Automatic Blood Cell Counting using Morphological Image Processing operations

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***Abstract*- The estimation of RBC plays a crucial role in medical diagnosis and pathological study. The main objective of this system is to detect and estimate the number of red blood cells present in the blood smear sample image. The process is initiated by image acquisition and image enhancement process. Morphological operations are applied on the blood image followed by RBC counting and WBC counting. The primary goal of the proposed system is to detect and count all the blood cells and then count RBC including the overlapping ones in the blood smear image**

Index Terms- Blood sample images, Image Processing, morphological Operations.

I. INTRODUCTION

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 were digitized by the optical trinaculor microscope. The composition of blood image consists of red blood cells, white 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 convert the color image into binary image. Then, removal of small objects filling the image after edge detection algorithm and each single blood cell is counted on the basis of centroid method. Currently the complete blood count is done using automated methods such as flow cytometry. Such methods give accurate results, but are costly. Also these methods give only the count of the cells in the blood. They cannot be used to detect irregularities or variation in the shape and size of the cells. Counting using the hemocytometer is manual and prone to human errors during counting. The pathologist has to differentiate between various types of cells in the blood while. Analyzing multiple blood samples can become strenuous. Counting overlapping blood cells is also a major problem. These methods require state of the art biomedical instruments which are costly and require trained personnel to operate. We will try to develop a system which will overcome the above drawbacks. The proposed system will take a magnified image of the blood smear and apply various image processing techniques to count the number of red blood cells in it. White blood cells, platelets will automatically be removed from the image. This reduces the region of interest. Overlapping cells can be easily detected. The user of the system does not have to be trained in any particular way. Any person with basic computing skill can easily operate the system. The system can be installed on basic computer configuration. Hence it will have widespread use and ease the method of counting. The objectives are to differentiate RBCs and WBCs which are present in a blood smear slide, average size estimation of the RBC particles, detect the overlapping RBC, mitigate problems posed by different conditions such as noisy and degraded images, differing blood staining techniques, various types of microscope illumination, overlapping and adjacent cells, to get an efficient result, to get an accurate result. First total blood cells are counted and the WBCs are counted from same sample. Automatically we get the count of RBCs. The proposed method is given as follows. Extracting WBCs from the total number of blood cells we get RBCs using morphological operations.

II. PROPOSED METHODOLOGY

The objective of our work is to automate some of the procedures followed in the laboratories such as:
a) Red Blood Cell Counting
b) White Blood Cell Separation and counting

WBC Extraction:
The first processing step of the architecture enhances the input image and it selects the white cells present into the image by separating them from others blood's components (red cells). All the modules of the presented system work on gray-level images. This design choice, which apparently can be thought as a leak of information, indeed is driven by the consideration that the colorant used to mark the white cells can greatly chance the chromatic characteristics of cells from one experiment to another. It can be related to many uncontrollable experimental parameters such as operator capabilities to prepare the slides.
Proposed pre-processing steps are based on three very well-established assumptions(Hypothesis):
a) The colorant used in the preparation of the blood tends to concentrate only in white cells, in particular in their nuclei that are typically center-positioned (as shown in figure (a) , white cells are the darker elements in images);
b) Red cells are thinner in their center than in the edge, hence their nuclei appear more pale than the border (leucocytes are in the opposite situation);
c) Platelets are much smaller than white and red cells.
Our approach to the identification of leucocytes in the blood image is based on a adaptive prefiltering and segmentation. The pre-filter uses hypotheses a), b) and c) to enhance only the leucocytes. It separates the others blood components with respect to the gray level intensities in order to achieve e very accurate leukocyte segmentation. The processing steps are as follows:

Contrast stretching:
Firstly, the input image is pre-filtered by a contrast stretching filter in order to enlighten only the leucocyte's nuclei. As described, they tend to be the darker areas of the gray-level image (hypotheses a).

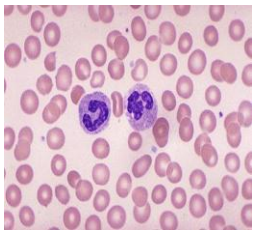
Opening:
Since the nuclei of leucocytes are a connected circular-shaped area of dark pixels and other blood components are not (hypothesis b and c), it is possible to enhance the nuclei and reduce other components by a morphological filter based on the opening operator with structured element. This operator, if applied to gray level images, tends to enhance pixels which belong to areas of similar intensity and larger than the structured element. Conversely it tends to reduce the intensity of small groups of pixels smaller than the structured element.

