WHITE BLOOD CELL NUCLEUS AND CYTOPLASM EXTRACTION USING MATHEMATICAL OPERATIONS

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Abstract- An automatic image segmentation system can make the inspection procedure of blood smear much faster. The most important step of such system is the White Blood Cell segmentation. In this mainly focus on nucleus segmentation thereby classifying whether it is grouped or single one. Then extract the cytoplasm of the White Blood Cells. Inorder to segment the nucleus from the whole body by using a combination of automatic contrast stretching supported by image arithmetic operation and minimum filter.

Index Terms- Image segmentation, Mathematical operation, White Blood Cells, Leukemia diagnosis, Contrast stretching, Minimum filter, Morphological operation.

1. INTRODUCTION

Blood is composed of Red blood cells, White blood cells and platelets. As White blood cell count is more compared to Red blood cells then it is the indication of Leukemia. There are different types of diseases related to blood system and the instruments which are used in the diagnosis of diseases are very costly, thus identification of white blood cells count that provides useful information to doctors in diagnosis different kind of disease in the blood system. Generally white blood cells are called leukocytes which protect against the foreign material and the infectious diseases and red blood cells are called erythrocytes which deliver oxygen to body tissues.

WBC is mainly classified as granulocytes and agranulocytes. There are three types of granulocytes namely neutrophils, eosinophils, and basophils. As seen under a microscope, the granules in these white blood cells are apparent when stained. There are two types of agranulocytes, also known as nongranular leukocytes: lymphocytes and monocytes. These white blood cells appear to have no obvious granules. Agranulocytes typically have a large nucleus due to the lack of noticeable cytoplasmic granules. White blood cells are produced by bone marrow within bone. Some white blood cells mature in the lymph nodes, spleen, or thymus gland. The life span of mature leukocytes ranges from about a few hours to several days. Blood cell production is often regulated by body structures such as the lymph nodes, spleen, liver, and kidneys. During times of infection or injury, more white blood cells are produced and are present in the blood. A blood test known as a WBC or white blood cell count is used to measure the number of white blood cells in the blood. Normally, there are between 4,300-10,800 white blood cells present per microliter of blood. A low WBC count may be due to disease, radiation exposure, or bone marrow deficiency. A high WBC count may indicate the presence of an infectious or inflammatory disease, anemia, leukemia, stress, or tissue damage.

When hematologists conduct blood tests, these experts uses two most common types of analyzing tools for diagnosing and screening blood smears: Complete Blood Count (CBC), Differential Blood Count (DBC). CBC machine uses an instrument called a “Cytometer” which is useful in the blood lab for counting the blood cells and components for each sample taken from patients.

Differential blood counting machines operate by sampling human blood and drawing a small amount of blood through narrow tubing. Inside this tubing there are sensors that count the number of each blood cell type, which are going through the tube. The drawbacks of this process are that the DBC sensors need occasional calibration, the maintenance cost is high, and the DBC might misclassify some cells.

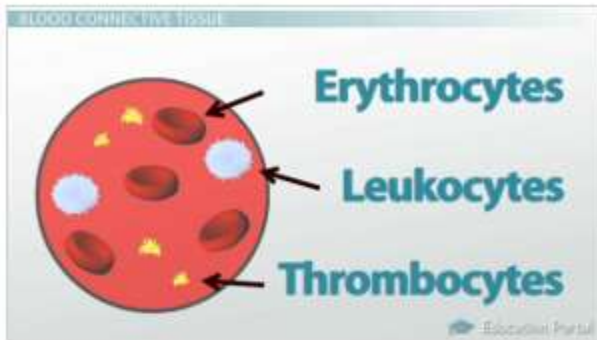

Fig.1 Blood Components

In this paper, first we make the copy of input image so as the first copy is contrast stretched and second copy is histogram equalized. Then through arithmetic operations nucleus are extracted. Then check whether the extracted nucleus is grouped or single. Finally cytoplasm are extracted from each nucleus. The grouped and single nucleus are identified depending upon the area.

2. RESEARCH METHODOLOGY

In this paper for segmentation of white blood cell nucleus mathematical morphing and some mathematical operations have been used.

A. Mathematical operation

In this section, we focus on the arithmetic operation on the image like addition and subtraction for highlighting the white blood cell components, removing the components which are not the white blood cells and brightening all the components in the image except the cell nucleus.

The addition of two images is performed straightforwardly in a single pass. The output pixel values are given by:

$$Q(I,j) = p_1(I,j)+p_2(I,j) \quad (1)$$

Or if it is simply desired to add a constant value C to a single image then:

$$Q(I,j) = p_1(I,j)+C \quad (2)$$

If the pixel values in the input images are actually vectors rather than the scalar values then the individual components are simply added separately to produce the output value. Addition is when you add the corresponding color channels of the images to each other. Each color component is a number between 0 and 255, so if the sum of the two colors becomes higher than 255, it has to be truncated to255 again, by taking the minimum of the result and 255. Copy paste this into the arithmetic loop and run it to see the result of the sum the two photos. Subtraction works in a similar way, but now you have to truncate negative results to 0.

B. Mathematical morphing

In this section, we focus on image morphing which remove the unwanted components like platelets from the image. In some research mathematical morphing is used as the final step for smoothing the region of interest. Erosion, dilation, closing and opening are the basic operations. The opening and closing operations are derived from the erosion and dilation of morphing. Closing removes the small holes. Erosion will allow thicker lines to get skinny and detect the hole inside the letter "o". Dilation is the dual operation of the erosion. Opening essentially removes the outer tiny "hairline" leaks.

