OPTIMIZATION AND ANALYSIS SEGMENTATION TECHNIQUE IN IMAGE PROCESSING USING MATLAB

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ABSTRACT

In the present communication, we have a categorized survey of different image thresholding techniques applied to five images, which illustrate the shortcomings and advantages of the different methods. The various algorithm parameters have been optimized for each image. The different techniques like mean thresholding, histogram thresholding, edge thresholding, variable thresholding and P-tile thresholding are applied on these images. The performances of these techniques are measured on the basis of black pixels ratio (BPR). The image having less number of black pixels is good binary image. We concluded that in histogram thresholding BPR is less as compare to other methods. So, it is the best thresholding method.

Keyword Segmentation, Image Processing,MATLAB

I. INTRODUCTION

Thresholding is a powerful tool for the separation of the objects from the background [1]. Image is divided into homogeneous regions in Image Segmentation process. Image segmentation is typically used to highlight lines, curves, etc. Each pixel in the image is similar with respect to some property (color, intensity, texture etc). Many algorithms are defined for segmentation of an image on the basis of one of the two properties intensity values discontinuity and similarity. In the first approach, image is partition on abrupt changes in intensity, such as edges in an image and another one is based on region based partition that is similar according to predefined criteria. Histogram Threshold approaches second category [2]. However, a popular technique in image segmentation is thresholding, which are computationally simpler, such as boundary detection or region-dependent techniques. Thus, if a computational requirement is of important consideration, as in machine vision, the thresholding technique is preferred to other techniques and is a widely used for image segmentation [3]. Also if thresholding is inappropriate, it leads to blotches, streaks, erasures, fractures of character shapes in the document. These are usually the main reasons for deterioration of OCR performance. Thresholding algorithms depend on factors such as distribution of the gray level of the document, presence of denser, non-text components such as photographs, local shading effects, the quality of the paper etc. There have been a number of survey papers on thresholding. Lee, Chung and Park [4] conducted a comparative analysis of five global thresholding methods and advanced several useful criteria for thresholding performance evaluation. In an earlier paper Weszka and Rosenfeld [5] also defined several evaluation criteria. Palumbo, Swaminathan and Srihari [6] addressed the issue of document binarization comparing three methods while Trier and Jain [7] had the most

extensive comparison basis (19methods) in the context of character segmentation from complex backgrounds. Sahoo et al. [8] surveyed nine thresholding algorithms and illustrated comparatively their performance. Glasbey [9] pointed out the relationships and performance differences between 11 histogram-based algorithms based on an extensive statistical study.

II. METHODOLOGY

This section deals with developing and implementing the various thresholding techniques algorithm for finding the threshold value so that binarisation of image can be done easily. Segmentation of an image entails the division or separation of the image into regions of similar attribute. The basic attribute for segmentation is image amplitude-luminance for a monochrome image and color components for a color image. Image edges and textures are also useful attributes for segmentation [10]. There is no theory of image segmentation. As a consequence, no single standard method of image segmentation has emerged. Rather, there are a collection of adhoc methods that have received some degree of popularity. Because the methods are adhoc, it would be useful to have some means of assessing their performance. The main goal of image segmentation is domain independent partitioning of an image into a set of disjoint regions that are visually different, homogeneous and meaningful with respect to some characteristics or computed properties, such as grey level, texture or color to enable easy image Discontinuity and similarity/homogeneity are two basic properties of the pixels in relation to their local neighborhood used in many segmentation methods [11].

Algorithm of thresholding techniques:

Under this section the algorithms are defined for various thresholding methods. Keeping the thresholding techniques in mind we have made algorithms for finding the threshold value so that binarisation of an image can be done easily.

Algorithm for Mean Thresholding:

In this the average of pixel value is calculated and is used as threshold. Various steps involved are:

1. Sum of pixel value is calculated.
2. Sum of pixels is calculated.
3. Threshold value is calculated as t=sum of pixel value/ sum of pixels (using 2 & 3).
4. This threshold value is used to convert a gray scale image into binary image.

