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A Review on Various Methodology of White Blood Cell Detection

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ABSTRACT
WBC count is an important subnet of total blood count. This paper approaches four methods of detection of white blood cells. The first method is namely, watershed transforms & level set. The second method is Threshold segmentation followed by mathematical morphology (TSMM) & the fuzzy logic method. The third method is approach K means method used for separating the nucleus from the other parts of cell & microscopic blood image.

Keywords- White Blood Cell, Segmentation, Morphology, Fuzzy Logic.

I. INTRODUCTION

The blood circulatory system is one of the important systems in human body. In human body blood cells are divided in three general categories RBC, WBC and Platelets. RBC (erythrocytes) carries oxygen & collects carbon dioxide through hemoglobin. WBC (leukocytes) of immune system involved in defending the body against infection & Platelets (thrombocytes) are natural source of growth factor. The number of leukocytes in the blood is often an indicator of disease, thus WBC count is an important subnet of complete blood count. Blood cell detection is a challenging problem due to complex nature of cell in video microscopy. In Manual methods for this purpose is very hard, difficult and highly subjective as compare to automated methods that perform this task in an objective and efficient way [9]. But there are only a few method available for cell detection or segmentation due to the complexity of the microscopic images.based on the detailed analysis of existing methods threshold segmentation followed by mathematical morphology (TSMM), and the fuzzy logic method— a new detection algorithm (NDA) based on fuzzy cellular neural networks is proposed. NDA is used to combines the advantages of TSMM and the fuzzy logic method, and overcomes their drawbacks. By using NDA, They can detect and get exact count of cell. Its adaptability is very powerful and the running speed is expected to be comparatively high due to easy hardware implementation using FCN. Now describing another method to perform automatic differential counting. In this explore the image simplification and contour regularization resulting from the application of the self dual multiscale morphological toggle (SMMT) [4]. To segment the nucleus, the image preprocessing with SMMT has shown with two welknown images segmentations techniques, namely, watershed transform and Level-Set methods. To identify the cytoplasm region, there are two different schemes, based on granulometric analysis and on morphological transformations. This proposed system is applied to large number of images, showing segmentation, image quality encouraging future work.

Nucleus is the main part of white blood cell (WBC) which contained chromosomes although white blood cells (WBC) with giant nuclei are the main symptom of leukemia. Another important symptom of leukemia is the existence of nucleolus in nucleus. The nucleus contains chromatin and a structure called the nucleolus. Chromatin was DNA in its active form while nucleolus is composed of protein and RNA, which are usually inactive In this paper, they used curvelet Transform to diagnose this symptom and in order to discriminate between nucleoli and chromatins, also which is a multiresolution transform for detecting 2D singularities in images[8]. For this reason, at first nuclei are extracted by means of *K*-means method, then curvelet transform is applied on extracted nuclei and the coefficients are modified and finally reconstructed image is used to extract the candidate locations of chromatins and nucleoli.

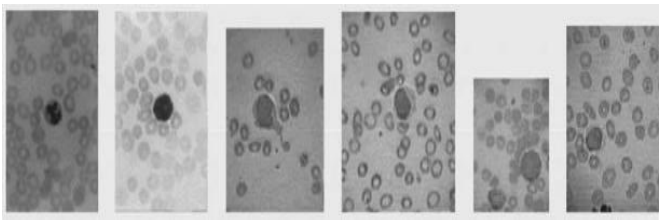
II. METHODOLOGY

A. TSMM and Fuzzy logic method-

In given the process of an automatic differential blood counter system they consider the steps were acquisition, detection, feature extraction and classification [6]. In this the blood smear image was magnified to a suitable scale under microscope and a modern charge-coupled device (CCD) camera smear image was transformed into a digital image. The cell segmentation yield a number of single cell image and each image was segmented into three regions cell nucleus, cytoplasm, and background. The feature vector analyzes each

