there exists at least one 4-connected path between any pair of pixels from that set. The 8-connected region has at least one 8-connected path between any pair of pixels from that set[1].

One of the simplest and most common algorithms for labelling connected regions after greyscale or colour thresholding exploits the "grassfire" or "wave propagation" principle: after a "fire" or "wave" starts at one pixel, it propagates to any of the pixel's 4- or 8-neighbours detected by thresholding. Each already visited (i.e. "burnt away" or "wet") pixel cannot be visited again, and after the entire connected region is labelled, its pixels are assigned a region number, and the procedure continues to search for the next connected region[3]. Magenta and yellow stars below indicate the fire, or wave front and the burnt away pixels, respectively. To label a region, the fire starts from its first chosen pixel:

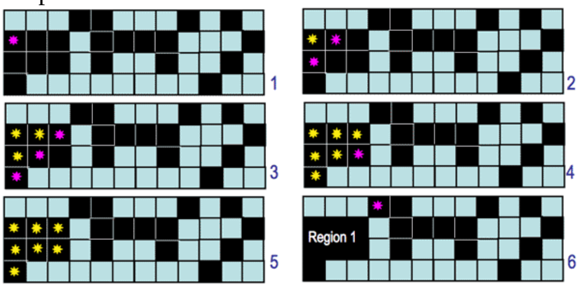

Figure 3: Pixel connectivity

4. Image Thresholding

Thresholding is a non-linear operation that converts a gray-scale image into a binary image where the two levels are assigned to pixels that are below or above the specified threshold value. It is however far more efficient to use the Image Threshold operation which also provides several methods for finding the "optimal" threshold value for a given image. Image Threshold provides the following methods for determining the threshold value[4].

4.1 Thresholding Methods

1. Automatically calculate a threshold value using an iterative method.
2. Approximate the histogram of the image as a bimodal distribution and choose a midpoint value as the threshold level.
3. Adaptive thresholding. Evaluate the threshold based on the last 8 pixels in each row, using alternating rows. Note that this method is not supported when used as part of the operation Image Edge Detection.
4. Fuzzy thresholding using entropy as the measure for "fuzziness".
5. Fuzzy thresholding using a method that minimizes a "fuzziness" measure involving the mean gray level in the object and background.
6. Determines an ideal threshold by histograming the data and representing the image as a set of clusters that is iteratively reduced until there are two clusters left. The threshold value is then set to the highest level of the lower cluster. This method is based on a paper by A.Z. Arifin and A. Asano but modified for handling images with relatively flat histograms.
7. Determines the ideal threshold value by maximizing the total variance between the "object" and "background".
8. Default method where you must use the /T flag to specify a threshold value.

4.2 Thresholding Technique

Threshold technique is one of the important techniques in image segmentation. This technique can be expressed as: T=T[x, y, p(x, y), f(x, y], where T is the threshold value. x, y are the coordinates of the threshold value point.p(x,y),f(x,y) are points the gray level image pixels.Threshold image g(x,y) can be define:

$$g(x,y) = \begin{cases} 1 \text{ if } f(x,y) & > 0 \\ 0 \text{ if } f(x,y) & \leq 0 \end{cases} \qquad f(x) = \begin{cases} -x, & x < 0 \\ x, & x \geq 0 \end{cases}$$

Thresholding techniques are classified as bellow:

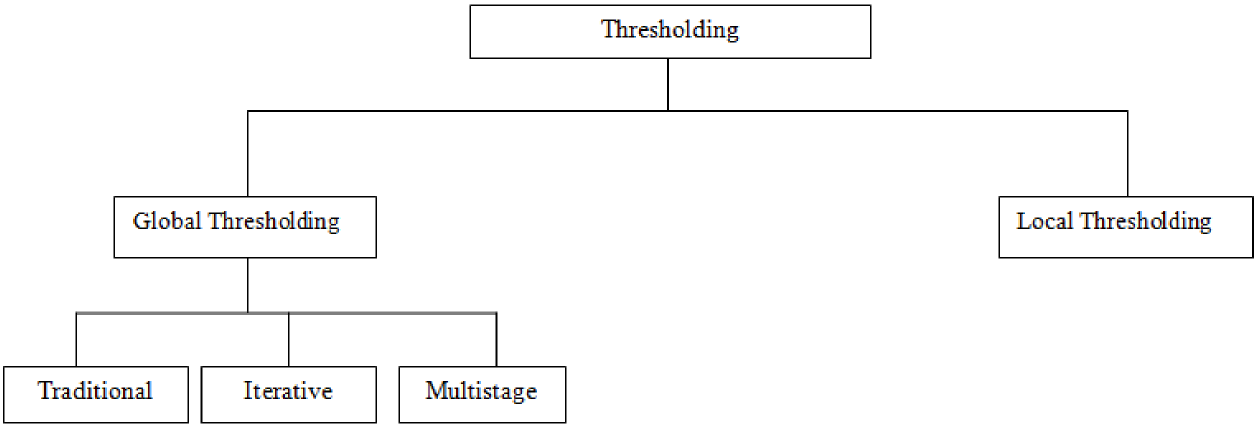

Figure 4: Classification of Thresholding Technique

4.3 Segmentation by Thresholding

Thresholding is the simplest segmentation method. The pixels are partitioned depending on their intensity value. Global thresholding, using an appropriate threshold T

$$g(x,y) = \begin{cases} 1, & \text{iff}(x,y) > T \\ 0, & \text{if } f(x,y) \leq T \end{cases}$$

Variable thresholding, if T can change over the image. Local or regional thresholding if T depends on a neighbourhood of (x, y). Adaptive thresholding, if T is a function of (x, y). Multiple thresholding:

$$g(x,y) = \begin{cases} a, \text{if } f\,(x,y) > T2 \\ b, \text{if } T1 < f(x,y)_{\_T2} \\ c, \text{if } f(x,y)\_T1 \end{cases}$$

5. Median Pixel Value Calculation

Mean, median, and mode are three kinds of "averages". There are many "averages" in statistics, but these are, I think, the three most common, and are certainly the three you are most likely to encounter in your pre-statistics courses, if the topic comes up at all[3].

The "mean" is the "average" you're used to, where you add up all the numbers and then divide by the number of numbers. The "median" is the "middle" value in the list of numbers. To find the median, your numbers have to be listed in numerical order, so you may have to rewrite your list first. The "mode" is the value that occurs most often. If no number is repeated, then there is no mode for the list.

The "range" is just the difference between the largest and smallest values.

Calculation of Median pixel value

Find the mean, median, mode, and range for the following list of values:

13, 18, 13, 14, 13, 16, 14, 21, 13

The mean is the usual average, so: (13 + 18 + 13 + 14 + 13 + 16 + 14 + 21 + 13) ÷ 9 = 15. Note that the mean isn't a value from the original list. This is a common result. You should not assume that your mean will be one of your original numbers. The median is the middle value, so I'll have to rewrite the list in order: 13, 13, 13, 13, 14, 14, 16, 18, 21. There are nine numbers in the list, so the middle one will be the (9 + 1) ÷ 2 = 10 ÷ 2 = 5th number: 13, 13, 13, 13, 14, 14, 16, 18, 21. So the median is 14. The mode is the number that is repeated more often than any other, so 13 is the mode. The largest value in the list is 21, and the smallest is 13, so the range is 21 – 13 = 8. Mean: 15, Median: 14, Mode: 13, Range: 8

6. Process Adopted for Segmentation of Historical Image

In this case we have selected the following process to create a segmented image using threholding technique.

