

Detection and Counting of Blood Cells in Blood Smear Image

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Abstract - This paper deals with an image processing technique used for detecting the blood cells in less time. The proposed technique also helps in counting and segregating the blood cells in blood smear image of different categories based on the form factor using various Morphological operations. Nowadays in Hospitals and clinical Laboratories the waiting time for getting their blood results and reports are more commonly 24 hours to 8 days in case of high severity diseases where the mortality rates are high. Doctors and technicians in healthcare sectors recommended that the patient's waiting time should be as less as possible and the treatment should be started immediately for the high risk diseases like Hepatitis B. The major other factor affects patient in healthcare field is the more expensive pathological tests which sometimes leading to loss of patient's life. The proposed technique gives improved accuracy in counting the number of blood cells in blood smear image in compare to manual counting in laboratories.

Keywords: Hepatitis B, Pathological tests, Image Processing, Morphological operations.

INTRODUCTION

The blood consists of a suspension of special cells called plasma. Blood consists of 55 % plasma, and 45 % by cells called formed elements. The blood performs many important functions. Hemoglobin in blood carries oxygen to the tissues and collects the carbon dioxide (CO₂). It supplies nutritive substances (e.g. sugars, mineral salts and amino acids) to the various tissues. Any problem to the physiological system directly affects the blood components. The analysis of blood components gives useful information about the status of the physiological system and helps in diagnosis of various diseases in Healthcare field. Blood cell components are erythrocytes, leukocytes and thrombocytes. The work flow of detecting the blood cells in blood smear image is given below:

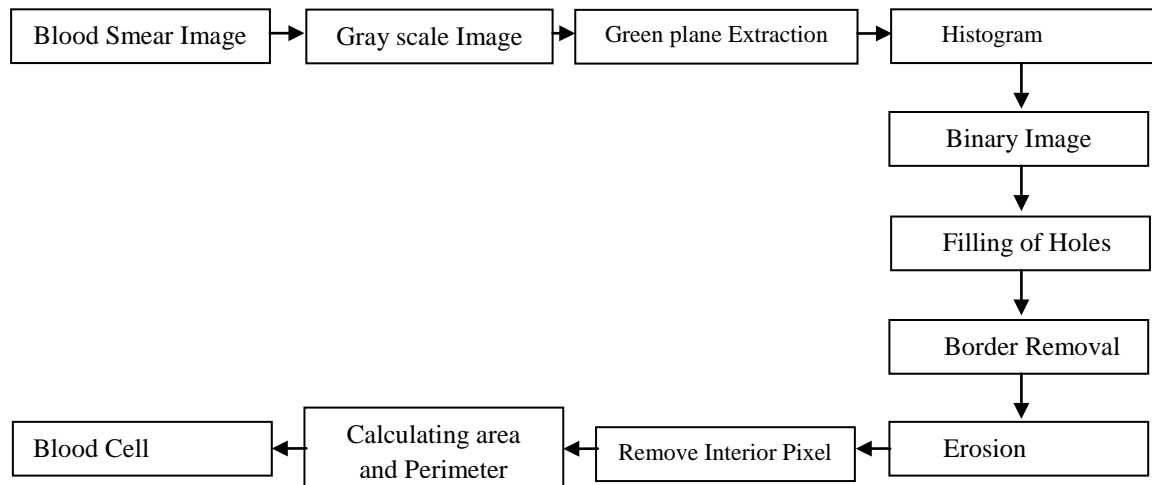


Fig. 1 Block diagram of proposed technique

The block diagram explains about the process of counting of the blood cells. The microscopic blood cell image is acquired from digital microscope as the input image and it is converted to gray scale image using Matlab Software. Green component alone is extracted from grayscale image, because the green component contains more information than red and blue channel. To attain uniform pixel distribution and uniform contrast in image histogram

equalization is performed. Binary image is obtained and then the holes in the binary image are filled using Image processing technique. The counting process does not include the border cells so that the border cells are cleared and erosion is applied to get separate individual pixels. The interior pixel removal is used to count the blood cell accurately. The area and perimeter is calculated to detect the blood cell from blood smear image.

II.METHODOLOGY

Image Acquisition

The digital microscope is interfaced to a computer and the microscopic images are obtained as digital images. The resolution of the digital image depends on the type of digital microscope used.

Image Enhancement

For better segmentation of the blood cells, the imported image has to be enhanced. This improves the quality of the image in terms of details.

Green Plane Extraction

The green plane is extracted from the imported blood cell image. The other planes such as red and blue are not considered because they contain less information about the image.

