



An Evaluation of Thresholding Techniques

Santosh Singh¹, Yogesh Singh², Ritu Vijay³^{1,3}Department of Computer Science, Banasthali University, Rajasthan, India²Department of Physiology, SMS Medical College and Attached Hospitals, Jaipur, Rajasthan, India

Abstract— Segmentation is the methods of dividing an image into segments to get better recognition of object of interest that can be distinguish the region of interest from the background. To implement the above purpose three different techniques are available which are threshold based, region-based and watershed transformation. This study shows the different threshold based approaches.

Keywords— Region-based, Region of interest, Segmentation, Threshold-based, Watershed

I. INTRODUCTION

Image segmentation has its wide spread usage as well as application. Three groups of segmented techniques are considered by shilpa kamdi et al. Those three groups are threshold, edge and region based. They also discuss the problems of edge based methods. There are several algorithms available for segmentation and each segmentation algorithm has its own applications, advantages and disadvantages. The main tendency of each are discussed by Ashraf et al in there review study which is useful for determining the suitable employ of the image partitioning methods [5].

Image segmentation has several problems and for computer vision they represent great challenges. Anitha et al proposed automatic segmentation system for low dose CT image in which fissures of lobes are difficult to see by naked eyes. A thoracic CT is made up of high-intensity pixels and low-intensity pixels. High-intensity pixels are located in the body, whereas the pixels present in the lung and the surrounding air are low-intensity pixels [Rahil]. As there is a large difference in intensity between these two groups, thresholding has led to a good separation. Inputting a grayscale image and converting it into a binary image is known as Thresholding. It is preferred due to its simplicity and the use of histogram. In thresholding the pixels are divided that depends on their intensity value. In general, there are two threshold-based segmentation methods local and global respectively. Problems with Thresholding are described by Morse in their study [4].

II. METHODOLOGY

Thresholding is the simplest manner of image segmentation. It is an effective way of partitioning an image into a foreground and background. It can be used to reduce binary image from gray scale image. Simple thresholding is not always possible due to presence of noise, variations in background gray level and many objects at different gray levels. As noise inhibits localization of threshold, image need to be smoothen.

Threshold value can be chosen by the following methods

- The uniformity of the reflectance
- The separation between peaks;
- The uniformity of the illumination;
- Peaks and valleys of the image histogram that helps in selecting the appropriate value for the threshold(s).

There are factors which have an influence on the suitability of the histogram for suggesting the choice of the threshold:

- The noise content in the image;
- The relative size of objects and background;

Local thresholding – It is useful when the background illumination is uneven and threshold value may vary.

Global thresholding - An appropriate threshold T is used:

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

Where $g(x, y)$ is a threshold version of $f(x, y)$ at some global threshold T,

This method is based upon assuming an initial value of threshold .The best way for selecting a threshold value according to the following algorithm [2].

1. An initial estimate value for T is chosen and is assumed to be the average of maximum and minimum values of intensity.
2. Using this value of T, an image is divided into two pixel regions (L1 and L2), L1 with all pixel whose intensity value is $< T$ while L2 with all pixels whose intensity value is $> T$.
3. The average intensity values m_1 and m_2 of regions L1 and L2 respectively is computed.
4. A new threshold value of T as $T = (m_1 + m_2) / 2$ is computed
5. Repeat the above steps 2 to 4 until the difference between two successive values of T is minimal.

Five threshold segmentation techniques Histogram Dependent Technique (HDT), P-Tile method, Mean method, visual Technique, and Edge Maximization Technique (EMT) are described by Salem Saleh Al-amri in their study [3].

III. FIGURES AND TABLES



FIG. 1 ORIGINAL IMAGE



FIG 2 GRAY LEVEL IMAGE



FIG. 3 LOCAL THRESHOLD IMAGE



FIG 4 GLOBAL THRESHOLD IMAGE

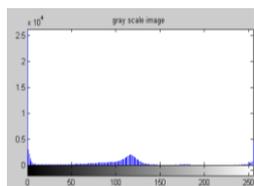


FIG. 5 HISTOGRAM OF GRAY LEVEL IMAGE

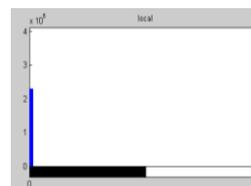


FIG 6 HISTOGRAM OF LOCAL THRESHOLD IMAGE

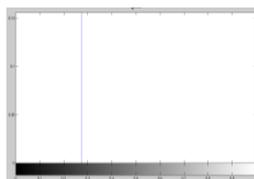


Fig. 7 Histogram of Global threshold image

TABLE I THRESHOLD VALUES OF BOTH TYPES

Local threshold	Global threshold
0.278431	0.273667

IV. CONCLUSIONS

Thresholding is a simple method of transforming a grayscale input image to a bi-level image. It can be done by using an optimal threshold. It is preferred due to its simplicity and the use of histogram. From the results, it is evident that as the value of the threshold is increased, the image becomes too dark. The above study shows that global thresholding (iterative method) is best suited for an image that has a bimodal histogram (i.e. an image which has two data peaks). Its success is dependent on how well the histogram of an image can be partitioned.

REFERENCES

- [1] Garnavi R, Dastjerdi A, Moghaddam H, Giti M, Adjari Rad A, "A New Segmentation Method for Lung HRCT Images" Proceedings of the Digital Imaging Computing: Techniques and Applications (DICTA 2005), IEEE, pp 52, 2005.

- [2] Sheenam B, Maini R “*A Comparative Analysis of Iterative and Ostu’s Thresholding Techniques*”, International Journal of Computer Applications(0975-8887), vol 66(12), pp 45-47, 2013.
- [3] Al-amri S S, Kalyankar N V, Khamitkar S.D, “*Image Segmentation by Using Threshold Techniques*”, Journal of Computing, vol 2(5), pp 83-86, 2010.
- [4] Bryan S. Morse, Brigham Young University, *Lecture 4: Thresholding*, Reading SH&B, Section 5.1.
- [5] Kamdi S, Krishna R K, “*Image Segmentation and Region Growing Algorithm*”, International Journal of Computer Technology and Electronics Engineering (IJCTEE), vol 2(1), pp 103-107.
- [6] Aly A, Deris S B, Zaki N, “*Research Review for Digital Image Segmentation Techniques*”, International Journal of Computer Science & Information Technology (IJCSIT), vol 3(5), pp 99- 106, 2011.