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AUTOMATIC RED BLOOD CELL AND WHITE BLOOD CELL COUNTING FOR TELEMEDICINE SYSTEM

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ABSTRACT

A complete blood count (CBC) is a blood test used to evaluate the overall health and diagnose a wide range of disorders, including anaemia, infection and leukaemia etc. CBC test infer about the kinds and numbers of cells in the blood such as Red Blood Cells(RBC), White Blood Cells(WBC) , Platelet. This blood cell count infers about the disorders against normal healthy blood cell count. Haematology analysis to be specific, accurate & reliable in the blood cell counts to mitigate diagnosis. Conventional haematology analysis triggers visit to clinic and is laboratory specialist dependent carried either manually (inaccurate) or by haematology analyser (costlier). Both are not affordable to the remote / rural areas. This paper introduces an cost effective automatic RBC and WBC counting accurately using image analysis technique for remote or rural areas using telemedicine approach independent of specialist to generate patient RBC and WBC report.

Keywords *– Telemedicine System, Red Blood Cell count, White Blood Cell count, MATLAB, Morphological operations, Hough Transform.*

1. INTRODUCTION

A complete blood count (CBC) is a blood test used to evaluate the overall health and diagnose a wide range of disorders, including anaemia, infection and leukaemia etc. CBC test infer about the kinds and numbers of cells in the blood such as Red Blood Cells(RBC), White Blood Cells(WBC) , Platelet. This blood cell count infers about the disorders against normal healthy blood cell count.

A complete blood count test measures several components and features of your blood, including :Red blood cells- which carry oxygen, White blood cells-which fight infection, Hemoglobin- the oxygen-carrying protein in red blood cells, Hematocrit- the proportion of red blood cells to the fluid component, or plasma, in your blood and Platelets- which help with blood clotting.Abnormal increases or decreases in cell counts as revealed in a complete blood count may indicate that you have an underlying medical condition that calls for further evaluation.

The Red Blood Cell or Erythrocytes are the more number of blood cells in the human body.Erythrocytes consist mainly of Hemoglobin .Erythrocytes are *anucleate* when mature, meaning that they lack a cell nucleus .A red blood cell count is a blood test that your doctor uses to find out how many red blood cells (RBCs) you have in your blood. It is also called an erythrocyte count. The test is important because RBCs contain haemoglobin, which carries oxygen to your body's tissues [1]. Red blood cells are also known as RBCs, red cells,[1] red blood corpuscles (an archaic term), haematids, erythroid cells or erythrocytes**.** White blood cells (WBCs), also called leukocytes, are an important part of the immune system. These cells help fight infections by attacking bacteria, viruses, and germs that invade the body. They live for about three to four days in the average human body.A WBC count is a test that measures the number of white blood cells in your body. This test is often included with a complete blood count (CBC). Your blood contains a percentage of each type of white blood cell. Doctors use the main information to diagnose various diseases excluding any fractures or any external injuries is the Red Blood Cell and White Blood Cell count.

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Blood cell types	Gender	
	Male	Women
RBC	4.5 - 6.0 million/microliter	4.0 - 5.0 million/microliter
WBC	4.5 - 11 thousand/ microliter	4.5 - 11 thousand/ microliter
Platelet	150 - 450 thousand/microliter	150 - 450 thousand/microliter

Table -1, Normal RBC and WBC Count Levels

1.1 Telemedicine system:

Telemedicine system facilitates the remote diagnosis and treatment of patients by means of telecommunications technology. The delivery of healthcare services, where distance is a critical factor,by all healthcare professionals using info and comm. tech for exchange of valid info for diagnosis , treatment and prevention of diseases and injuries.Telemedicine, made possible by the availability of mobile networks, is revolutionizing health care.It provides special healthcare for rural patients in less cost in improved form This paper introduces an cost effective automatic RBC and WBC counting accurately using image analysis technique for remote or rural areas using telemedicine approach independent of specialist to generate patient RBC and WBC report. In this approach the records i.e., blood sample images of the patients from rural side are captured and sent for diagnosis by the trained experts. The results are then communicated to the village knowledge centers.

Pathologists can get valuable information regarding various blood oriented disorders through red blood cells counting in a blood sample. In the conventional method of red blood examination in a blood sample done by manpower; hence it has deficiencies such as less accuracy, poor reliability, and strong subjectivity. The diagnosis is defined as the process of finding out what kind of disease a certain patient has and those diagnosed must always be accurate. Sometimes a wrong diagnosis may lead to situation that wrong dosage of drugs given to the patient, some cases it may lead to loss of patient life[2].
To overcome these situations, some researchers have done some useful works [3-5] especially in classifying blood cells from other cells, for example, distinguishing white blood cells from other cells such as red blood cells and platelets [6]. The conventional method is not suitable for telemedicine system. In this paper we use Hough transform technique [7] to count number of red blood cell and white blood in the blood smear image and also this will be compatible with telemedicine system.

