Detection of Accurate Segmentation in Blood Cells Count –A Review

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***Abstract*— The count of white blood cells, red blood cells and platelets Cells are very crucial to diagnose various diseases. Diseases like thalassaemia, anaemia, leukaemia and Thrombocytopenia etc, cannot be easily diagnosed by conventional methods. Methods such as manual calculation and manual measurement of white blood cells (WBC), red blood cells (RBC) and Platelets are tedious and time consuming and yield incorrect results. The Healthcare centres are focusing on approach to generate report on blood cell count in a fast and cost-effective way. In market, there are numerous systems available for the automatic Quantification of blood cells. These systems allow counting the number of different types of cells within the blood smear slides, but these machines are too expensive. The objective of this survey is to review a computer vision system that used image processing algorithms to detect and estimate the number of RBC, WBC and Platelets in the blood sample image. In this survey, segmentation is the most important factor in image processing to enable researcher/health practitioners to have excellent result for blood cells counts. Image processing algorithms involve seven major steps: image acquisition, image enhancement, image segmentation, image labelling/detection and counting/Disease detection. Image segmentation is reviewed and highlighted for future research direction.**

***IndexTerms*— Red Blood Cells; Segmentation; White Blood Cell; Platelets**

I. INTRODUCTION

AComplete_blood_count (CBC) gives important information about the kinds and numbers of cells in the blood, especially red_blood cells , white_blood_cells , and platelets. A CBC helps your doctor check any symptoms, such as weakness, fatigue, or bruising, you may have. A CBC also helps him or her diagnose conditions, such as anaemia, infection, leukaemia and many other disorders. The main purpose of the research is to describe the development of a blood smear image based process to help for diagnosis of disease. The disease can be diagnosed by the number and morphological changes of blood cells. The diagnosis can still be performed by manual count. So also, The accuracy of the manual count depends on the operators expertise and attentiveness.[1]The mistake of the operator may highly affect the analysis.[2]

A. **Red blood cells**: Also known as Erythrocyte are the most important and numerous blood cells in the human body. Main function of RBCs is to carry oxygen to the cells in the body. They are minute disc shaped cells and contain a protein called haemoglobin which gives red colour to blood [2]. Decrease in level of RBC's may cause severe diseases including anaemia, and leukaemia. The total red blood cell (erythrocyte) count is the number of red cells in one cubic millimetre of blood. The normal red blood cell count is as follows: one

TABLE 1: Number of RBCs

ADULT MALE	4.2 to 6.0 million per mm^3
ADULT FEMALE	3.6 to 5.6 million per mm^3
CHILDREN	4.8-7.2 million per mm^3
NEW BORN	5 to 6.5 million per mm^3

B. **White blood cells:** Also known as leukocytes are important part of the body blood cells which act as the body immune system, They protect the body against bacteria, viruses, cancer cells, infectious diseases. The density of the leukocytes in human blood is 5000-7000 /mm3. Leukocytes are categorized into 5 different types. They are Neutrophil, Eosinophil, Basophil, Monocyte, and Lymphocyte [2]. Low WBC counts may indicate that a person is in risk of infection. High WBC counts might Indicate an existing infection, tissue damage, or leukemia

Neutrophil**:** the size is 10-15 microns with nucleus of 2-5 lobes. When dried it looks like a pink-purple granule. Its normal range is 40-70%, as shown Fig1.

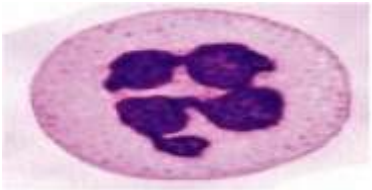

Fig 1: Neutrophil

Eosinophils: The size is 12-17 microns and nucleus 2 lobes. When it is dried it looks like an orange-red granule. and Its normal range is 1-8%,as shown Figure 2

Fig 2: Eosinophils

Monocytes: The size is 10-20 microns to 30-40 microns with several nucleus which includes kidney-shaped with many cytoplasm. The normal range is 2-9%, as shown Figure3

Fig3: Monocytes

Lymphocytes: This has two characteristics which include small lymphocyte in size 6-9 microns with similar in size to red blood cell. Its nucleus is nearly full but its cytoplasm is not full and large lymphocyte in size 10-17 microns with cytoplasm alot of small lymphocyte. It helps body's immune system. Its normal range is 20-50%, as shown Fig4.

