A COMPREHENSIVE REVIEW ON ESTIMATING THE BLOOD CELL COUNT USING VARIOUS ADVANCED TECHNIQUES

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*Abstract:-*The advent of medical sciences starting from its inception, since seventeenth century has undergone tremendous transformations in all medical domain. Special emphasis has been given to pathological tests especially the blood synthesis that was the key factor to identify all types of diseases that existed in the humans. The developments in bio medical electronics and computers have led to the more accurate analysis of blood samples that can throw light on the aliments causes in humans. The field also has brought up several developments that has revealed many physicians the exact analysis of blood leading to determination of red blood cells and white blood cell count values. This information has acted as a catalyst to diagnose various diseases. Many bio medical instrumentation methods exist to identify this count values effectively. This paper gives an overview of various modern methods employed especially computer vision to investigate blood cells count.

I. INTRODUCTION

Several conventional methods are presently being used to effectively compute the RBC and WBC count values in a given human blood sample. We briefly present the most popular methods used. The conventional method employs a blood sample in a capillary that is rotated at high speed to yield three distinct layers of separation namely plasma, WBC and RBC. using centrifuge technique. The light emitter and detector arrangement yields three voltage levels that is fed to a microcomputer is a via A/D converter to read the count values with an efficient firmware. This method sound effective but may introduce errors as the voltage variations near the separation junctions are not taken into account. Hence there is a need to develop advanced state of the art techniques employing computers that use image processing or pattern recognition tools to detect the voltage levels based on volume of cells present. This image of the blood centrifuge is transformed to obtain grey image. The preceding section elaborates the computer vision methods with their merits and demerits [1-7].

II. VARIOUS METHODOLOGY USED

A method to achieve automatic detection and counting of red blood cells in microscopic images can be done using Hough Transform. In this method the image analysis is carried out to identify the pixels that are aligned on straight line. The computations involved will be complicated and will take more computer memory.

Edge Detection

Edge detection is a type of image segmentation techniques which determines the presence of an edge or line in an image and outlines them in an appropriate way. The main purpose of edge detection is to simplify the image data in order to minimize the amount of data to be processed. An edge is defined as the boundary pixels that connect two separate regions with changing image and tristimulus values in an image. The detection operation begins with the examination of the local discontinuity at each pixel element in an image. Amplitude, orientation, and location of a particular subarea in the image that is of interest are essentially important characteristics of possible edges. Based on these characteristics, the detector has to decide whether each of the examined pixels is an edge or not.

Different Edge Detector operators used for the comparison study of SEM blood sample are detailed below:-

1. Canny Edge Detection

It is a method to find edges by isolating noise from the image without affecting the features of the edges in the image and then applying the tendency to find the edges and the critical value for threshold. Canny method is a better method without disturbing the features of the edges in the image. Then by applying the algorithm to find the edges and the serious value for threshold is identified.

The algorithmic steps are as follows:

• Convolve image f(r, c) with a Gaussian function to get smooth image f^(r, c), f^(r, c)=f(r,c)*G(r,c,6)

• Apply first difference gradient operator to compute edge strength then edge magnitude and direction are obtained.

• Apply non-maximal or critical suppression to the gradient magnitude.

• Apply threshold to the non-maximal suppression image.

2. Sobel Operator

It performs 2-D spatial gradient measurement on an image and so emphasizes regions of high spatial frequency that correspond to edges. The convolution mask of Sobel operator which are used to obtain the gradient magnitude of the image from the original as shown in Fig. 1.

1	2	1		-1	0	1
0	0	0		-2	0	2
-1	-2	-1		-1	0	1

Hx (Convolution Kernel in x direction)   Hy (Convolution Kernel in y direction)

Fig. 1. Convolution Kernel

The magnitude of gradient at each point given by

|H|=|Hx| + |Hy|

Each direction mask is applied to the image of interest, and then two new images are created. One image shows the vertical responses & the other shows the horizontal responses. Two images combined into a single image. The purpose is to determine the existence & location of edges in the Image [2].

3. Roberts Operator

It performs 2-D spatial gradient measurement on an image. It highlights regions of high spatial frequency which often correspond to edges. The cross convolution mask as shown in Fig.2.

-1	0		0	1
0	-1		-1	0

Hx(Convolution kernel in x direction)   Hy(Convolution kernel in y direction)

Fig. 2. Convolution Kernel

4. Prewitt Operator

To estimate the magnitude and orientation of an edge, Prewitt is a correct way. Even though different gradient edge detection wants a quite time consuming calculation to estimate the direction from the magnitudes in the x and y directions is shown in fig.3, the compass edge detection obtains the direction directly from the kernel with the highest response. It is limited to 8 possible directions; however knowledge shows that most direct direction estimates are not more perfect. This gradient based edge detector is estimated in the 3x3 neighbourhood for eight directions.

All the eight convolution masks are calculated. One complication mask is then selected, namely with the purpose of the largest module. Prewitt detection is slightly simpler to implement computationally than the Sobel detection, but it tends to produce noisier results.

