ANALYSIS OF BLOOD SAMPLE IMAGES

CH NOOKA RAJU [1] , G.S.N RAJU [2]
[1] Department of Radiology, Centurion University of Technology and Management – AP, India.
Email: nookaraju@cutmap.ac.in
[2] Department of ECE, Centurion University of Technology and Management - AP, India.

ABSTRACT

Analysis of the image of blood cells by using image processing is both more precise and effective in terms of cost and time. In the field of RBC counting, research work is growing, and various image processing techniques are being applied to get more accurate results. Using image processing techniques is useful and better than current medical testing and blood cell counting methods, given that blood smear standardisation is performed correctly to produce an image of blood cells. The segmentation aim is to extract desired objects from the background. Segmentation is a more complex step and requires more time to process compared with other methods. It is however the most important and challenging step because the extraction and counting of the feature depends on precise segmentation of RBC.

I. INTRODUCTION

In the manual process, counting of blood cells (RBC) requires more time and it is difficult to analyse the number of samples within the time. To overcome this problem, various image segmentation algorithms are proposed to achieve efficient and accurate results. Analysis of an image requires prior processing of image processing, including the application of various techniques [1] on the image to improve quality, remove noise and unwanted pixels and to obtain more information about the image. Moreover, during capturing of biomedical signal or image there may be chance for inclusion of noise [2] due to human artefacts leads to loss of quality. This requires prior processing of an image will give better analysis results, and is helpful for accurate diagnosis, this is important for better treatment of the disorders of the patient.

Most of the medical images are more complex with different intensity pixels, require segmentation of pixels and clustering regions of homogeneity base characteristics of pixels like gray level, texture, intensity and other characteristics [1]. In this chapter, images of blood sample slides are used and this type of images consists of overlapped and un-segmented cells. The author describes the salient features of watershed segmentation technique, considering as the best and most efficient for complex images. For better segmentation of binary images, different distance transform techniques like Euclidean, City block, Chess board and Quasi Euclidean are applied, evaluated and compared the performance of watershed segmentation, are also included in this chapter.

Watershed method is a powerful mathematical morphological tool for the image segmentation [1]. It is more popular in the fields like biomedical and medical image processing, and computer vision [3]. In geography, watershed means the ridge that divides areas drained by different river systems. If the image is viewed as geological landscape, the watershed lines determine boundaries which separate image regions. The watershed transforms computes catchment basins and ridgelines, where catchment basins are corresponding to image regions and ridgelines relating to region boundaries [4].

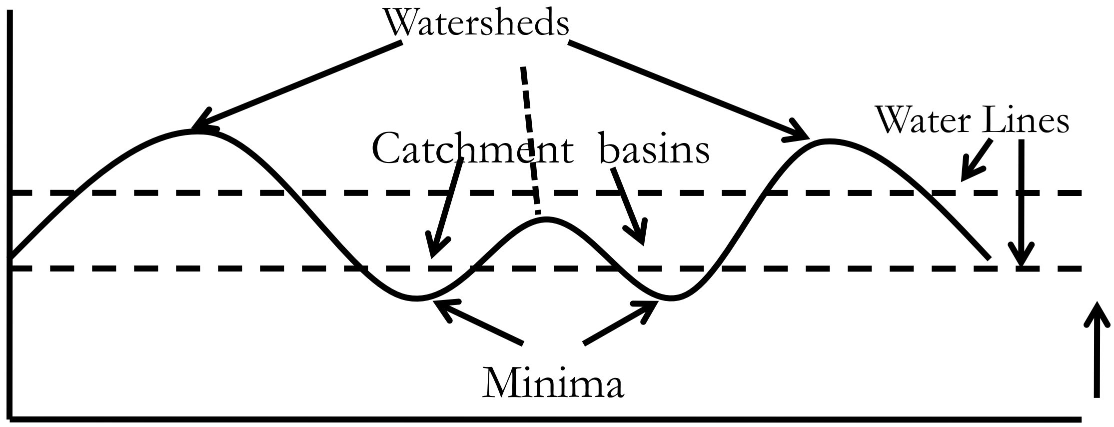

Fig.1 Watersheds and Catchment basins.

Watershed algorithms based on watershed transformation have mainly two classes. The flooding-based watershed algorithms, a traditional approach and rain falling based watershed algorithms as the second.