Fig 4: Lymphocytes

C Platelets, also called **thrombocytes** (thrombocyte "blood clot cell"), are a component of blood whose function (along with the coagulation factors) is to stop bleeding by clumping and clotting blood vessel injuries[3]. Platelets have no cell nucleus: they are fragments of cytoplasm that are derived from the megakaryocytic [4] of the bone marrow, and then enter the circulation. These unactivated platelets are biconvex discoid (lens-shaped) structures[3], 2–3 µm in greatest diameter [4]. Platelets are found only in mammals; whereas in other animals (e.g. birds, amphibians) thrombocytes circulate as intact mononuclear cells[3].The ligands, denoted by letter L, signal for platelets (P) to migrate towards the wound (Site A). As more platelets gather around the opening, they produce more ligands to amplify the response. The platelets congregate around the wound in order to create a cap to stop blood flow out of the tissue. On a stained blood smear, platelets appear as dark purple spots, about 20% the diameter of red blood cells. The smear is used to examine platelets for size, shape, qualitative number, and clumping. The ratio of platelets to red blood cells in a healthy adult is 1:10 to 1:20.

II. LITERATURE SURVEY

Venkatalakshmi. B et al. proposed a method for automatic red blood cell counting using Hough transform[3]. The algorithm for estimating the red blood cells consists of five major steps which are 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.

Izyan Ahmed and Raja Zahratul Azma compare and investigate the ability to separate RBCs overlap using IRIC,EDCircle (geometrical features) and CHT(spatial features) [5].They divide by three level of overlap which are (simple, moderate and complex) blood smear images. The method used Firstly, input image is acquired from a light microscope. Next, the segmentation

took place to distinguished foreground from the background by using Otsu's threshold method [1]. Follow by some post-processing method such as morphological dilation and erosion methods in order to create a solid and noise free foreground map. Later, overlapping RBC detected and the process for counting RBC begin which IRIC method produce the best precision with 2 overlap cell(85.8%,84.3%),3 overlap(54.3%,50.2%),4overlapped cell(37.5%,30.4%)and5overlapcells(28.0%,16.2%).

Kartthikeyan.Kand K.Brharama Neelima a method is using image processing technique the RBC is counted automatically[6],result will be produce at the spot itself at low cost and disease is easily identified based on the count, The blood sample is placed below the camera; the light is placed under the sample. To loosen the blood sample density, the liquid is mixed with the blood and then placed under the camera. The image is captured by the camera and it is send as input to the matlab process the RBC cells are segmented separately using Hough transform algorithm. The features of the sample are extracted and the RBCs are found based on the features. The total number of RBCs is counted and according to the value, the disease is identified, The result is compared between the proposed method and and the manual method: It is observed that the results obtained by the proposed method offer a good conformity with the manual method, and a Graphical User Interface is developed to provide user friendly for analysis which is one of the tool provide by MATLAB software.

Akshay P. Sahastrabuddhe study the different methodologies of cells counting,[7] The survey was done using image processing technique that can automatically detect and count the number of RBCs and WBCs in the blood sample image, Image Acquisition, PreProcessing,ImageEnhancement, Image segmentation, Image post-processingand counting algorithm. In which MATLAB software was proposed for the analysis and the accuracy of the system depends upon the quality of input image, and the camera used for acquiring the image.

Kaushiki Roy et al.proposed and automated system for counting platelets in which the method has two phases[8]: The segmentation phase which explain the algorithm of platelet segmentation as,Imagepre-processing, Histogram Based Thresholding, WBC removal block, Morphological Operation and the Segmented output image is produced which move to the next phase of platelet count which is done by firstly inputting the image containing only platelets, Count of the platelets per image, Calculation of total number of platelets present in per micro litre of blood and then produce the final result which gives the accuracy of 97.73%.