Contrast Adjustment

To enhance the image, its contrast is adjusted by altering its histogram. The image's histogram is equalized. Histogram is defined as a graph plotted between gray level value and no of pixels. Histograms are the basis for numerous spatial domain processing technique. Histogram manipulation can be used effectively for image enhancement. Histograms are simple to calculate in software and also lend themselves to economic hardware implementations thus making them a popular tool for real time image processing.

Intensity Resolution

The quality of a gray-level image is significantly affected by its gray-level resolution. Other word, increasing the number of bits per pixel has a great effect in improving the quality of gray-level images. This is because that a higher number of gray levels would give a smooth transition along the details of the image and hence improving its quality to the human eye.

Complementary Image

The Photographic Negative is probably the easiest of the intensity transformations to describe. we are working with grayscale double arrays where black is 0 and white is 1. The idea is that 0's become 1's, 1's become 0's, and any gradients in between are also reversed. In intensity, this means that the true black becomes true white and vice versa.

III. MORPHOLOGICAL OPERATIONS

Filling Holes

$BW2 = \text{imfill}(BW, \text{'holes'})$ fills holes in the input binary image BW. In this syntax, a hole is a set of background

pixels that cannot be reached by filling in the background from the edge of the image. A hole may be defined as a background region surrounded by a connected border of foreground pixels.

Let us denote by a set of whose elements are 8-connected boundaries, each boundary enclosing a background region (a hole). Given a point in each hole, the objective is to fill all the holes with ones. An image that could result from thresholding to 2 levels a scene containing polished spheres (ball bearings). Dark spots could be results of reflections. The objective is to eliminate reflections by whole filling.

Clearing Borders

$IM2 = \text{imclearborder}(IM)$ suppresses structures that are lighter than their surroundings and that are connected to the image border. Use this function to clear the image border. IM can be a grayscale or binary image. For grayscale images, imclearborder tends to reduce the overall intensity level in addition to suppressing border structures. The output image, IM2, is grayscale or binary, depending on the input. The default connectivity is 8 for two dimensions, 26 for three dimensions and $\text{conndef}(\text{ndims}(BW), \text{'maximal'})$ for higher dimensions.

Erosion and Interior Pixel Removal

It is one of the two basic operators in the area of mathematical morphology, the other being dilation. It is typically applied to binary images. The basic effect of the operator on a binary image is to erode away the boundaries of regions of fore ground pixels. Thus areas of fore ground pixels shrink in size, and holes within those areas become larger. The erosion operator takes two pieces of data as inputs. The first is the image which is to be eroded. The second is usually a small set of coordinate points known as structuring element (kernel) which determines the precise effect of the erosion on the input image. In interior pixel removal, this technique sets a pixel to 0 if all its 4-connected neighbors are 1, thus leaving only the boundary pixels on.

Image Segmentation

This involves selecting only the area of interest in the image. Here only the blood cells are selected, because they are the areas of interest A segmentation can be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing of image database look up. Form factor threshold is fixed for different blood cells. All the cells having the form factor value less than 0.6 are considered abnormal and the cells having the form factor range between 0.6-1 are considered as normal cells. Based on these criteria the normal cells are detected. By incrementing a counter value within for loop, the number of normal cells and abnormal cells can be calculated. Form factor is calculated for the labeled cells. So the basic aim is to calculate the area and perimeter.

Calculation Of Area

Number of pixels in one cell makes its area. So the number of pixels having same label constitute the area of the labeled cells.

Calculation Of Perimeter

Any pixel whose four neighborhoods are white is surely not a boundary pixel as it lies interior of the cell. So we get number of those pixels whose four of the neighborhoods are white. And if we subtract this value from the total area

of the Image then this will give area outside the cell along the perimeter of the cell.
 Form factor= $4 * \pi * \text{area} / (\text{perimeter} * \text{perimeter})$

IV. RESULTS AND DISCUSSION

The total number of blood cells present in the image is counted using proposed algorithm (Implemented using MATLAB software). The algorithm shows the form factor for the blood cells which are more or less in circular shapes. Also, the total number of cells is estimated and it matches with manually counted blood cells.