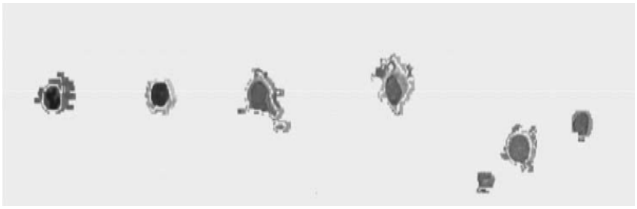
segmented cell to form feature vector from color, shape and texture feature. By using this entire step automatic white blood cell detection was possible. Its accuracy and stability have direct and great influence on the running speed and recognition accuracy of the system. Automatic white blood cell detection was very difficult. In microscopic blood image, there were mixing of white blood cell, red blood cell, platelets and other objects. To distinguish one element from other becomes very difficult when occlusion, illumination were inconsistent. Hence sometimes manual detection still needed in many cases. Regarding the detection step, a few methods have been presented Threshold segmentation followed by mathematical morphology (TSMM), a method based on fuzzy logic was introduced [6]. Binary threshold segmentation is performed as the first step of TSMM because the gray value of white blood cell nuclei was regarded as the smallest in the image. Then the individual white blood cells are detected quickly and automatically according to the shape feature.

The procedures were described as follows: 1) use the pyramidal method to compress the original image; 2) take the average gray value of cytoplasm as the threshold and do the binary segmentation; 3) perform *n* erosions/ dilations to the binary image, where *n* is set by experience; 4) segment the nuclei with the shape features such as area and round degree; 5) locate each nucleus, set the proper size of window, recover the original image inside the window, and finally achieve the purpose of detecting all white blood cells in an image at once. By considering this method to do background eliminate, eliminate red blood cell, small disturbing objects and finally separate white blood cell from the bigger disturbing objects. Therefore it is not easy to omit the white blood cells. It only applies to gray images, especially to those images in which the nuclei of white blood cells have the smallest gray value. However, inconsistent illumination or a different staining reagent can yield diverse microscopic images for the same microscopic field. Without a proper transformation method, a color image may also suffer a great loss of necessary information when transformed into the corresponding gray image. Thus, there were no guarantees that the nuclei of white blood cells always have the smallest gray value. There were too many parameters determined by experience. The fuzzy logic method presented in supposes that one microscopic image consists of two regions. One was the interest region, which contains all white blood cells. The other was the no interest region, which includes the background, red blood cells, and the contours of white blood cells. Background corresponds to the region having a very light gray level with homogeneous texture; Red blood cells (RBC) are in the region with light-medium gray level and homogeneous texture; and contours of white blood cells are in correspondence with no homogeneous areas. In this way, the fuzzy rule base was determined. Once the no interest region was obtained, the interest region can be easily obtained by applying the traditional complement operator to the no interest region. In this way, the white blood cells were detected.



(a)

(b)



(c)

Fig.1. Experimental Results Carried Out By Leyza Baldo Dorini of Two Existing Methods. (A) The Original Color Microscopic Images. (B) The Results Obtained By TSMM. (C) The Results Obtained By The Fuzzy Logic Method.

In this proposed technique NDA algorithm is used as detection algorithm which is fully based on cellular neural networks. Using this algorithm they can detect all and complete white blood cells. This technique is having strong adaptability and high running speed comparatively. For better performance of NDA they had improved FCNN and also distinguished between nucleus from cytoplasm is hardly

possible. This problem was cured in using watershed and level set method as using mathematical morphology operations [4].

B. WBC Segmentation Based On Multiscale Analysis-

Image segmentation is basically on partitioning an image into a set of two homogeneous region and their aim is to accurately segment the nucleus and cyptoplasm component of blood smear image to further extract shape based features. To segment the nucleus component, in this explore two approaches namely, watershed transform and level set methods [4]. The cytoplasm was segmented by applying simple morphological transformations on images processed at different scales by the SMMT. In both cases, the preprocessing with the SMMT was essential to ensure satisfactory precision rates.