-1	-1	-1		-1	0	+1
0	0	0		-1	0	+1
+1	+1	+1		-1	0	+1

Hx (Convolutional Kernel In x direction)   Hy (Convolutional Kernel In y direction)

Fig. 3. Convolution Kernel

5. The Laplacian of Gaussian (LoG)

LoG was proposed by Marr (1982). The LoG of an image f(x,y) is a second order derivative defined as,

$$\nabla^2 f = \frac{d^2 f}{dx^2} + \frac{d^2 f}{dy^2}$$

It has two effects, it smoothes the image and it computes the Laplacian, which yields a double edge image. Locating edges then consists of finding the zero crossings between the double edges. The digital implementation of the Laplacian function is usually made through the mask shown in fig.4,

0	-1	0		-1	-1	-1
-1	4	-1		-1	8	-1
0	-1	0		-1	-1	-1

Hx Convolution kernel in x direction   Hy (Convolution kernel in x direction)

Fig. 4. Convolution Kernel

Laplacian is generally used to found whether a pixel is on the dark or light side of an edge.

Watershed Transform:

The watershed transform can be classified as a region-based segmentation approach. The intuitive idea underlying this method comes from geography: it is that of a landscape or topographic relief which is flooded by water, watersheds being the divide lines of the domains of attraction of rain falling over the region.
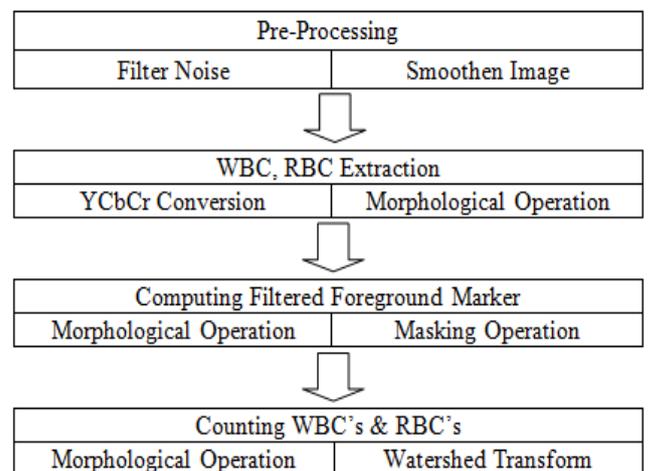
Pre-Processing	
Filter Noise	Smoothen Image

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WBC, RBC Extraction	
YCbCr Conversion	Morphological Operation

⬇

Computing Filtered Foreground Marker	
Morphological Operation	Masking Operation

⬇

Counting WBC's & RBC's	
Morphological Operation	Watershed Transform

Fig. 5. Watershed Transform

Morphological Image Processing:

Morphology is a wide set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of pixels in the output image is based on a comparison of the corresponding pixels in the input image with its neighbors [3]. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image as shown in fig.6.
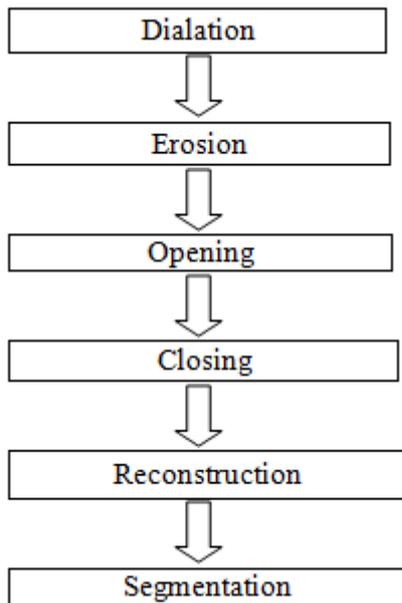
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┌─────────────────────┐
│      Dialation      │
└─────────────────────┘
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┌─────────────────────┐
│       Erosion       │
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│       Closing       │
└─────────────────────┘
          ⇩
┌─────────────────────┐
│    Reconstruction   │
└─────────────────────┘
          ⇩
┌─────────────────────┐
│     Segmentation    │
└─────────────────────┘
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Fig. 6. Block diagram of Morphological Image Processing

In image processing before feature extraction and object segmentation we have to detect edges from frame. This edge detection process detects outlines of an object. Object and background in image is isolated by edge detection feature. A sharp discontinuity in image is located by edge detection. The boundary of object in any image is characterized by discontinuity which gives instant change in pixel intensity. This process compress image without losing any important feature of that image. Edge detection is the initial stage of image processing but it is corrupted with white noise. These edge detection methods are classified into two categories, gradient and Laplacian. Matrix area gradient operation is basic Edge detection operator. By putting mask on detected pixel calculate value of detected point using edge detector operator. If the value is greater than threshold value then it considered as edge point. Robert, Prewitt and Sobel are example of gradient based edge detection algorithm .Kernel operator play a vital role in gradient based edge detection algorithm which calculates the slope in directions that are perpendicular to each other [6].

Fuzzy Approach

There are situations where the separation of the blood sample is not distinct but is rather blurred or is inter leaved with other layers of blood sample. Under such conditions the count value detected is prone for errors. Hence Fuzzy approach can yield to satisfactory results. The fuzzy sets can be formed taking into consideration triangular function or

trapezoidal function. A choice between the two has to be decided based on the results obtained. The fuzzy function can be taken from the MAT LAB frame to carry out the simulation study. Emulation is also possible by taking the blood sample image and converting it to gray image. Then the Fuzzy rules can be applied to get best suited results.

III. CONCLUSION

The paper presents various methods both conventional and computer based to judiciously identify the blood separation layers which yielded an insight for the researchers to grasp the methods and tailor fit it to the area of his or her interest. The paper also clearly brings out the merits and demerits of the various methods involved. The discussion of the possibility of incorporating the FPGA model in design to develop ASIC is also discussed.

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