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Segmentation of Red Blood Cells

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***Abstract*—** The study of abnormal cells is important to identify diseases like anemia, thalassemia and polycythemia. Cell features are important to identify abnormality in a given cell. The manual method used to identify abnormality of red blood cells is tedious, prone to human errors and time consuming. Hence, there is a need for fast and accurate system which can identify red blood cell abnormality and helps the doctor to quickly diagnose the diseases. Also, early detection of abnormality helps to prevent chronic diseases. **T**his paper aims to develop such fast and accurate computer aided system which can automatically segment rbc in a given microscopic image. Further, the features of segmented cells are analyzed to detect abnormality. As the microscopic blood samples includes various cells like red blood cells, platelets, white blood cells, enzymes, biological debris, it is significant to segment only red blood cells by eliminating other unwanted cells in the given sample. So, this paper uses image segmentation technique to separate red blood cells in a given sample by eliminating white blood cells and platelets. These segmented cells are further used for feature extraction and classification.

Keywords- Red blood cells, normal, abnormal, anemia, platelets, computer-aided

I. INTRODUCTION

Blood is a tissue consisting of cells in plasma. Blood cells contain red blood cells (RBC), white blood cells (WBC) and platelets. The abundant cells in blood are small reddish erythrocytes that are used to transport oxygen to the cells of the body from the lungs.

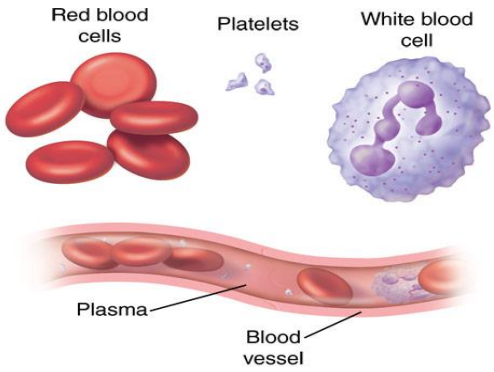

Figure 1. Image of blood cells in blood vessel

RBC has a biconcave disc like structure which is round and flat, like a shallow bowl and does not have nucleus. The normal range of RBC in human body is approximately 4500-10000 cells per micro liter.

Currently, Pathologists are analyzing red blood cells and diagnosing particular disease manually. In this process, blood sample is collected from the patient, and then placed on a microscope slide using suitable staining procedure. This slide is placed on microscope and studied by pathologists to identify abnormality in red blood cells if any. This manual process is complex, consumes more time and causes errors. Hence there is a need for computer aided system which can analyze red blood cells automatically at faster rate with accuracy. Such systems can be designed using image processing techniques.

Here, red blood cells microscopic images are captured by placing CCD camera at the eye-piece as shown in Figure-2.

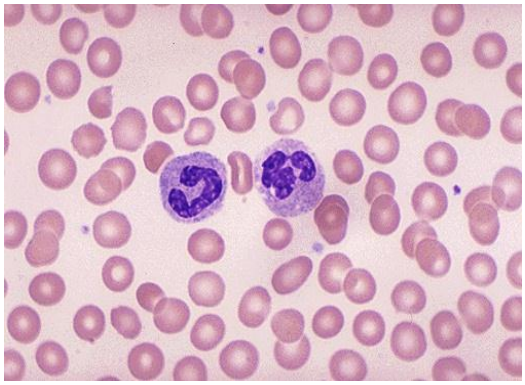

Figure 2. Microscopic image of blood sample
[Courtesy: www.library.med.utah.edu]

In this method, red blood cells are segmented and classified into normal and abnormal. Classification is done based on cell features like radius, area, diameter, circularity and width. Also, count of red blood cells is one of the important features to identify abnormality especially identifying the diseases like anemia, malnutrition and thyroid disorders.

II. LITERATURE SURVEY

Aditi.K and Deepali.K presented that separation of clustered blood cells can be done successfully by convexity closer and erosion limit using Circular Hough transform. Efficiency of count is 95% and it successfully detects disc shape normal RBC. But it has failed to segregate clustered or overlapped cell. [2]

Manpret Singh Bawa, ER. Manjeet Singh presented that automatic counting of RBC using computer vision and compared between watershed and Hough transform. It helps to perform the count accurately using image-based analysis. But there is less accuracy poor reliability and strong subjectivity [3].

There are many papers proposing methods to segment blood cells but they are not accurate when more number of overlapped blood cells is present. Few authors have worked on only overlapped cells but few features are extracted. This paper concentrates on more features by the following methodology

III. METHODLOGY

This paper proposes a method in which red blood cells are separated from white blood cells and platelets in a given microscopic image using image segmentation. The following methodology is employed.

1. Image Acquisition
The microscope is attached to a computer and the digital images are obtained from the microscopic images of blood cells.

2. Image Preprocessing
It typically deals with contrast enhancement, removal of noise etc.

Type 1: Noise due to acquisition - due to image capturing
The Linear Filtering, Adaptive Filtering, Median Filtering are digital filtering techniques, often used to remove noise from an image.

Type 2: Biological noise
Noise due to platelets, lymph cells, enzymes, other biological debris in the microscopic image.

3. Image Segmentation
The image segmentation process mainly involves Separation of RBC in a given blood sample.

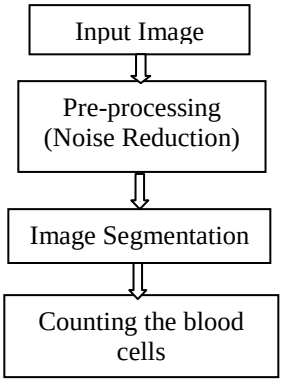

Figure 3. Overall working of RBC Segmentation

Algorithm for RBC cell Segmentation is as follows:

Step-1: Convert the input RGB image into Grayscale image.
Step-2: Remove the noise in the image and increase the contrast using wiener filter.
Step-3: Perform edge detection using log filter.
Step-4: Fill the holes to ignore small objects like platelets.
Step-5: Find the properties of each segmented object and label.
Step-6: Plot the edges of segmented regions and mark with red color.
Step-7: Display labeled image and number of cells found.

IV. RESULTS AND DISCUSSION

It is concluded that overlapped red blood cells are highly challenging issue in segmentation. This paper proposes a methodology to separate red blood cells. The outcome of the project helps in early detection of disease due to abnormal blood cells. The accuracy of this proposed method is 97%. The expected outcome for the input image shown in Figure 4.

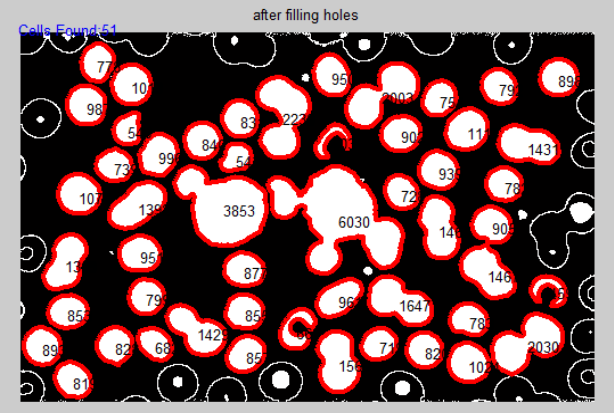

Figure 4. Segmented image of red blood cells

Here, the RBC's have minimal variation in size and shape and have a zone of central pallor of 1/3.

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