

DETECTION OF ABNORMAL BLOOD CELLS USING IMAGE PROCESSING TECHNIQUE

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ABSTRACT

Image processing techniques are widely used in the domain of medical sciences for detecting various diseases, infections, tumors, cell abnormalities and various cancers. Detecting and curing a disease on time is very important in the field of medicine for protecting and saving human life. Mostly in case of high severity diseases where the mortality rates are more, the waiting time of patients for their reports such as blood test, MRI is more. The time taken for generation of any of the test is from 1-10 days. In high risk diseases like Hepatitis B, it is recommended that the patient's waiting time should be as less as possible and the treatment should be started immediately. The current system used by the pathologists for identification of blood parameters is costly and the time involved in generation of the reports is also more sometimes leading to loss of patient's life. Also the pathological tests are expensive, which are sometimes not affordable by the patient. This paper deals with an image processing technique used for detecting the abnormalities of blood cells in less time. The proposed technique also helps in segregating the blood cells in different categories based on the form factor.

Keywords: *Abnormal Blood Cells, Form Factor, Image Processing*

I. INTRODUCTION

The blood consists of a suspension of special cells in a liquid called plasma. Blood consists of 55 % plasma, and 45 % by cells called formed elements. The blood performs a lot of important functions. By means of the hemoglobin contained in the erythrocytes, it carries oxygen to the tissues and collects the carbon dioxide (CO₂). It also conveys nutritive substances (e.g. amino acids, sugars, Mineral salts). Mostly in case of high severity diseases where the mortality rates are more, the waiting time of patients for their reports such as blood test, MRI is more. The time taken for generation of any of the test is from 1-7 days. In high risk diseases like Hepatitis B, it is recommended that the patient's waiting time should be as less as possible and the treatment should be started immediately. The current system used by the pathologists for identification of blood parameters is costly and the time involved in generation of the reports is also more sometimes leading to loss of patient's life. Also the pathological tests are expensive, which are sometimes not affordable by the patient. Hence, there should be an automated system where the blood reports should be generated in a very less time with as minimum cost as possible. The proposed system would be an initiative to generate the blood test reports in minimum time and will be cost effective [1].

Currently the time taken by pathologist is 1-7 days to generate the reports. The reports will get generated after chemical treatments on blood samples which requires more time. It is also costly as the instruments used for identification of the blood parameters are costly. The patients suffer due to both these reasons physically as well as mentally.

In detection process several methods used for the segmentation of red blood cell from white blood cell Using color space model with the help of MATLAB software. We can get the accuracy up to 87%.

II. TYPES OF BLOOD CELLS

There are two types of blood cells: (A) Normal blood cells & (B) Abnormal blood cells.

2.1 Normal Blood Cells

The various normal blood cells are: Erythrocytes, Leucocytes, and Thrombocytes [2].

2.1.1 Erythrocytes

The erythrocytes are the most numerous blood cells i.e. about 4-6 millions/mm³ They are also called red cells. In man and in all mammals, erythrocytes are devoid of a nucleus and have the shape of a biconcave lens. In the mother vertebrates (e.g. fishes, amphibians, reptilians and birds), they have a nucleus. The red cells are rich in hemoglobin, a protein able to bind in a faint manner to oxygen. Hence, these cells are responsible for providing oxygen to tissues and partly for recovering carbon dioxide produced as waste. However, most CO₂ is carried by plasma, in the form of soluble carbonates.

2.1.2 Leucocytes

Leukocytes, or white cells, are responsible for the defense of the organism. In the blood, they are much less numerous than red cells. The density of the leukocytes in the blood is 5000-7000 /mm³ Leukocytes divide in two categories: granulocytes and lymphoid cells or agranulocytes. The term granulocyte is due to the presence of granules in the cytoplasm of these cells. In the different types of granulocytes, the granules are different and help us to distinguish them. In fact, these granules have a different affinity towards neutral, acid or basic stains and give the cytoplasm different colors.

2.1.3 Thrombocytes

The main function of platelets, or thrombocytes, is to stop the loss of blood from wounds (hematostasis). To this purpose, they aggregate and release factors which promote the blood coagulation. Among them, there are the serotonin which reduces the diameter of lesioned vessels and slows down the hematic flux, the fibrin which trap cells and forms the clotting. Even if platelets appear roundish in shape, they are not real cells. In the smears stained by Giemsa, they have an intense purple color.