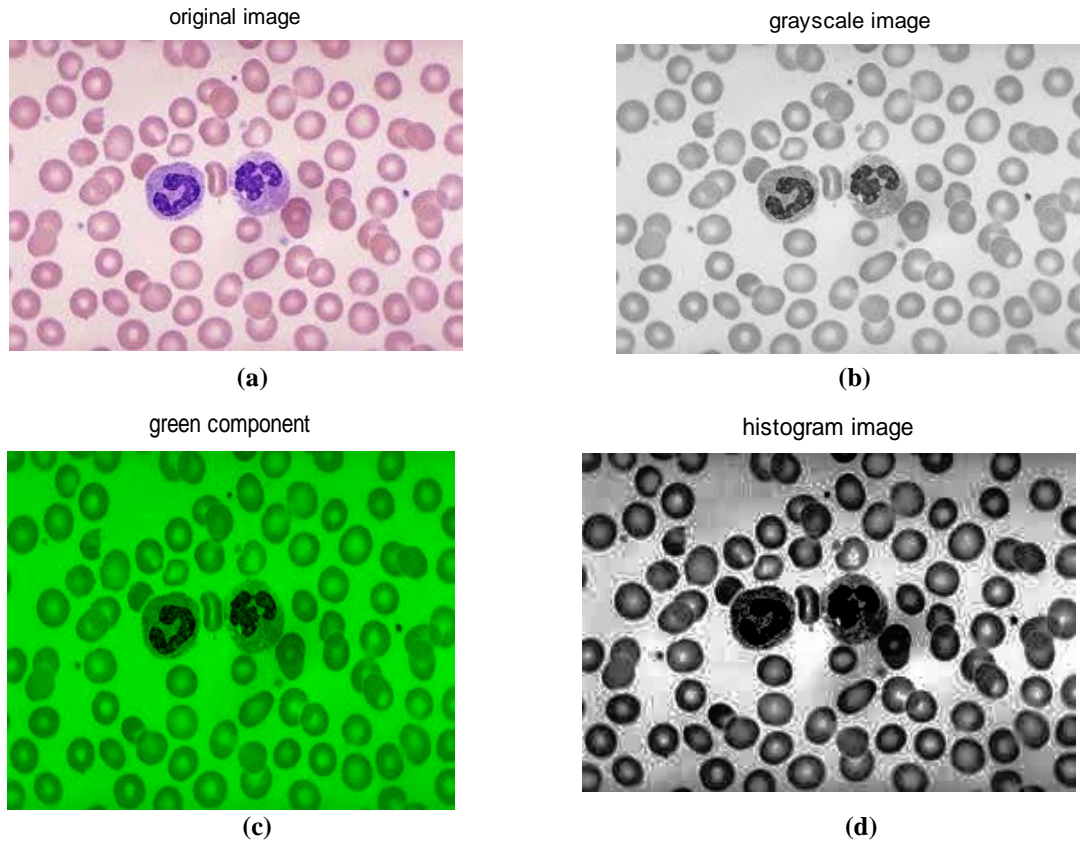
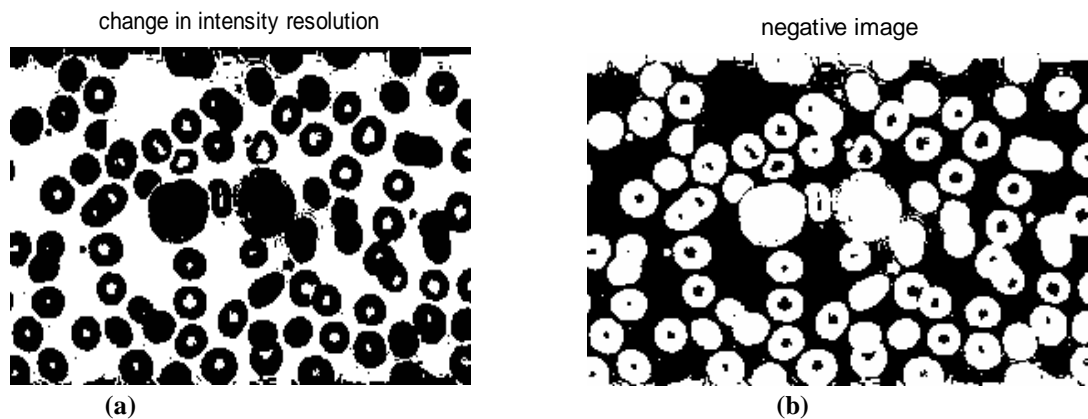
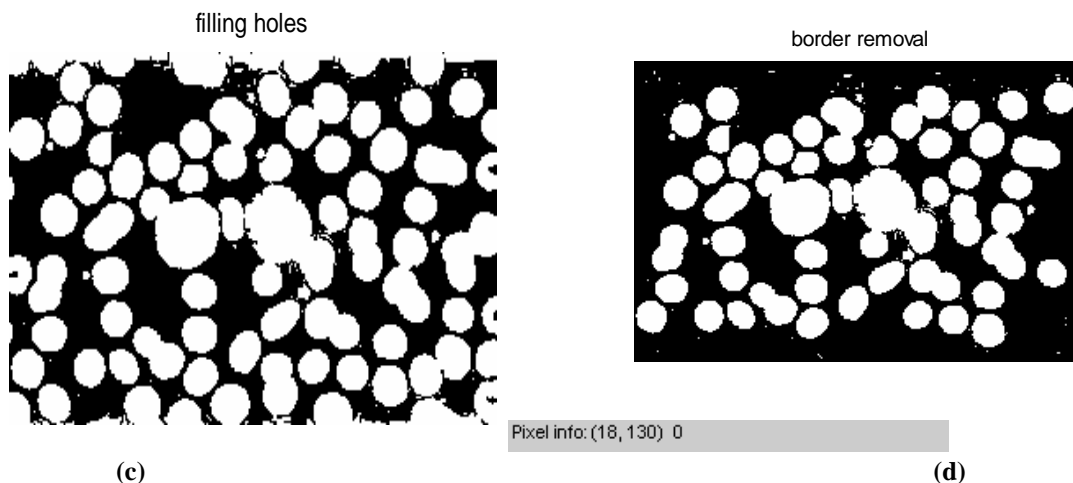
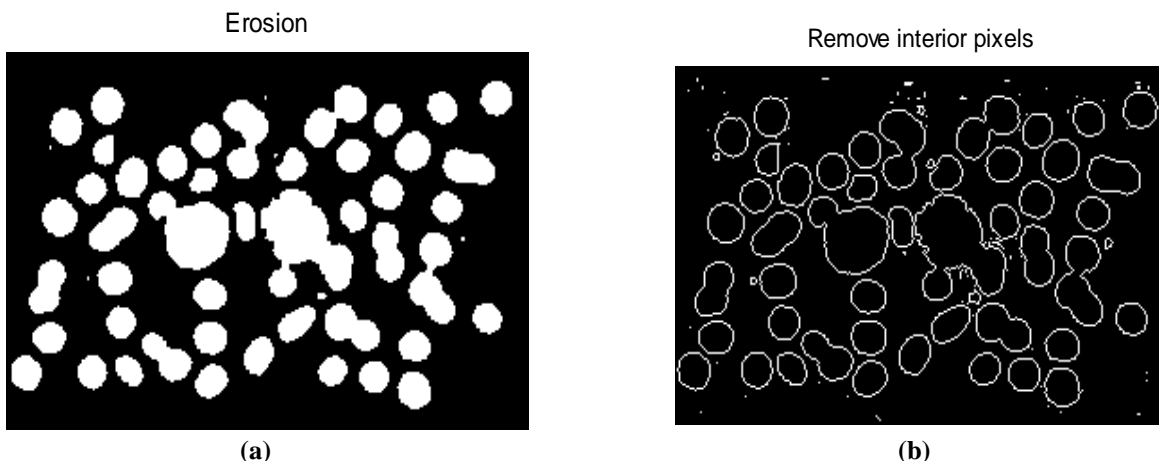