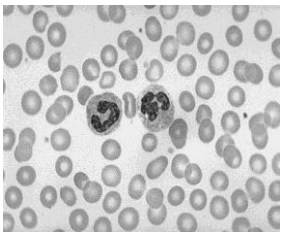
Blurring:
The blurring, or degradation, of an image can be caused by many factors: Movement during the image capture process, by the camera or, when long exposure times are used, by the subject. Out-of-focus optics, use of a wide-angle lens, atmospheric turbulence, or a short exposure time, which reduces the number of photons captured. Scattered light distortion in confocal microscopy.

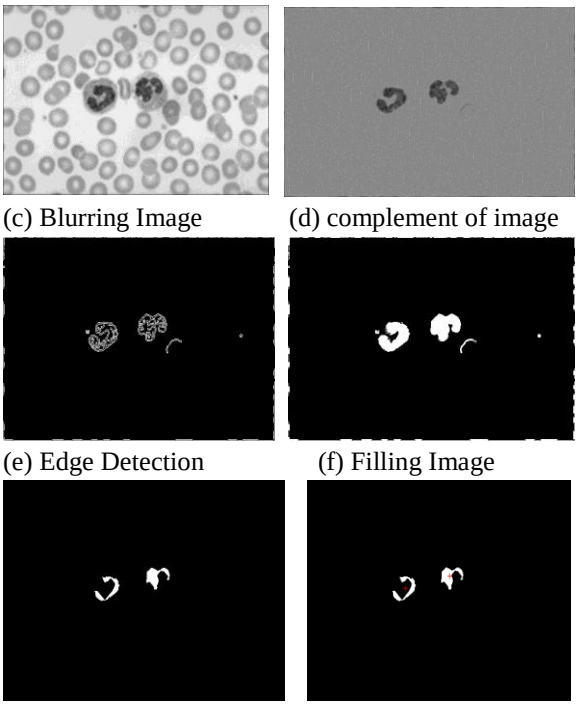
Compliment:
The Image Complement computes the complement of a binary, intensity, or RGB image. For binary images, the block replaces pixel values equal to 0 with 1 and pixel values equal to 1 with 0. For an intensity or RGB image, the block subtracts each pixel value from the maximum value that can be represented by the input data type and outputs the difference.

Edge Detection and erosion :
Edge detection method finds the edges of the i.e. where there sharp change in the intensity. There are many edge detection methods such as sobel, canny, prewitt etc. Erosion is performed to separate the overlapped cells.

Centroid:
Centroid is the property of the region specified under the command regionprops in the matlab. This method finds the centroid of the specified region, thus counting these centroid we can get the count of WBCs & RBCs.


(a)Original Image


(b) Gray Scale image



(c) Blurring Image (d) complement of image

(e) Edge Detection (f) Filling Image

(g) Erosion (h) Plotting Centroid

Figure 2: Processing steps in WBC Counting

RBC Counting:

From the above process we calculated the WBCs. To calculate the RBCs subtract the count of calculated WBCs from total number of blood cells, we get the exact count of RBCs.

The steps involved in calculation total number of blood cells

a. Take original Image
b. Convert the image into gray scale Image
c. Find Binary Image
d. Then apply the Small Object Removal technique
e. Filling Large holes
f. Edge Detection
g. Filling Image
h. Erosion of Image
i. dilation of image
j. Centroid Plotting of Each Cell

Performing all the steps we can calculate the total count of blood cells. In this proposed method we have use the twenty samples for testing and calculating the RBCs and WBCs.

III. RESULT AND DISCUSSION

There are many established methods in the laboratories for blood cell counting such as chamber test & counter machine as discussed in the literature review. In chamber test the counting is manual and in counter machine the blood cells are counted with automated method.

The counting results by using our coding in MATLAB software give satisfactory results as compared to the manual testing methods in laboratories. Actually there are three sections of the slide, so we will get the better results and accuracy if we capture the image of blood from the body section of the slide instead of capturing it from head or tail section. Furthermore the disease identification is till now is a manual process. We identified the malaria disease depending on their morphological features such as color, intensity level, shape and size etc.

Twenty microscopic blood images were tested, and the proposed framework managed to obtain. It was counted the total number of blood cells, WBCs and RBC count. The proposed method calculates more precisely and accurately than the manual method.

IV CONCLUSION

The automated counting of blood cell reduces most of the human efforts and gives best results. These AI techniques removes the human errors in detection, number of steps involved are also less. The morphological analysis of blood's white cells is achievable and it offers remarkable classification accuracy.

V. FUTURE SCOPE

We can extend our work for finding all the blood parameters such as identifying the different types of WBCs and classify on the basis of their nuclei shape. Each disease affect the blood cell differently thus the infected blood cell will differ in shape, size, color, intensity levels etc. based on these parameters we can identify different disease like malaria , anemia etc.

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