2.2 Abnormal Blood Cells

The various abnormal blood cells are: elliptocyte, echinocyte, dacrocyte, and sickle cells.

2.2.1 Elliptocyte

Elliptocytes are red blood cells that are oval or cigar shaped. They may be found in various anemias, but are found in large amounts in hereditary elliptocytosis.

2.2.2 Echinocyte (Crenated Red Blood Cells)

Echinocytes are red blood cells with many blunt spicules, resulting from faulty drying of the blood smear or from exposure to hyperosmotic solutions. Pathological forms are associated with uremia. Echinocytes contain adequate hemoglobin and the spiny knobs are regularly dispersed over the cell surface, unlike those of acanthocytes.

2.2.3 Dacrocyte (Tear Drop Cells)

Teardrop shaped red blood cells are found in myelofibrosis and other myeloproliferative disorders, pernicious anemia, thalassemia, myeloid metaplasia, and some hemolytic anemias.

2.2.4 Sickle Cells

Sickle cells are red blood cells that have become crescent shaped. When a person with sickle cell anemia is exposed to dehydration, infection, or low oxygen supply, their fragile red blood cells form liquid crystals and assume a crescent shape causing red cell destruction and thickening of the blood. Since the life span of the red blood cell is shortened,[3]

2.3 Basic Overview of Paper

The aim of this paper is to detect the abnormal blood cells by image processing technique. First we perform the edge detection technique than determine the form factor by calculating the area and perimeter. Then count the cells.

This research work will propose a system which will help in reducing the cost as well as waiting time of the patients for availing the pathological reports. The system will be working as follows:- Once the patient's blood sample is collected, it will be processed immediately and using an high end camera's in microscope, the images can be captured and using the image processing techniques, the different values of the desired parameters can be calculated immediately [1]. Use of parameter dependent image processing technique will definitely reduce the cost involved and also will save the time of generating the reports. This will definitely help to reduce the mortality rate in high risk diseases [2]. Section III,IV and V gives a basic block diagram , flow chart and form factor calculation to detect abnormal blood cells using image processing technique respectively. Section VI discusses the results obtained. Concluding remarks are given in section VII.[4]

III. BASIC BLOCK DIAGRAM [5]

Fig. 1 shows the basic block diagram for detecting the abnormal blood cells. And Fig. 2 shows the flowchart for the system

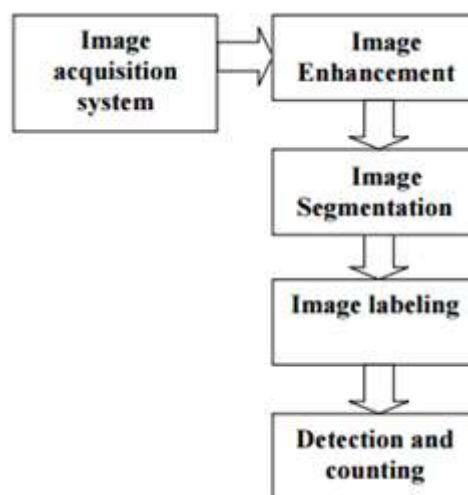


Fig. 1: Block Diagram for Detecting Abnormal Blood Cells

3.1 Image Acquisition

The digital microscope is interfaced to a computer and the microscopic images are obtained as digital images. The resolution of the digital image depends on the type of digital microscope used.

3.2 Image Enhancement

For better segmentation of the blood cells, the imported image has to be enhanced. This improves the quality of the image in terms of details.

3.2.1 Green Plane Extraction

The green plane is extracted from the imported blood cell image. The other planes such as red and blue are not considered because they contain less information about the image.

3.2.2 Contrast Adjustment

To enhance the image, its contrast is adjusted by altering its histogram. The image's histogram is equalized.[6]

3.3 Image Segmentation

This involves selecting only the area of interest in the image. Here only the blood cells are selected, because they are the areas of interest. A Segmentation can be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing or image database look up.