In traditional flooding based efficient algorithm, implementation of watershed based image segmentation approach is proposed by Luc Vincent and Pierre Soille [5], the image is considered as a topographic surface as shown in the figure 1 contains three points, which indicate regional minimum, highest probability of water to fall into a single minimum region and probability of water to fall into more than one such a minimum region. For regional minimum, the groups of points satisfy the second condition called watershed or catchment basin of that minimum and the groups of point satisfy the third condition makes a crest line of topographic surface termed as a watershed line.

To understand this traditional concept clearly, a simple gray scale image and its topographic surface represents, the height of the topographic surface is proportional to gray level values of the given image. The maximum height of the topographic image is similar to the maximum gray level value of the image.

The relationship and understanding of various measures of space path is useful in selecting a appropriate measurement for a given program. Specific distance measurements, Euclidean distance, City block, Chess board and Quasi-Euclidean distance are defined in detail in the section on analysis [6].

Image Entropy: Image entropy is a quality which is used to describe the ‘amount of information ‘of the image, which must be coded for by a compression algorithm. Image entropy is calculated by

$$\text{Entropy} = -\sum_i p_{i\,Log_2} p_i$$

p_i – Probability that the difference between 2 adjacent pixels equal to i

$Log2$ - The base 2 logarithm

Applying the distance transformation techniques like Euclidean, City block, Chess board, and Quasi-Euclidean the analysis is presented in the next section.

II. ANALYSIS

Watershed segmentation is a better technique for gray level images. The distance transform (DT) technique is required to be applied as a pre-process to watershed transform, when two black blobs are connected together [7] shows only one catchment basin in the topographic surface of the binary image surface.

Different distance transform techniques also used are Euclidean, city block, chess board and quasi-Euclidean distance transform. The Euclidean distance is the straight-line distance between two pixels as shown in the figure 2. The city block distance metric measures the path between the pixels based on a 4-connected neighbourhood. Pixels whose edges touch are 1 unit apart; pixels diagonally touching are 2 units apart as shown in the figure 3. The chessboard distance metric measures [8] the path between the pixels based on an 8-connected neighbourhood. Pixels whose edges or corners touch are 1 unit apart as shown in the figure4. The Quasi-Euclidean metric measures the total Euclidean distance along a set of horizontal, vertical, and diagonal line segments as shown in the figure 5.

The distance transforms of a binary image are the distance from every pixel of the object component which is black pixels to the nearest white pixel. In binary images there are only two gray levels 0 and 1 where 0 stand for black and 1 stand for white. The following are different ways to define the distance between two pixels [i_1, j_1] and [i_2, j_2]in a digital image.

Several commonly used distance transform functions [9]for image processing are:

i) Euclidean

The Euclidean distance between two pixels (i_1 ,j_1) and (i_2,j_2) is defined as

$$d_{Euclidean}([i_1, j_1], [i_2, j_2]) = \sqrt{(i_1 - i_2)^2 + (j_1 - j_2)^2} \quad (1)$$

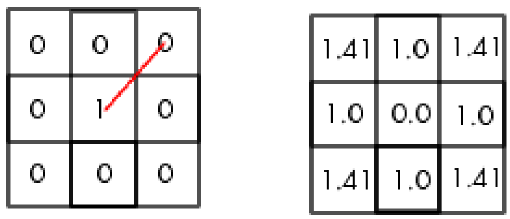

Image Distance transform

Fig.2 Euclidean distance transform

ii) City block

The city block distance between two pixels (i_1 , j_1) and (i_2, j_2) is defined as

$$d_{Cityblock}([i_1, j_1], [i_2, j_2]) = |i_1 - i_2| + |j_1 - j_2| \quad (2)$$

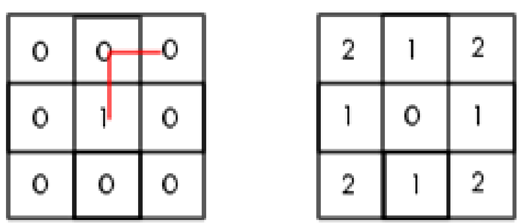

Image Distance transform

Fig. 3City block distance transform

iii) Chessboard

The chess board distance between two pixels (i_1, j_1) and (i_2, j_2) is defined as

$$d_{Chessboard}([i_1, j_1], [i_2, j_2]) = \max|i_1 - i_2|, |j_1 - j_2|) \tag{3}$$

