Survey on Blood Cell Counting and Disorder Estimation Using Image Processing Approach

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Abstract- *In the field of biomedical rearch of microscope blood test pictures is the initial step for preliminary determination of most diseases. Blood stream is characterized in three sorts of platelets: White platelets (WBCs), Red Blood Cells (RBCs) and Platelets. Complete blood cell count (CBC) gives the counting of these platelets. Because of various morphological components of the cells, assurance of various platelets through manual process gives susceptible errors. Likewise very overlapping cells are hard to check in manual counting. In this way, there is a need of mechanization for identification and counting of distinct platelets. As image processing gives the cost effective and quicker outcome than manual counting it has turned into an imperative to study distinct systems. Image processing method consist of five essential components which are image acquisition, image preprocessing, image post-processing and image analysis. The most basic step in image processing is the segmentation of the image In this paper, we examine some of the general segmentation techniques that have discovered application in order in biomedical-image processing particularly in platelet image processing.*

Keywords- Blood cells, blood cell count, image processing, image segmentaion.

I. INTRODUCTION

The complete blood count (CBC) is the blood test utilize to calculate the health of person and to distinguish the disorders like iron deficiency, disease and leukemia. In medical analysis Complete blood count is essential. There are basically four classes of cells:Red Blood Cells (RBCs), White Blood Cells (WBCs), Platelets and Plasma. These groups can be separated utilizing texture, shading, size, and morphology of core and cytoplasm. Cells count is imperative to shows the immunity and capacity of the body system. The abnormal count of cells shows the presence of illness and individual needs of medical assistance. Current research is on an execution of image processing based mechanized counting of RBCs and WBCs from blood image. WBCs are likewise called leukocytes. These cells are animportant piece of immune framework. These ensures body by evacuating infections and microbes in a body. Medical term use to describe low check is Leukopenia. Leukopenia demonstrate the presence of contamination. Medical term utilize to depict high count is Leukocytosis. Leukocytosis demonstrate a presence of contamination, leukemia or tissue harm.

RBCs are also called erythrocytes. The capacity of RBC is to convey oxygen and collects carbon dioxide from a lungs to the cells of body. They contains protein called hemoglobin. The presence of internal and external layers of protein gives red color to blood. Hemoglobin take every necessary step of conveying oxygen. An abnormal count of RBCs prompt to anemia which brings about mental tiredness, illmess, weakness, dizziness. In the event that it is not treated promptly it comes about into more genuine indications like malnutrition and leukemia. RBC files gives data about size and state of cells and are likewise valuable in separating sorts of iron deficiency.

Table 1. Standard Amount of CBC in Healthy Person

Blood Cell Type	Women	Men
RBC	4-5 M/ul	4.5-6.0 M/ul
WBC	4.5 -11 M/ul	4.5-11 M/ul
Platelets	150-450 M/ul	150-450 M/ul

Following table shows the causes of low blood cell count.

Table 2. Causes of Blood Cell Count Variations

Cell Type	Increases	Decreases
RBC	Can be caused by Smoking, Carbon-mono oxide, Lung Diseases, Kidney diseases, some cancers, certain heart diseases, liver diseases, polycythaemia Vera, disorder in hemoglobin, dehydration, diarrhea	Anaemia, stomach ulcers, colon cancer , inflammatory bowel disease, some tumours, Addison's disease, thalassemia, lead poisoning, sickle cell disease
WBC	Infection, inflammation, heart attack, fever, injury, surgery, kidney failure, lupus, tuberculosis (TB), rheumatoid arthrites, malnutrition, leukemia, cancer, underactive adrenal glands and thyroid gland problems, removal of	Aplastic anaemia, viral infections, malaria, alcoholism, AIDS, lupus, and Cushing's syndrome

	spleen.	
Platelets	Bleeding, iron deficiency, some cancer, or problems with the bone marrow	Idiopathic thrombocytopenic purpura (ITP) and other conditions that affect how platelets are made or that destroy platelets.

Platelets are likewise called as thrombocytes. The capacity of the platelets is to stop bleeding by bunching and clotting vein wounds. A low platelet count is called thrombocytopenia. It avoids blood clotting and flowing properly. High platelet check is called thrombocytosis. It clumps blood inside vein and prevents blood from streaming legitimately. Hence for appropriate blood stream platelets include must be typical range. As said before, CBC incorporate counting of RBCs, WBCs, Platelets, Hematocrit and Hemoglobin component in the platelet. Table 1 demonstrates the standard CBC for healthy person.