2.0 RELATED WORK:

Venkatalakshmi.B, Thilagavathi.K Automatic Red Blood Cell Counting Using Hough Transform(ICT 2013)[18],This paper introduces an automatic RBC counting using Hough Tranform, we are extending this paper to include WBC counts.

3.0 METHODOLOGY

This paper introduces an automatic RBC and WBC counting using computer vision which helps to perform the counts accurately using image based analysis from which the blood smear image taken by the digital camera attached with the microscopic setup. There are several steps involved in the process of estimating the Red blood cells and White Blood cell . These are input image acquisition, preprocessing, segmentation, feature extraction, RBC and WBC counting. In the pre-processing step the original blood smear image taken under microscope is converted into saturation image. Segmentation is done by histogram thresholding and morphological operations. Next step is feature extraction which is through morphological operations to differentiate between different cells i.e., red blood cell ,white blood cells, platelets and background. The final step is to find out the number of Red Blood Cell and White Blood Cell from the blood smear image by using Hough Transform .

3.1 Overall flow of proposed system:

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Three main techniques are used to estimate the number of RBC and WBC in the blood smear image which are logical, morphological and Hough transform. Fig 1 shows the complete flow chart of proposed system.

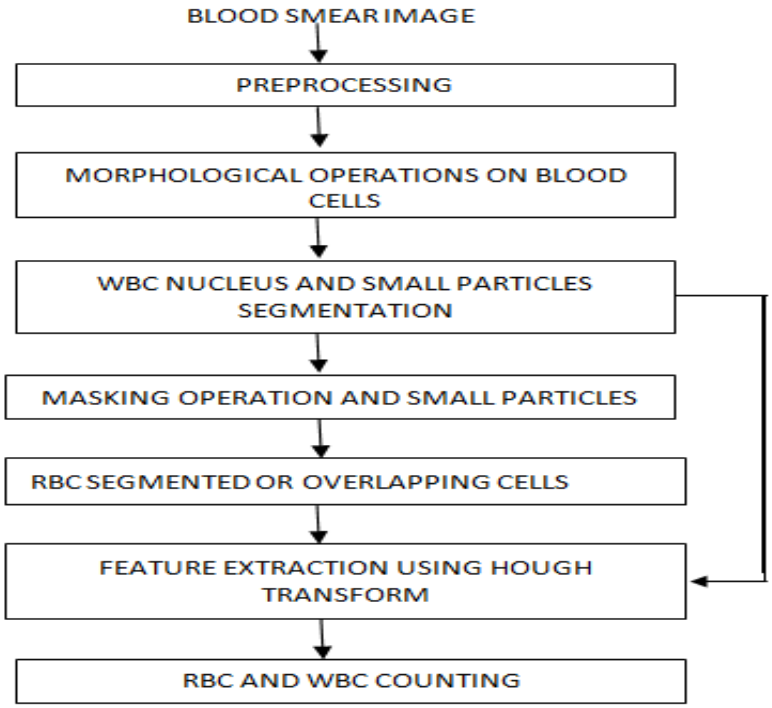

Fig 1. Flow Chart of RBC and WBC counting Process

The images are used in data acquisition stage are taken from online medical library [12, 13]. The input image needs to be pre-processed for further analysis. Segmentation and extraction is the process of differentiate red blood cell background and another cells. The final stage is counting the number of RBC and WBC counting using Hough transform technique.

3.2 Image pre-processing:

The input for this step is blood smear image, this image is enhanced o get good quality required for next steps. We will filter the noise, adjust the contrast and smoothen the image. First, convert the given image into HSV image. Then we analyze the saturation component S this shows clearly the bright objects such as WBC and platelets. Fig 2. Shows the original input image and saturation image [18].

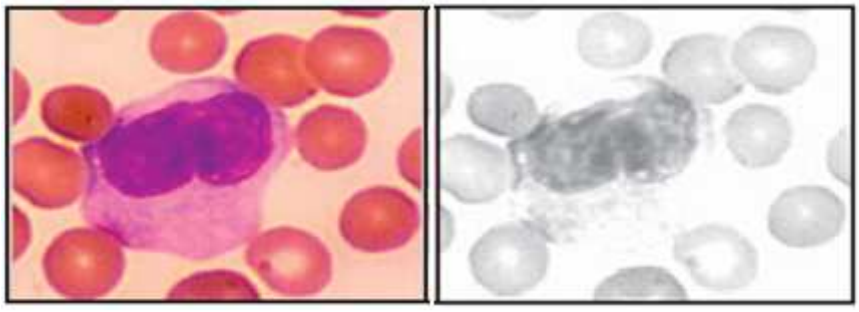

Fig 2. The original input image and saturation image

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3.3 Morphological operations on blood cells:

The output from preprocessing is input for this step, the intensity between the RBC and other cells used to differentiate WBC and RBC. After applying pre-processing stage, the outcome of image is feeding to the segmentation stage. Segmentation is carried out based on histogram thresholding and morphological operations. Mathematical morphological will be used to segment RBC based on elimination WBC appearance. Find out lower and upper threshold value from histogram image of saturation image. Then divide the saturation image into two binary images based on these threshold values. To extract the objects from the background is to select a threshold 'T' that separates these modes. Then any point (x, y) for which f(x, y) < T is called an object point, otherwise, the point is called a background point.