Flowchart:

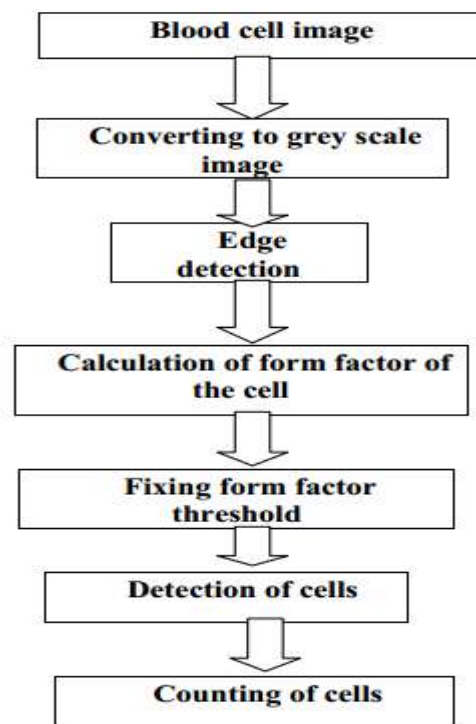


Fig. 2: Flowchart for Detection of Abnormal Blood Cells

IV. DETECTION AND COUNTING OF ABNORMAL CELLS

Form factor threshold is fixed for different abnormal cells. All the cells having the form factor value less than 0.6 are considered abnormal and the cells having the form factor range between 0.6-1 are considered as normal cells. Based on these criteria the abnormal cells are detected. The flow chart for detection and counting the blood cells is given in Fig. 2. By incrementing a counter value with in a for loop, the number of normal cells and abnormal cells can be calculated.[7],[8].

V. FORM FACTOR CALCULATION

Form factor is calculated for the labelled cells. So our basic aim is to calculate the area and perimeter .[9],[10]

5.1 Area

Number of pixels in one cell makes its area. So the number of pixels having same label constitute the area of the labelled cells.

5.2 Perimeter

Any pixel whose four neighborhoods are white is surely not a boundary pixel as it lies interior of the cell. So we get number of those pixels whose four of the neighborhoods are white. And if we subtract this value from the total area of the Image then this will give area outside the cell along the perimeter of the cell. Hence the form factor can be calculated easily.

VI. RESULTS AND DISCUSSION

The proposed algorithm is tested on the blood cell images as shown in Fig. 3. The total number of blood cells present in the image is counted using proposed algorithm (implemented using MATLAB). The algorithm shows the form factor for the blood cells which are more or less in circular shapes is in the range of .8 to 1 and that for others in the range of 0.4 to 0.6. Also, the total number of cells is estimated and it matches with the actual count.

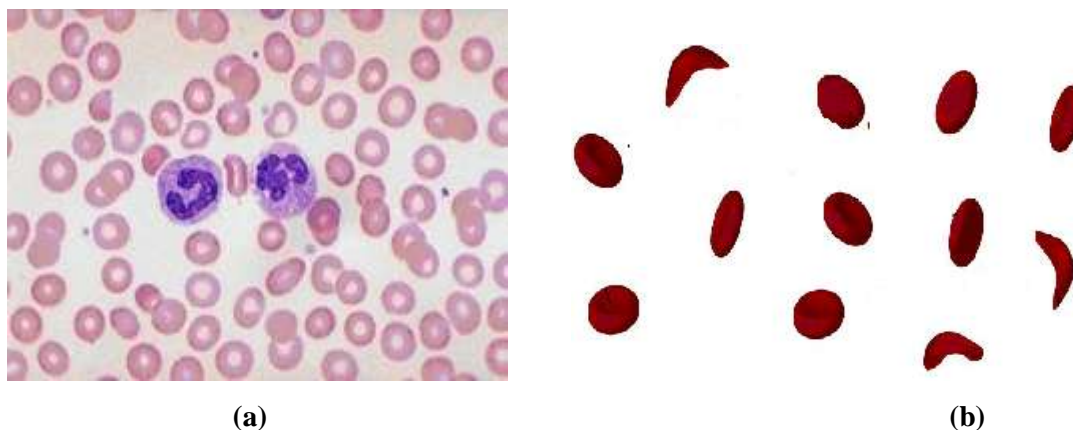


Fig. 3: Blood Cell Images

VII. CONCLUSION

The paper proposes an image processing technique for detecting and counting the abnormal blood cells. The proposed method detects the abnormalities in blood cell in very less time and efficiently. Based on the form factor, the abnormalities of the blood cell can be segregated.

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