A. Counting Blood Cell with Traditional Approach

The customary strategy used to count platelets includes checking by Hemocytometer. This device was uniquely designed for the total blood count. Louis-Charles Malassez designed this hemocytometer. It consists of cember of specific measurements. This chamber is made by a rectangular thick glass magnifying lens slide. This chamber have matrix of perpendicular lines scratched on it. For counting purpose, person have to see Hemocytometer through a microscopeand number platelets utilizing hand count counter. The depth of the chamber and zone limited by perpendicular lines is known. Thusly it is conceivable to count the quantity of cells present in a particular volume of fluid, and subsequently figure out the concentration of cells in the fluid overall [8].

In the manual WBC count, 950µl dilution arrangement is blended with 50µl of blood. The dilution proportion is of 1:20. The WBC nucleus is srained. At that point the counting chamber is quickly loaded with this blended of dilution solution and blood. After few minutes, the numbering of the WBCs starts. This counting is done the 4 extensive squares.

Formula for WBC count:
WBC (in count/µl) =
(Number of WBCs counted * dilution factor) / (Number of Suqre * Volume above a big square)

In a manual count of RBC, 10 µl of blood is blended with 2000µl of dilution solution. i.e dilution proportion is 1:200. At that point counting chamber is quickly loaded with all around blended dilution solution and blood. Following 3-4 minutes, the RBCs will have settled, and the counting the RBCs begins. This counting is done 80 little squares.

Formula for RBC count:
RBC (in count/µl) =
(Number of RBCs counted * dilution factor) / (Number of Suqre * Volume above a small square)

Limitations:

- It is time-consuming and laborious.
- Counting overlapping blood cells is a major problem.
- It is difficult to get accurate results from visual inspection.

B. Counting Blood Cell with Image Processing Approach

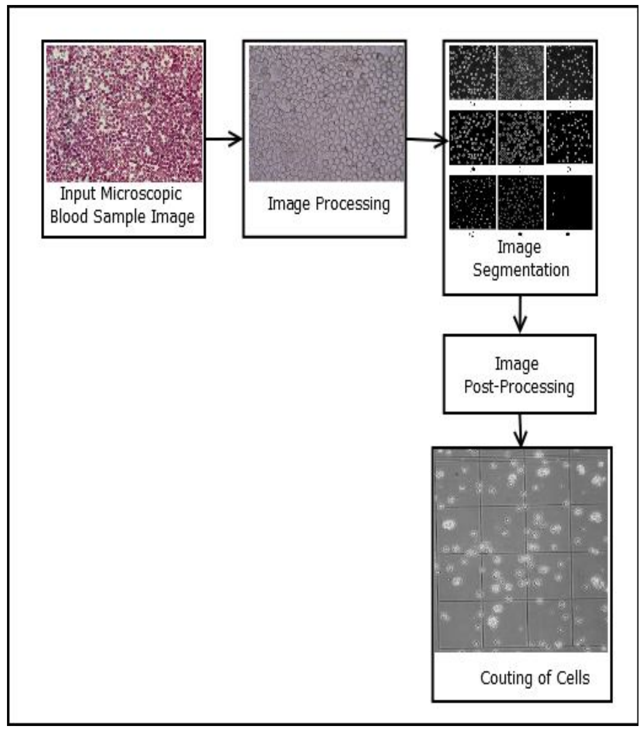

Figure 1. Basic Flow of Blood Cell Counting with Image Processing Technique

Some normal strides which are required for platelet count delineated figure 1.

1. Input Image

Here the input image is the patient's microscopic blood test image which is prepared for counting platelet. This image is shading image.

2. Picture Pre-handling

Image pre-processing step is required to upgrade the image before image segmentation. Here an input image is changed over into grey scale image. For upgrade of image distinctive analysts have connected diverse pre-processing steps like image contrast, noise filter to remove noise from image etc.

3. Segmentation of Blood cells

In PC vision, segmentation is the way toward apportioning image into distinct regions. Here RBCs, WBCs, and Platelets are portioned. Diverse researchers have connected distinctive strategy to segment platelets.

4. Image Post Processing

Before counting of platelet after segmentation some post processing steps are required to get the exact counting. Gap filling of cells, removing halfway cells from borders, Image naming, edge discovery, evacuating additional not associated parts and so on are some post processing steps after segmentation. Combination of at least one stages is connected to image processing counting.

5. Counting of cells

Finally counting of cells gives count of RBCs, WBCs and platelets. For this additionally unique researchers had connected distinctive system. Circular Hough change customary circle identification, Watershed segmentation, associated component labeling, back projection of artificial neural system and so forth are a few procedures which have been utilized for counting and order of cells.

II. PROCEDURE FOR PAPER SUBMISSION

A. Basic Approaches for Blood Cell Count

1. Thresholding for segmentation

Thresholding is based on pixel distribution in image. It converts multilevel image into binary image by choosing proper thresholding value T. If the pixel value is greater than T, than it belongs to object region otherwise it is from background region. It is fastest and efficient approach for segmenting different portion of images.