Algorithm for Histogram thresholding:

In histogram thresholding, there are so many methods of thresholding but we are taking mid -point method for our consideration. Various steps involved are:

1. An initial threshold value is determined, t.
2. Two different mean values are calculated for below (m1) and above (m2)
3. The new threshold value is calculated. tn = (m1 + m2) / 2.
4. If the threshold is stabilized $(t = tn)$, then this would indicate that the new threshold level is this one. Else wise, t would become tnand it would also reiterate from step2.

Algorithm for Variable thresholding:

In variable thresholding, threshold value is changed from pixel to pixel of an image. The steps for variable thresholding are:

1. Input image is divided into different sub images p1, p2, p3 …p8.

2. Take p1= I (1:32; 1:256).

3. Sum of pixel values of sub image is calculated.

4. Sum of pixels of sub image is calculated.

5. The threshold value is calculated as, t=sum of pixel value/ sum of pixels.

6. This threshold value is used to convert a gray scale sub image into binary sub image.

7. Steps 3 to 6 are repeated for all eight sub images.

8. All binary sub images are combined together to a single binary sub image.

The variable thresholding is also named as adaptive thresholding as threshold value is different for different sub images.

Algorithm for Edge thresholding:

In edge thresholding method, boundaries of an object are detected. The steps involved are:

1. Gaussian filter is used to smooth the image. $g(x,y)=G(x,y)*i(x,y)$.

2. Gradient and magnitude of $g(x,y)$ is computed. $M(x,y)=sqrt(g_x^2(x,y)+g_y^2(x,y))$.

3. Direction is computed $\theta(x,y)=\tan^{-1}(g_y(x,y)/ g_x(x,y))$.

4. Using a particular threshold image is thresholded.

5. Non- maxima pixel in $\theta(x,y)$ is suppressed.

6. Image is thresholded using two thresholds T1 & T2 to obtain binary images.

7. Edge segments are linked to get complete edges.

Algorithm for P-tile thresholding:

1. Set threshold by finding the intensity level.

2. Grey level is calculated by using histogram value H(g).

3. P% should have intensity less than the grey level.

4. To find the best threshold, H(g) is examined in the neighborhood of g.

III. RESULTS

The images used for investigation are bird image, boy image, building image, cameraman image and rose image which are all grey scale images of size 256x256. Six thresholding methods are applied to all the five grey scale images for converting them to the binary images. The parameter which is used for comparison is black pixels ratio (BPR). The black to white pixels ratio (BWR) is calculated for each image and then the BPR is calculated which is tabulated for comparison.

3.1 Result of Mean thresholding:

In mean thresholding results are evaluated by taking a bird image for testing purpose. The size of the image is 256x256. The picture is a gray scale image. After mean thresholding it will convert into binary image as shown below:

Input image   Image after thresholding

Fig.1 Result of Mean thresholding
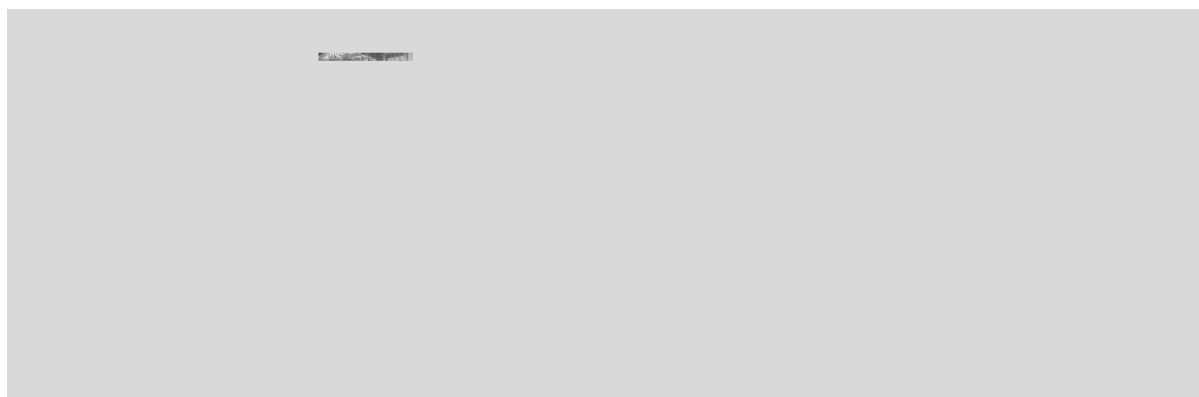
3.2 Result of Histogram thresholding:

In Histogram thresholding results are evaluated by taking boy image as an input image. The size of image is 256x256. The picture is a gray scale image. After taking a particular threshold it will convert into binary image as shown below:

Input image   Image after thresholding

Fig. 2 Result of Histogram thresholding

Parts of input image   Image after thresholding

Fig. 3 Result of Variable thresholding

3.3 Result of Variable thresholding:

In variable thresholding we take a building image as a testing image. The size of image is 256x256. Image is a gray scale image. The result of variable thresholding is as shown above where variable thresholding image is first separated into different patches. Then individual threshold is chosen for each image and thresholding is done. Fig.3 shows parts of input image. Image is divided into eight parts. Then threshold of each part is done. The threshold parts of image are as shown in fig. These parts are then combined into a complete image. The complete image is as shown below:
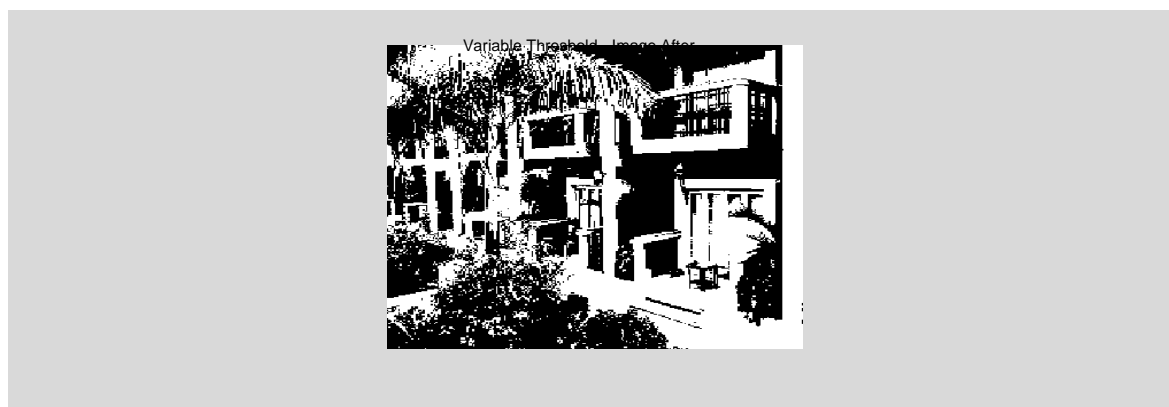

