Detection of RBC and Counting

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Abstract---Blood cell counting by laboratory task utilizes haemocytometer and microscope. It is laborious. This shows the effectiveness of an automatic image processing method to detect blood cells by peripheral blood smear microscope image. The traditional method of manual count under the microscope yields inaccurate results and put an intolerable amount of stress on the Medical Laboratory Technicians. Although hardware solutions such as the Automated Haematology Counter, are not capable of deploying such prohibitively expensive machines in every hospital laboratory in the country. As a solution to this problem, this Paper aims to provide a software-based cost effective and an efficient alternative in recognizing and analysing blood cells.

Keywords: - Blood Cells; Image Processing; Morphological Processes; Thresholding; Cell Counting.

I. Introduction

Blood is a connective tissue consisting of cells suspended in plasma. Blood's major functions are to transport various agents such as oxygen, carbon dioxide, nutrients, wastes, and hormones. Blood cells are composed of erythrocytes (red blood cells, RBCs), leukocytes (white blood cells, WBCs) and thrombocytes (platelets). The most abundant small reddish cells are erythrocytes and called red blood cell. An erythrocyte is a discoid cell with a thick rim and a thin sunken center. RBCs' two principal functions are to move oxygen from lung to tissues elsewhere and transport carbon dioxide from tissues to the lung. Whereas, the Leukocytes or white blood cells are part of the immune system. The conventional device used to count blood cells is the hemocytometer. It consists of a thick glass microscope slide with a rectangular indentation creating a chamber of certain dimensions. This chamber is etched with a grid of perpendicular lines. It is possible to count the chamber of cells in a specific volume of fluid, and calculate the concentration of cells in the fluid. To count blood cell, physician must view hemocytometer through a microscope and count blood cells using hand tally counter. The overlapped blood cells on the top-side and right-side of hemocytometer are not counted. Normally, the counting task is time-consuming and laborious. Several attempts have been made to mimic the procedure of cell recognition from image. The major application of neural networks was devoted to the WBCs classification via extracted morphologic parameters. Some red blood cell classification task using neural network was adapted for Thalassemia diagnostic tool. Many commercially available products have been developed to automatically count RBCs or WBCs. Their advantages include automatic cell counting cells without hand tally counter, no requirement of messy washing and no associated biohazard. However, these products are expensive.

II. Experiment

This work aims to apply image processing to extract the blood image taken from blood smear microscope, then automatically counting red blood cells. This work can help release physicians from tedious and laborious blood cell counting task. The images of blood cell was digitized by the optical microscope. The composition of blood image consists of red blood cells, white blood cells and sickle red blood cells. The image was analyzed by manually looking for red blood cells. After that, the red blood cells were counted using the proposed red blood cell counting method, automatically. The proposed method consists of three steps. The first step is to apply an image processing to delete in-completed blood cells that overlap on the boundary of the image. Then, single blood cells were extracted from the image using edge detection algorithm and each single blood cells image scale to 31x30 pixel. Finally, each single blood cells were analysed by using a neural network to search for red blood cells and count them.

Digital image processing was extensively used in this work. It is the key performance index to establish the ability of the proposed method.

III. Image Processing

The main image processing tasks consists of enhancing the image's qualities and deleting overlapped blood cells in the boundary area of the image. Both tasks can be subdivided into smaller tasks.

A. Pre-Processing:

The main objective for pre-processing is to remove the unwanted noise and improving the quality of Image.

B. Contrast Adjustment:

To adjust brightness of an image, an histogram of the interested image is used to determine data and display ranges of the image. The data range is the range of intensity values actually used in the image. The display range is the black-to-white mapping used to display the image determined by the image class. Contrast adjustment is done by manipulating the display range of the histogram while the data range of the image remains constant.

C. Cell Detection:

The major challenge of white blood cell detection is the incomplete or overlapped blood cells around the boundary area of an image. The objective of blood cell detection is to detect cells which differentiate themselves from the background in terms of contrast. Changes in contrast can be detected by image processing operators that calculate the gradient of an image. Then a threshold can be applied to create a binary mask containing the segmented cell.

D. Image Dilation:

The first step is to apply morphological operator to create a structuring element specified by interested shapes, disk shaped structuring element. Depending on shape structures,

disk-shaped approximation are suitable for computing metrics. Disk-shaped structuring element is approximated by specifies radius from the origin of granule. The structuring element members, binary gradient mask, consist of all pixels whose no greater than radius away from the origin. Then the binary gradient mask is dilated using the vertical structuring element followed by the horizontal structuring element. The dilation morphological operator has been used to better connect separated points of the membrane

E. Hole Filing:

The dilated gradient mask shows the outline of the blood cell quite nicely, but there are still holes in the interior ofthe cell. Filling internal holds of the connected element get the biggest area in the processed image.