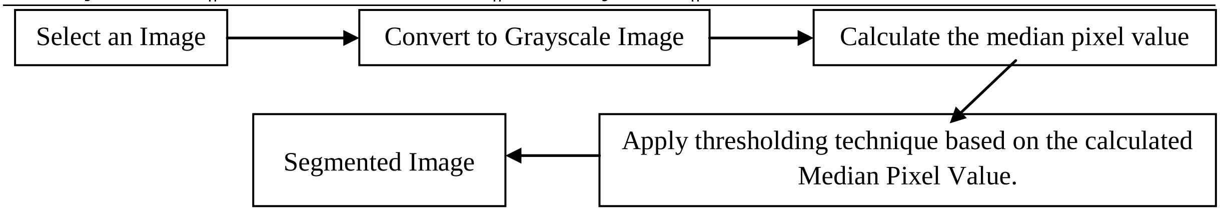

Figure 5: Process adopted for segmentation of historical image

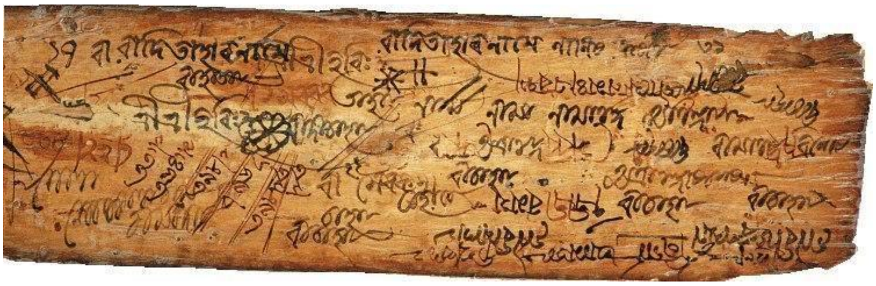

Figure 6: Original Image (a)

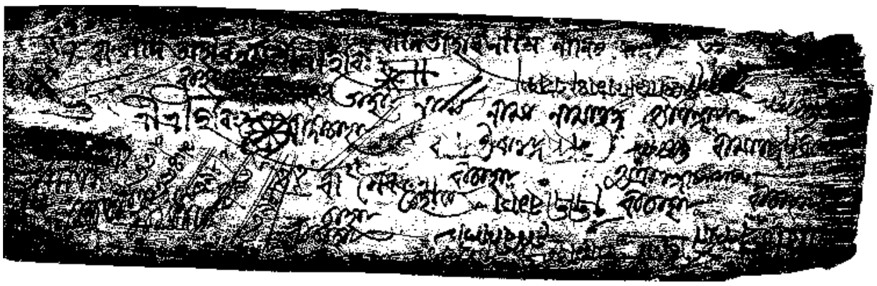

Figure 6: Segmented Image (b)

Figure 6: Original Image (c)

Figure 6: Segmented Image (d)

References

[1] Muzamil Bhat. "Digital Image Processing". International Journal of Science & Technology Research. Volume 3 (issue 1)

[2] Pushmeet Kohli, Stefanie Jegelka, "A Principled Deep Random Field Model for Image Segmentation". (2013).

[3] Nikita Sharma, Mahendra Mishra, Manish Shrivastava, "Color Image Segmentation Techniques and Issues: An Approach", International Journal of Science & Technology Research. Volume 1 (issue 41), (2012, May).

[4] D.Sasirekha, Tamilnadu, India, Dr.E.Chandra, Dr.SNS Rajalakshmi, "Enhanced Techniques for PDF Image Segmentation and Text Extraction", International Journal of Computer Science and Information Security (IJCSIS). Volume 10 (issue 9)

[5] Rafael C. Gonzalez and Richard Eugene Woods, “Digital Image Processing”, 2009

Author Profile

Arnab Acharyya, received the B.Tech. degree in 2009 from Hooghly Engineering & Technology College under WBUT and M.Tech in Computer Technology from Jadavpur University in 2014. During 2010-2017, he stayed in Technique Polytechnic Institute as Lecturer in Computer Science & Technology and joined Elitte College of Engineering as Assistant Professor in the year 2018.

Sumit Samanta, received the B.Tech. degree in 2005 from IACR Engineering College under BPUT and M.Tech in Software Engineering from JIS College of Engineering under WBUT in 2010. During 2007-2009, he stayed in Domkol Institute of Engineering & Technology as Lecturer in Computer Science & Engineering. During 2010-2017, he stayed in Elitte Institute of Engineering & Management as Lecturer in Computer Science & Technology department and joined Elitte College of Engineering as Assistant Professor in the year 2017.

Partha Halder, received the Diploma in Computer Science & Technology in 2015 from Technique Polytechnic Institute under WBSCTVESD. During 2015-2018, he stayed in Technique Polytechnic Institute as Technical Assistant in Computer Science & Technology.