Fig.4 Complete thresholded image

3.4 Result of Edge thresholding

In this we take cameraman image as a testing image. Edge detection is a method in which boundaries are characterised. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. The result of edge detection with sobel operator are as shown below:
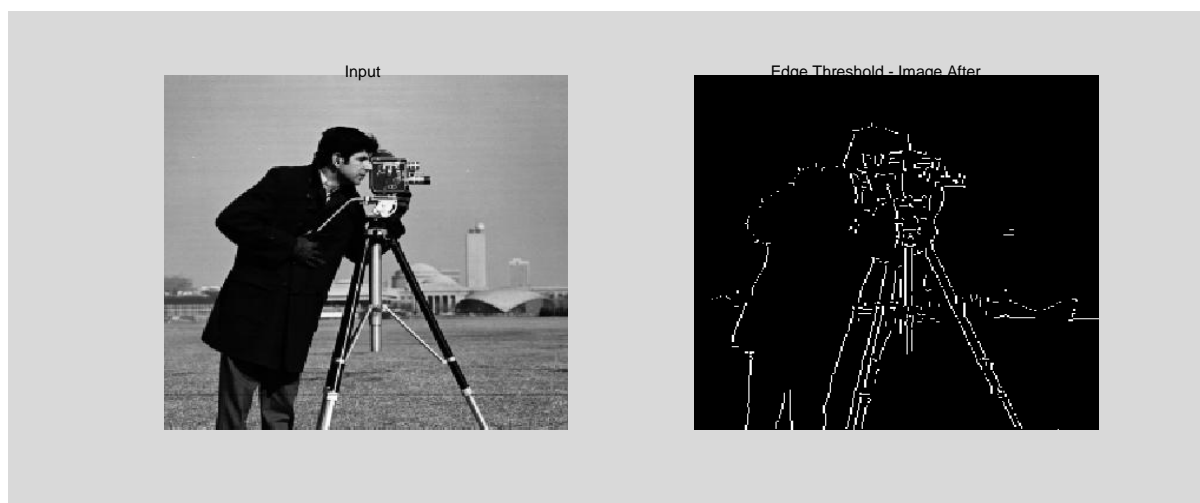

Fig. 5 Result of Edge thresholding

3.5 Result of P-tile thresholding:

In P-tile thresholding rose image is considered as a testing image. Image used is a gray scale image of size 256x256. Result of P-tile thresholding is as shown below:
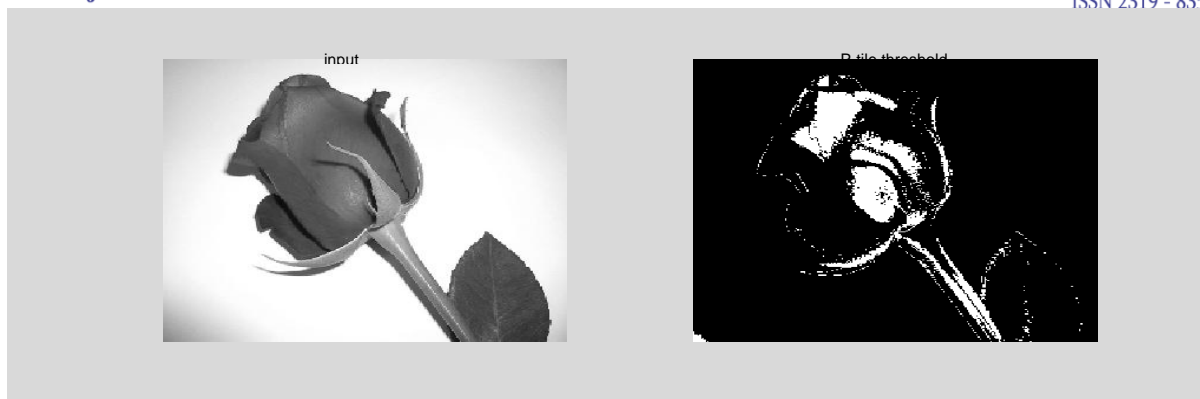
Fig. 6 Result of P-tile thresholding