Blood cells have different intensity levels, so it can be easily extracted using thresholding.

- Otsu’s thresholding: To extract WBCs and RBCs from microscopic blood sample images [1].
- Intuntinsic Fuzzy Set Thresholding (IFS): For segmenting WBCs from image [2].

2. Morphological Operations for post processing

Morphology is a wide set of image processing operation that process image base on shapes. Morphological operations apply a structuring element to an image and create output image of same size. In these operation, the value of pixel in the resultant image is based on a comparison of corresponding pixels in input image with its neighbors. Here the number of pixels added or removed from the objects in resultant image depends on the size and shape of structuring element used to process the image.

Many researchers have applied morphological operation with the combination of other methods to segment and count blood cells. Erosion and Dilation are widely used operations to segment blood cells. Dilation and eriosion is used in [3] for hole filling in cells. After that they have used erosion for smoothening the image before counting.

3. Watershed Transform for segmentation

The watershed transform can be classified as a region-based segmentation technique. The instinctive idea underlying this method comes from geography: it is that of topographic relief which is flood by water, water shades being the divide lines of the domains of attraction of rain falling over the region.

A clumped cell appears largely in blood smear images with various degree of overlapping. Watershed segmentation is an attractive method and tends to favour in the attempts to separate touched or overlapped objects which is one of the most difficult image processing operations [4].

4. Region Growing

In thresholding and edge detection technique each pixel is treated independently but in region growing approach check’s connectivity between pixels, to decide whether this pixels belongs to same or different region. It selects region depending upon homogeneity of color, texture or shape. For extracting different blood cells from image, color homogeneity can be used.

Khaled et al. in [5] describes the region growing method for cytoplasm segmentation form WBCs using region growing method. This algorithm requires the seed pixel inside the region of interest (ROI) and threshold for stopping criteria.

B. Advance Approaches for Blood Cell Count

Venkatalakshmi. B et al. presented a method for automatic red blood cell counting using Hough transform [6]. The algorithm for estimating the red blood cells consists of five major steps: input image acquisition, pre-processing, segmentation, feature extraction and counting. In pre-processing step, original blood smear is converted into HSV image. As Saturation image clearly shows the bright components, it is further used for analysis. First step of segmentation is to find out lower and upper threshold from histogram information. Saturation image is then divided into two binary images based on this information. Morphological area closing is applied to lower pixel value image and morphological dilation and area closing is applied to higher pixel value image. Morphological XOR operation is applied to two binary images and circular Hough transform is applied to extract RBCs.

Siti Madihah Mazalan et al. also presented an approach for automatic RBC counting using circular Hough transform technique [7]. It contains two major steps viz. finding out minimum and maximum radius of RBC and hough transform. For measurement of minimum and maximum radius, sub steps are carried out that include: cropping the image, RBG to gray conversion, morphological processing, thresholding, noise removing and finally measuring mean, standard deviation and tolerance. With the help of known

Table 3. Comparative Analysis

Sr. No.	Paper Title	Method Used	Advantages	Research Gap
1	Automatic Red Blood Cell Counting Using Hough Transform	Hough transform	an efficient and cost effective computer vision system for automatic red blood cell counting using image based analysis	Not focused on complete blood cell count like white blood cell and platelets using suitable segmentation and counting algorithm based on the shape and size of the cells.
2	Automated Red Blood Cells Counting in Peripheral Blood Smear Image Using Circular Hough Transform	detect and count the number of RBC based on the range radius of cells with CHT	Accuracy using CHT method is 91.87%.	The result unable to get 100% accuracy was due to the out of range of the radius during the cropping process.
3	An automated system for platelet segmentation using histogram-based thresholding	histogram based thresholding and morphological operations to extract platelets from the microscopic image of blood cells	image processing based approach to count a total number of platelets present per microliter of blood in human body	Disorder detection is not considered
4	An automated system for segmenting platelets from microscopic images of blood cells	Color-based segmentation and morphological operation, platelets can be extracted.	Efficient and Effective System	Since the color of the cells is the main segmentation parameter, low intensity or blur image will produce an erroneous result.
5	Detection of abnormal blood cells on the basis of nucleus shape and counting of WBC	count number of WBC and also identify the abnormal ones	useful to detect different kind of diseases like Chronic Obstructive Pulmonary Disease, Immune system disorders, Neutropenia, HIV/AIDS, Lymphocytopenia, leukemia etc	Shape is not consider during disorder detection. There is a scope of improvement to identify and count RBC, WBC, and Platelet along with overlapped cells more accurately.

radius, circular Hough transform is applied to count RBCs in peripheral blood smear image.