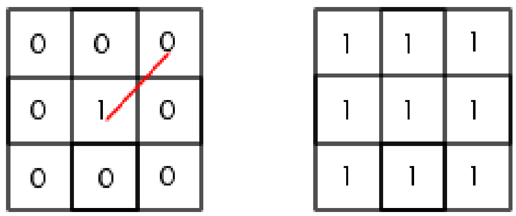

Image Distance transform

Fig.4 Chess board distance transform

iv) Quasi-Euclidean

The Quasi-Euclidean distance between two pixels (i_1, j_1) and (i_2, j_2) is defined as

$$d_{Quasi\text{-}Euclidean}([i_1, j_1], [i_2, j_2]) = \begin{cases} |i_1 - i_2| + (\sqrt{2} - 1)|j_1 - j_2|, & \text{for} |i_1 - i_2| > |j_1 - j_2| \\ (\sqrt{2} - 1)|i_1 - i_2| + |j_1 - j_2|, & \text{otherwise} \end{cases} \tag{4}$$

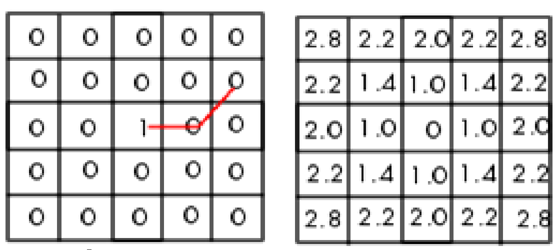

Image Distance transform

Fig. 5 Quasi-Euclidean distance transform

III. RESULTS

The analysis is done using different distance transformation techniques like Euclidean, City block, Chess board, and Quasi-Euclidean to segment the blood cell images and further the entropy values are obtained are tabulated below in the table 1.

Table 1: Shows the samples with entropy values obtainedto different distance transform techniques

Method → / Sample no. ↓	Euclidean	City block	Chessboard	Quasi-Euclidean
1	0.3750	0.3489	0.3517	0.3637
2	0.3539	0.3232	0.3275	0.3370
3	0.3926	0.3691	0.3719	0.3940
4	0.4299	0.4010	0.4038	0.4262
5	0.2730	0.2656	0.2659	0.2706
6	0.3755	0.3754	0.3756	0.3776
7	0.3764	0.3735	0.3749	0.3762
8	0.3785	0.3760	0.3770	0.3793
9	0.3715	0.3687	0.3687	0.3724
10	0.4020	0.3989	0.3988	0.4020

IV. CONCLUSION

The segmentation aim to extract desired objects from the background of the blood cell images is done with different distance transformation techniques. The most important challenging step of extraction and precise segmentation of RBC is done to satisfactory. The extraction of more information from the image is done with all the four techniques but Euclidean and Quasi-Euclidean are showing better extraction with their best entropy values comparative to the other two techniques. Further, there is more scope for the work to develop by using even better techniques to exteract more information from the image in the future.

REFERENCES

1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing,” *Prentice-Hall*, 2002.
2. Babak Yazdanpanah, G.S.N.Raju, and K. Sravan Kumar , “Reduction noise of ECG signal using extended kalman filter,”*International Journal of Advanced Research in Electronics and Communication Engineering*, Vol. 3, 2014.
3. Md. Shakoswat Zaman Sarker, Tan Wooi Haw and Rajasvaran Logeswaran, “Morphological based technique for image segmentation,”*International Journal of Information Technology*, Vol. 14, 2007.
4. Manisha Bhagwat, R. K. Krishna and Vivek Pise, “Simplified watershed transformation,”*International Journal of Computer Science and Communication*, Vol. 1, 2010.
5. Luc Vincent and Pierre Soille, “Watersheds in digital spaces: an efficient algorithmbased on immersion simulations,” *IEEETransactions of Portent Analysis and Machine Intelligence*, Vol. 13, 1991.
6. CH. Nooka Raju, G.S.N. Raju, V.K. Varma Gottumukkala, “Studies on Watershed Segmentation for Blood Cell Images Using Different Distance Transforms”, International Organization of Scientific Research Journal of VLSI and Signal Processing, Vol. 6, 2016.
7. Qing Chen, Xiaoli Yang, Emil M Petriu, “Watershed segmentation for binary images with different distance transforms,” *IEEE conference,*2004.
8. Ramesh Jain, Rangachar Kasturi, and Brian G.Scbunck, “Machine Vision,”*McGraw-Hill*, 1995.
9. The Mathworks online documentation, Matlab Image Processing Toolbox, *http://www.mathworks.com/access/helpdesk/help/toolbox/images/images.shtm*.