(1)Watershed transform -

Morphological watersheds provide a complementary approach to the segmentation of objects [7]. It is especially useful for segmenting objects that were touching one another. Apply watershed transform by IFT (Image forecasting transform). The IFT assigns a minimum cost path to each pixel such that each seed become a root of an optimum path three composed by its most strongly connected pixels. Cost of path in graph was determined by cost function which usually depends on its color and gradient. The resulting optimum path consists of two sub forest – Object and background. The internal seeds must necessarily belong to the interest object, and the external ones are initialized as its edges (gradient image). Exploring the fact that the WBC nucleus is the darkest part of the image, apply a threshold to obtain one sample of each WBC nucleus to be considered as internal marker. Due to illumination inconsistencies, the contrast of the boundary between nucleus and cytoplasm can change significantly, frequently resulting in a weak-gradient image. This may cause a failure called "leaking", i.e., an object seed conquers background pixels or vice versa. Since the cell nucleus was not sharp, eventually it was necessary to discard small regions connected to it that in fact correspond to cytoplasm pixels. Thus, they compute erosion on the image processed by the SMMT operator before extracting the gradient.

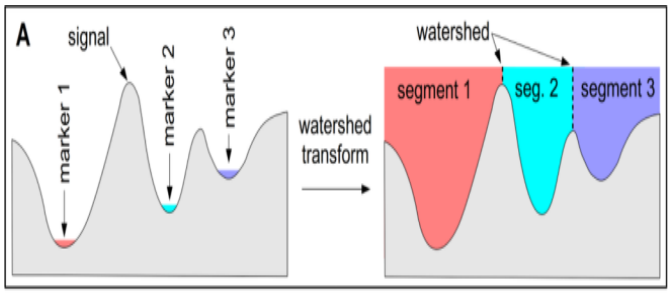


Fig.2. Watershed Algorithm

Given fig shows watershed algorithm, the dam boundaries correspond to the watershed lines to be extracted by Watershed transform algorithm. Watershed segmentation technique had been widely used in medical segmentation. Watershed transform was used to segment grey matter white matter.

(2) Level set -

To illustrate the relevance and robustness of the preprocessing step with SMMT, the same transformed images were also segmented using Level-Set Methods [3]**.** The important process consists on the representation of a surface as the level zero interface of a higher dimensional function called Level-Set function. One of the main advantages of the method was the capability to deal with topological changes and discontinuities that may arise during the evolution of the level zero curves. To prevent the leaking of the curves moving toward object edges, the following term is introduced:

$$gI(x, y) = 1/(1 + |\nabla(G\sigma * I(x, y))|)$$

Where, $G\sigma * I$ denotes the convolution of the image I with a kernel of standard deviation σ. The term $\nabla(G\sigma * I(x, y))$ is essentially zero, except near significative. Thus, $gI(x, y)$ approaches one out of the edges and tends to zero near them. Consider a velocity function of the form $F = \pm 1 - \_\kappa$, where $\_$ a constant that acts as an advection term, and κ is the curvature at a point, the Level-Set function may produce shocks and region flattening, causing errors in further processing tasks[3]. To avoid this, such function need to be periodically reinitialized, thus increasing the computational cost. By using these two methods, the cytoplasm segmentation methods were carried out using mathematical morphology operations, such as the granulometric function and the combination of the bottomhat and area opening transforms.

C. Segmentation Using K-Mean Method-

The important part of White blood cell is their nucleus which contains chromosomes. The nucleus contains chromatin and structure called the nucleoli. Nuclei were extracted by clustering the microscopic image into three color cluster in luv color system using k-means method then the

curvelet transform was applied on extracted nucleus [8]. According to which extraction of the candidate locations of chromatins and nucleoli is possible. The aim of the nucleus from other part of cell and microscopic blood smear image. Human blood cells are generally divided into three categories Red Blood Cells (RBC), White Blood Cells (WBC), Platelets which appears in a different color from Red cell and other parts of peripheral blood smear images. By using color information, after applying several processing step nuclei were extracted by K-mean method. According to effective extraction of nucleus was a challenging part overcome as nuclei are effectively extracted by means of k-means method used in this paper[8] [9].

III. CONCLUSIONS

In this paper, we have proposed different methods to detect and segment WBC into the morphological components, nucleus and cytoplasm. At first proposed system NDA algorithm is used which is fully based on cellular neural network. They can detect all and complete WBC. In second method we can carried out segmentation using mathematical morphology operations. In third we show effective extraction of nucleus by using K-mean method which is carried out by Ramin Solanzadeh. Finally it can be seen that White blood cell detection is done by various methods, also in future work different automatic methods must be developed.

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