Due to recent advancement, automated detection of red blood cell using image processing method is gaining popularity. In order to expand the accuracy of the results, it is preferred to accommodate experienced specialist in the RBC counting. In [9], a new approach is presented for semi-automatically count of the RBCs. The user can specify the dimension of RBC by dragging two points over the image and then apply the Hough transform to find the oval and biconcave shape of RBC with the specified diameter. The proposed semi-automatic system outclass the automated system in terms of the executing time.

Platelet count is a crucial diagnostic metric for identifying several diseases. In most of the laboratories, Leishman stained blood slides are used for counting platelets. However, the problem arises when huge numbers of blood samples are to be tested by the laboratory technicians making the entire process time-consuming and prone to human errors. In [10], author propose an automated system for counting platelets, which eliminates the need of expert lab technicians and reduces the cost and time of the test. Author have used histogram based thresholding and morphological operations to extract platelets from the microscopic image of blood cells. After the platelets are extracted, automated system uses a mechanism analogous to the one that is used in laboratories to count the number of platelets present per microliter of blood for each patient.

Platelet count is a very essential diagnosis test to identify diseases like Dengue, Malaria, Yellow fever, and others. Platelet count is often needed for dengue patient monitoring. So another automated system for platelet count is proposed in [11], which can extract platelets from the microscopic image of blood cells, and that makes platelet counting task easy. Microscopic images of stained blood slides are represented using a light microscope. Then using color-based segmentation and morphological operation, platelets can be extracted.

C. Approaches for Blood Analysis and disorder Estimation

Cell morphology has been an active area in the field of bio-medical research. When applied for blood microscopic images, one can study blood cell characteristics and detect abnormalities. In [12], author introduce an automatic, cost effective and accurate way of red blood cell analysis and evaluation through Blob detection, Morphology operations and Hough circle transformation techniques for identification of four common types of anemia. The achievements are highlighted as efficiency through automation, cost effective, elimination of human error and easy to manipulate.

A completely automatic low cost and exact framework is proposed in [13] to distinguish four regular sorts of anemia and give an account of platelet count. The outcome of framework demonstrate a decent contact with the manually prepared consequences of 99.678% precision of Red Blood Cell count. The diagnosis of Elliptocytes, Microcytes, Macrocyte and Spherocytes anemia result in the scope of 91%-97% exactness.

Dengue is a major medical issue in tropical and Asia-Pacific regions which typically spreads quickly in number of infection patients. Thusly, in [13], a model is proposed which can analyze dengue fever disease. This study utilized blood spread images that were taken under a computerized microscope with 400 × amplification specifications by mean of image processing procedures, for example, shading change, image segmentation, edge detection feature extraction and white platelets classification. In this study white platelet counting of the part of cell separation as another component that can classify dengue viral infections of patients by means of decision tree techniques. The outcomes demonstrated that, the white platelets classification displaying method of 167 cell images brought about 92.2% exactness while dengue classification demonstrating system of 264 platelet image brought about 72.3% precision.

The significant intension [14] is to count number of WBC furthermore distinguish the irregular ones. The proposed work is helpful to recognize diverse sort of diseases like Chronic Obstructive Pulmonary Disease, Immune framework issue, Neutropenia, HIV/AIDS, Lymphocytopenia, leukemia and so forth on the premise of counts of various blood constituents. This paper will give approach to perceive sorts of various sort of WBC in its ordinary and irregular shape. This will likewise supportive for hematologists for clear distinguishing proof and blood cells..

Southeast Asian Ovalocytosis (SAO) is an erythrocyte issue, which is described by oval-molded cells with maybe a couple of transverse ridges or a longitudinal slit on blood smears. To check the SAO utilizing thin blood spread requires manpower and is time consuming. Examine in [16] was planned to consequently distinguish the SAO from thin blood spread images. Computerized images were acquired utilizing an advanced camera associated with a light microscope. Images experienced gray-scale transformation to decline representation of pictures. Otsu's Method was actualized to separate blood segments and the background. All bunches display in the picture were then prepared to be isolated utilizing recursive bottleneck discovery calculation. The major and minor axes of each extracted erythrocyte were then acquired for the calculation of proportion. The proportion figured out if the erythrocyte is typical or oval, and a count was kept between them. The rate of oval erythrocyte over aggregate erythrocyte was utilized as the assurance of SAO positive or negative.

III. CONCLUSION

This paper introduces a survey on software based solutions for counting the platelets, their investigation and diagnosis of scatters identified with platelet counts. Image processing based technique for cell counting is quick, cost effective and creates exact outcomes. The exactness of a framework relies on the nature of input image, Camera utilized for securing a image. Some essential and propel segmentation strategies are likewise examined here which is a standout amongst the most critical and troublesome steps of fundamental blood count process. This paper gives the diverse strategies utilized for segmentation and measurement of platelets from microsocpe blood test images.

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