Fig. 2 (a) Original Image acquired from Digital Microscope , (b) Converted gray scale image (c) Green component alone is extracted from grayscale image (d) Uniform pixel distribution obtained using image Histogram Equalization technique





(c) (d)
 Fig. 3 (a) (b) Obtained Binary Image from the histogram equalized image (c) Holes in Blood smear image are filled by Morphological operator (Fill Hole) (d) Border cells in boundary are cleared for counting process



(a) (b)
 Fig. 4 (a) Structuring pixel element using Erosion operator (b) Internal Pixel are removed

In the cell image we have total 45 cells Comparison of the Result between the proposed method and the manual method: It is observed that the results obtained by the proposed method offer a good conformity with the manual counting method. In our method, we have left out the cells that are not totally in the image field. However, in a real blood test where blood count is done manually, the practice is to count the cells on two adjacent edges of the image field and take each cell as one irrespective of how much of it is in the image field. It is assumed that two opposite sides have same number of such cells. As this edge correction has not been considered, in each of the samples the count values by the proposed method are slightly less than the count values obtained manually.

Proposed method is very cost-effective and can be easily implemented in medical facilities anywhere with minimal investment in infrastructure. It can also identify overlapping blood cells and count them separately. It is also very time effective as manual counting is a very tedious job and time consuming. However, the software must be modified to count the effective number of RBCs which are partly in the image fields to obtain more accurate result.

V. CONCLUSION

As a conclusion, this proposed technique successfully utilizes morphological approached for segmentation, extraction and estimation in order to solve problem in image processing of the blood cells. The results of the image can be used as good input in detecting the number of blood cells in blood smear image. With framed algorithm, the blood cells can be detected and segmented as well as estimated the number of the blood cells for counting. Through system created using MATLAB, it also enable the study of the morphological features of the blood cells image, thus, can determine whether the person is normal or otherwise by referring amount of blood cells in human blood. This technique does not involve too much looping process when develops the MATLAB source code program. One of the factors that need to be considered in healthcare field to improve this study is to reduce the time taken by the user determine the blood cells parameters in laboratories and hospitals.

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