III. IMAGE PROCESSING APPROACH

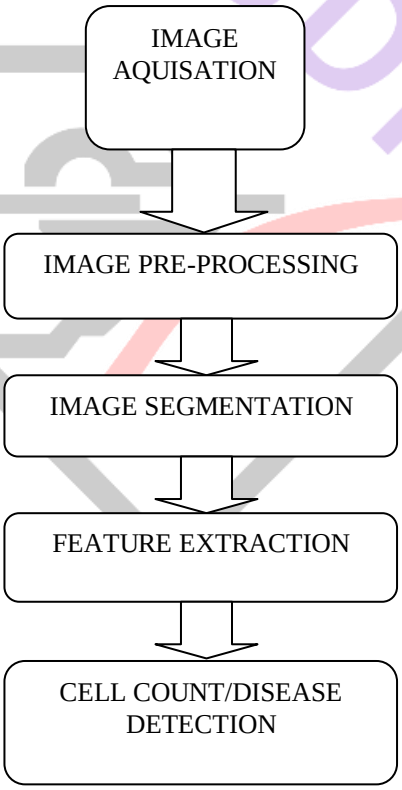

Fig.5: Proposed Approach

A. IMAGE AQUISATION – The action of retrieving an image from some source, usually sample from a donour, so it can be passed through microscopic image in order to obtain as digital image.

B. IMAGE PRE-PROCESSING- pattern recognition system to improve its performance and used to reduce variations and produce a more consistent set of data.

C. IMAGE SEGMENTATION – This involves selection of only the region of interest. This means in this study only the blood cells are selected and highlighted,

D. FEATURE EXTRACTION- In simple words features are nothing but the unique signatures of the given image or unique properties that defines an image which is needed in cells blood count because of several features the methods used in the survey is stated in table III

E. CELL COUNT –This is the method used to count the cells either automatically or by manual counting method Units.

TABLE II: Survey of 2012 to 2016

[9]S/N	AUTHOR/YEAR	SEGMENTATION/REFERENCE	ACCURACY
1	**J.M.Sharif et al 2012**	**Morphology and masking**[10]	
2	**Ventalakshmi.B et al 2013**	**Histogram thresholding and morphological operation**[3]	
3	**Pooja R.patil 2014**	**Otsu method and Hole filling**[7]	**94.58%**
4	**S.Chandrasiri et al 2014**	**Compared novel, Distance transform, marker controlled & Blob Detection**[11]	**99.68% novel**
5	**Biplab kanti D.S. et al 2014**	**Grey threshold and edge detection**[12]	**85%**
6	**Krishna kumar JHA et al 2014**	**Edge detection using morphological analysis of 2D & 3D and Hole filling**[13]	**85%**
7	**Sedat Nazlibbilet et al 2014**	**Otsu's method**[14]	**65% and 95%**
8	**Pawan agrawal et al 2015**	**Morphology** [15]	**74%**
9	**Sarach tantikiti et al 2015**	**Thresholding**[2]	**92.2%**
10	**Karthikeyan.K et al 2015**	**Morphological Approach**[6]	
11	**Pradipta maji et al 2015**	**Otsu's threshold and hole filling** [16]	
12	**Vishwas Sharma et al 2016**	**Maker controlled watershed segmentation**[17]	**80.6%**
13	**Prabhjot kaur et al 2016**	**PCNN segmentation**[18]	**93.18%**
14	**Kaushik roy et al 2016**	**Histogram based thresholding** [8]	**97.7%**
15	**Sayari gosh 2016**	**Thresholding**[19]	
16	**Izyan Ahmed et al 2016**	**Otsu thresholding**[5]	
17	Prof.Mrs.S.T.Khot et al 2012	Morphological features using Artificial Neural Network[19]	73.57%

IV.CONCLUSION

In this paper, a survey of study between 2012-2016 on the segmentation of blood cells count was made and the accuracy found by the researchers, because segmentation is a very strong key in blood cell count to enable researcher to achieved high accuracy and achieved accurate result for Disease detection. This recommended that researchers should look forward to come up with a better algorithm which gives maximum accuracy. Hence, the scope is wide in developing such a robust methodology to segment and count red blood cells as well as white blood cells and platelets with maximum accuracy.

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