3.4 WBC nucleus and small particles segmentation:

If the structuring element is not present then morphological openings are used ,this removes, break and diminished the connection or objects In contrary, morphological closing functions to join, fill and build connection and objects in the image. Similar task which is smoothen the object contours but in different ways. For reconstruction, it using two images which is marker and mask as initial point of transformation and transformation inducer. The structuring element will act as connectivity element. One of the technique is opening by reconstruction which restored the exact shape of the object which is been eroded while the normal opening technique will depends on the similarity between objects and structuring element. For filling holes and clearing border objects reconstruction is applied with the combination of marker and mask function.
Fig. 3 and Fig. 4 shows the result of morphological operations [3]. The WBC nucleuses are extracted by removing the small particles which are platelets.

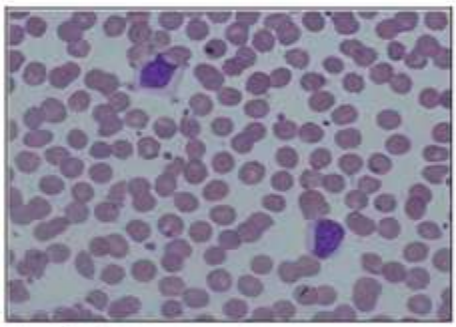

Figure 3 Original image of blood

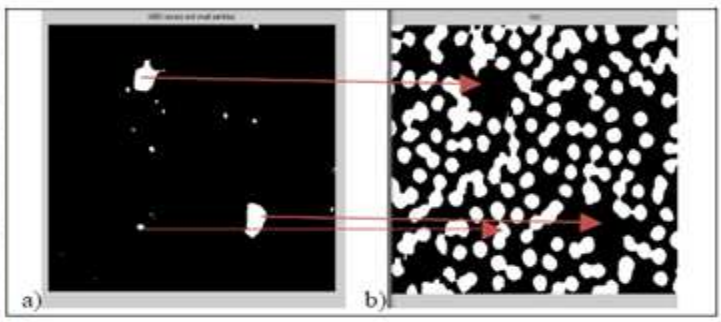

Figure 4. a) Segmented WBC nucleus b) RBC segmentation from the elimination of WBC nucleus and small particles.

Fig 3. Original Image **Fig. 4. Results of morphological operations**

3.5 Masking operation, RBC segmentation and feature extraction using Hough transform:

The morphological operations, logical operations and Hough transform technique are used in this stage to extract the red blood cells from other cells and background. Morphological and XOR operation are applied on two images i.e., image obtained with WBC Nucleus and small particles along with original Image. After that Hough transform is applied to this image to extract the RBC.
Red and white blood cell detection is done through this accumulator space. WBC counts can also be done by finding number of connected components which is obtained from image Fig 4 –Segmented WBC Nucleus. Here the small noise i.e., platelets can be eliminated outcome contain only WBC nucleus .
Fig. 5 below shows the result of image blood samples by using circular Hough transform technique.[18]

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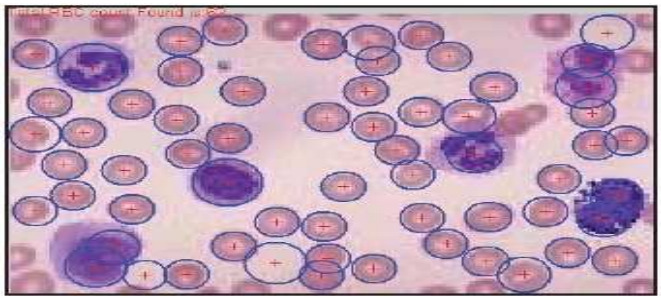

Fig. 5. Result of image blood samples by using circular Hough transform technique.

4.0 CONCLUSIONS :

The combination of Morphological operations, logical operations and Hough Transform used to segment RBC and WBC. The Circular Hough Transform provides an effective and efficient computer vision system for automatic counting of red blood cells and white blood cells. This approach aids affordable healthcare service for remote or rural areas using telemedicine system and avoid laboratory visit. With the advent of this proposed system makes the human healthcare management ease and convenience irrespective of geography and time which saves many lives. Compare to manual counting it is ease of operation and less time consuming. This approach explored for RBC and WBC counting further the same can be explored for complete blood cell counting such as platelet count.

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