IV. COMPARISON OF VARIOUS THRESHOLDING TECHNIQUES

An objective of research work is to compare various thresholding techniques and compare them to find the best method out of them. For this purpose various images are used for comparison by using Mean thresholding, Histogram thresholding, Variable thresholding, Edge thresholding and P-tile thresholding method. The parameter for comparing is Black Pixels Ratio (BPR). After applying all the five techniques to the images to be investigated the black to white pixel ratio and black pixel ratio is calculated which is than compared and thresholding method having the less number of BPR is evaluated which is the best method among all the five methods and this comparison is tabulated.
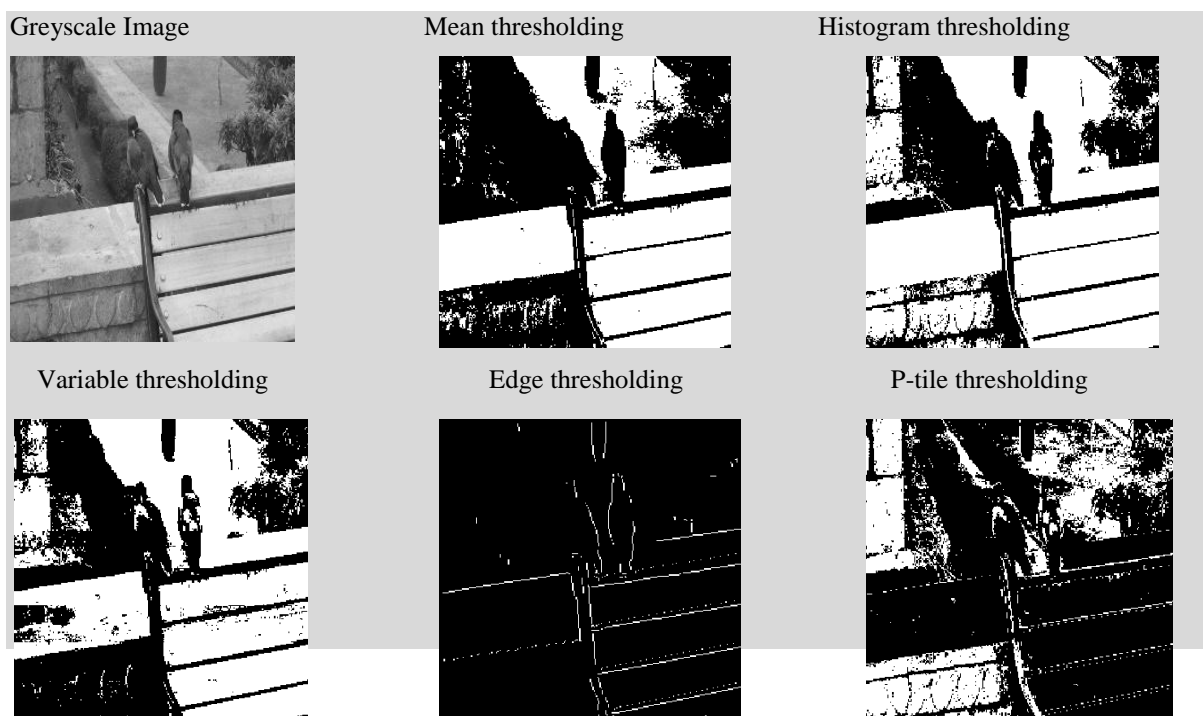
Bird image:

Fig 7 Comparison of bird image

Thresholding techniques	Black to white pixel ratio	BPR (%AGE)
Mean thresholding	131366:130778	50.11
Histogram thresholding	24660:237484	36.12
Edge thresholding	224499:37645	97.94
Variable thresholding	107002:155142	46.14
P-tile thresholding	80919:181225	73.25

Table 1 Comparison of thresholding techniques for bird image

From above table we can investigate that Histogram thresholding is the best thresholding method.

V. CONCLUSION

In this paper, we make a categorized survey of image thresholding techniques. The different techniques of thresholding have been applied to five images, which illustrate the shortcomings and advantages to the different methods. Images are bird, boy, building, cameraman and rose. All the images are grey scale images having size of 256x256. The performance of these techniques is taken on the basis of black pixels ratio (BPR). The image having less number of black pixels is good binary image. We conclude that in histogram thresholding BPR is less as compare to other methods. So, it is the best thresholding method. The images do not show sharpness. In future such kind of thresholding methods can be developed which shows good sharpness in an image.

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BIBLIOGRAPHY

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