3. PROPOSED METHOD

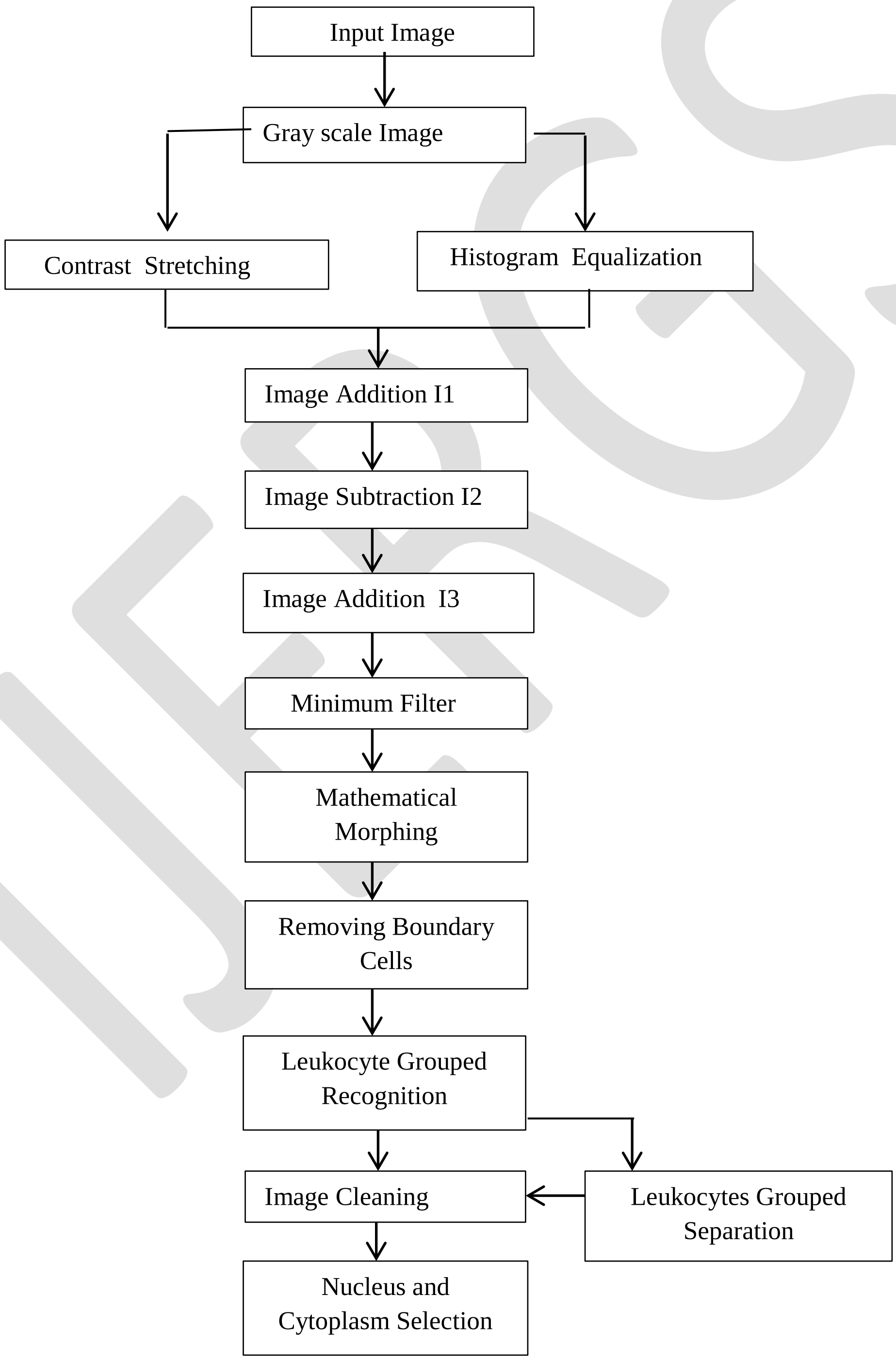

Fig.2 Proposed Method Schema

Firstly, all the images are converted into grayscale images, so that the nucleus part of the cell will be darker. The identification of white blood cell nucleus is based on the contrast stretching, histogram equalization and image arithmetic. After converting the original image into grayscale image, make two copies of the image. First image is contrast stretched and second image undergoes histogram equalization. Then addition operation is applied on these two copies referred as I1.

$$I1(I,j) = L(I,j)+H(I,j) \tag{3}$$

I1 is then subtracted from histogram equalized image to get R2.

$$I2(I,j) = I1(I,j)-H(I,j) \tag{4}$$

Then I1 and I2 are get added to get I3.

$$I3(I,j) = I1(I,j)+I2(I,j) \tag{5}$$

After applying mathematical operation we apply 3-by-3 minimum filter in order to reduce the noise present in the image I3. Then apply mathematical closing operation so that holes present in the segmented image will be filled. From the nucleus segmented image, remove the objects which are on the boundary of the image. After getting the leukocyte image, recognize whether the leukocytes are grouped or not. Then image cleaning is done. Thereby we can select the nucleus and cytoplasm from the image.

4. CONCLUSION

The prominent fact of automatic blood cell recognition and analysis is the ability to find all the nucleated cell in the image and remove all the remaining components. This paper introduces the automatic white blood cell localization by using mathematical operations and morphological operations for segmentation. In this research, we firstly apply mathematical operation for segmenting the white blood cells. Then minimum filter is applied to avoid the noise content in the image. Finally apply the morphological closing operation inorder to fill the holes in the image. This research introduces a method for white blood cell nucleus and cytoplasm identification and segmentation as a first step towards a fully automated system for diagnosis of different kind of diseases and classification using peripheral blood microscopic image. White blood cell segmentation is the key procedure in the automatic leukemia diagnosis system.

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