F. Eroding:

All of blood cells of interest has been successfully segmented. Finally, in order to make the segmented object look better, the objects in the processed image can be smoothed by eroding the image. This step reduces thespur elements along the membrane edges. Figure 3shows the outline of the resulting smoothed image.

G. Cell Separating:

To separate white blood cells, the red blood cells are the first to be removed from the target image. There are several steps involved in red blood cells removal as followings. The most important step is to apply low pass filter and count only labelled white blood cell in blood plasma that show in Fig 5.

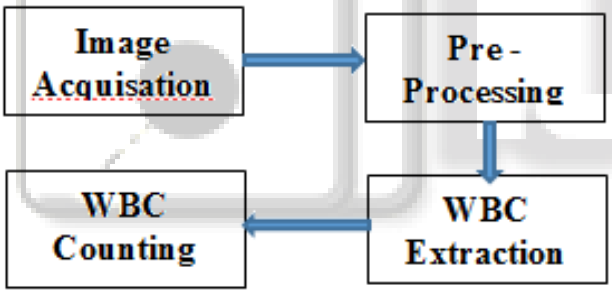

Fig. 1: Procedure of white blood cell separation and counting.

The process for extracting the WBC are shown in following Fig. 2 – Fig. 7

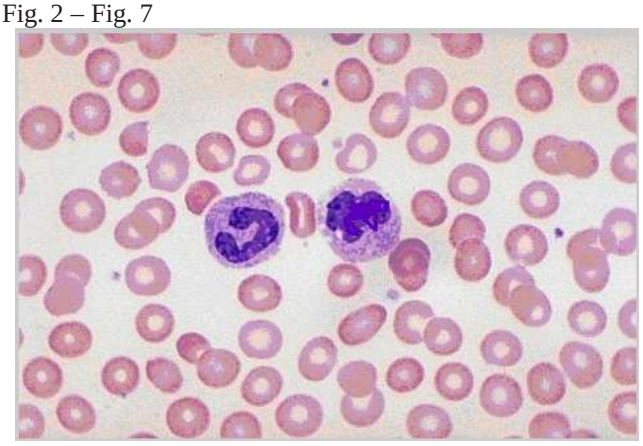

Fig. 2: Original Image

Fig. 3: Filtering the Image

Fig. 4: Detecting the Cell

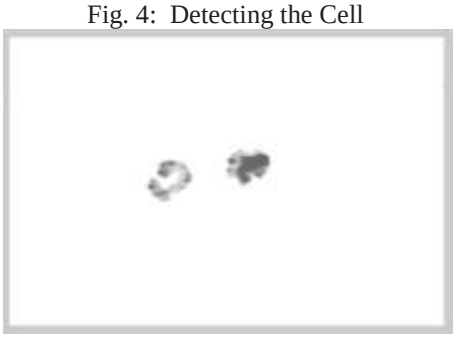

Fig. 5: Eroding the Image

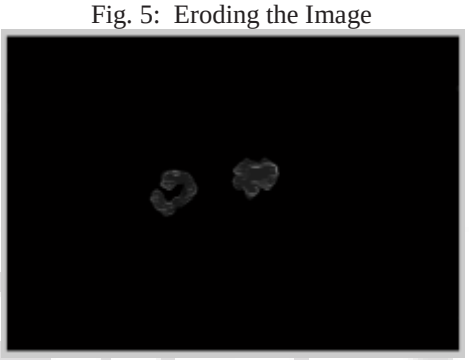

Fig. 6: Hole Filling

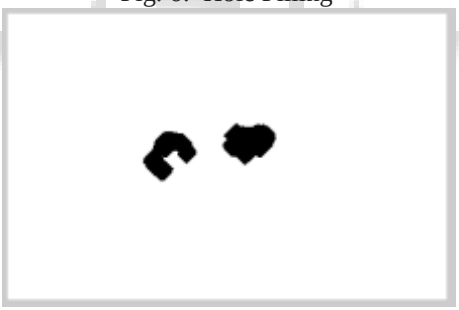

Fig. 7: Dilating the Image

Labelling the fig 7 will gives total no of WBC in Image.

The counting process of the cell is carried out by following equation

Total Count =WBC in Image * DF * VC Eq. (1)

Where DF is Dilution Factor

VC is Volume Coefficient

The above count is in unit of Millions per litre.

IV. CONCLUSION

The detection of WBC, WBC Counting is done by pathologists manually using Microscopes. So, the chances of false detection due to human error are high, which in turn can result into fatal condition. Also using Haemocytometer the chances of false counting are high and also it is very time taking process. This paper curbs the human error and in less time while detecting the blood sample by using image processing and automation.

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