

# Automatic Detection of Leukemia Using Blood Smear Sample

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**Abstract:** — In this paper, we describe a preliminary work for developing & detection of leukemia using microscopic blood sample smear images. The detection is done automatically by using our tool. This automatic detection not only reduces the time also diagnosed which help to doctors. Due to high defenselessness in human error and large time consumption, better and more effective image processing software is needed. In this paper, we propose a solution to automatic detection, this paper proposed an image processing technique for counting the number of blood cells by using color and morphological features. The number of counted blood cells will then be used to calculate the ratio of blood cells for leukemia detection. In addition to, we introduce an interface for laboratory work to detect leukemia. The whole work has been developed into MatLab environment.

**Keywords:** blood smear, Leukemia, color feature, morphological feature.

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## I. INTRODUCTION

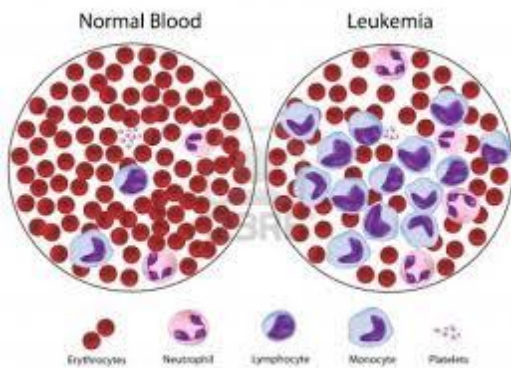
Leukemia is one of the common cancer diseases in India and entire world. In the Leukemia, the blood cancer related with white blood cells [1-10]. Abnormal white blood cell begins to continuously replicate itself known as bone marrow disorder. The major problem with these cells that they are not functions normally. Time to time, these leukemic cells spread into bloodstream and they divided continuously. Therefore, they create tumors and damaging organs such as the liver & kidney [5].

Acute leukemia is categorized into two types: Acute Lymphoblastic Leukemia (ALL) and Acute Myelogenous Leukemia (AML)[6,8]. In the Acute Lymphoblastic Leukemia, it rapidly progressing disease that affects mostly cells that are unformed. This disease generally founds into children while Acute Myelogenous Leukemia mainly affects adults as well as children also.

As reported said, in 2009 more than 31,490 was diagnosed with leukemia while in Malaysia more than 21,773 cancer cases were diagnosed. Due to high number of the leukemia cases, it draws the attention of healthcare industry and researcher to develop some automatic tool that will count blood cell automatically and identify the Leukemia blood cancer diseases.

Medical image processing is one of the commonly and very important filed. From last decades, the medical image processing is highly involved into Computer Science area. The researcher and industry people are trying to develop some automated tool for detecting the several diseases. These automated tools relay a lot of help to the Doctors. We already have a lot of expert knowledge required for the diagnosis of commonly related medical problems and diseases. So using this expert knowledge and incorporating the same for automation of diagnosis of the disease by automatic analysis of the medical images.

Now a day's Medical image processing and Digital image processing technique are combined and researchers and industry people trying to develop a diagnosis tool that help them in their analysis and diagnosis by enhancing the visibility of the interested features of the related diseases. In his paper, we are automatic detecting the leukemia by using digital image processing technique. This paper basically focuses on the comparison of RBC and WBC in a blood sample smear and according to that the result will display.

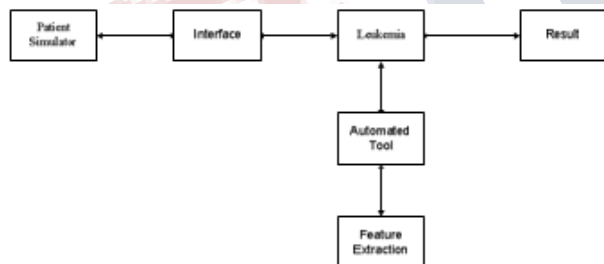


**Figure1: Normal and Leukemia cells**

This paper has been organized as follow. In II we will discuss the framework architecture of our proposed tool. In Section III, we present working model. In section IV, we will propose a method for detecting and identification of the Leukemia cancer. In the last section, we will draw the conclusion.

**II. FRAMEWORK ARCHITECTURE**

Figure 2 describe the automated tool interface. This block diagram shows that, how the images come and how our tool wills diagnose it. The description of each block is given below:



**Figure 2 Architecture of automated tool describing the working of tool**

**Patient Simulator:** Patient Simulator is a realistic, hands-on simulator of the anesthetized or critically ill patient. A "hands-on" simulator is one in which the clinical environment and the patient are represented as real physical objects. A specially instrumented patient mannequin stands in for the patient, and real clinical equipment is used to make up the work environment.

**Interface:** The interface or the device which exists between the patient and the Leukemia device.

**Leukemia:** An Leukemia is a medical device consisting of a long, thin, flexible (or rigid) tube which has a

light and a video camera. Images of the inside of the patient's body can be seen on a screen.

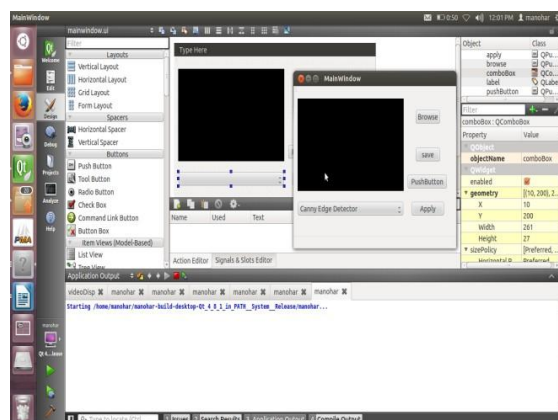
**Automated Tool:** An application tool developed for automated Leukemia image analysis such that any new algorithm can be added and be implemented for the image processing.

**Feature Extraction:** It is one of the important parts of the automated tool. In this phase, this tool detections such as red spot and color image segmentation, morphological to find the resultant of the diagnosis.. Here we used the color image segmentation technique for recognizing the red spot or the wounded portion which has more red intensity as compared to other parts.

**III. WORKING MODEL**

In this section, we show our developed automated tool which supports to detection of Leukemia. Leukemia tool is created by using the MatLab over the Linux platform. MatLab is a cross- platform application framework that is widely used for research, developing application software with a graphical user interface (GUI). This tool feature's in take the input from appropriate device. We have incorporated some fundamental algorithms like histogram equalization, edge detection etc in form of a drop down box such that the algorithm that was selected can be applied on the selected image.

We used MatLab which is a cross- platform application framework that is widely used for developing application software with a graphical user interface (GUI).



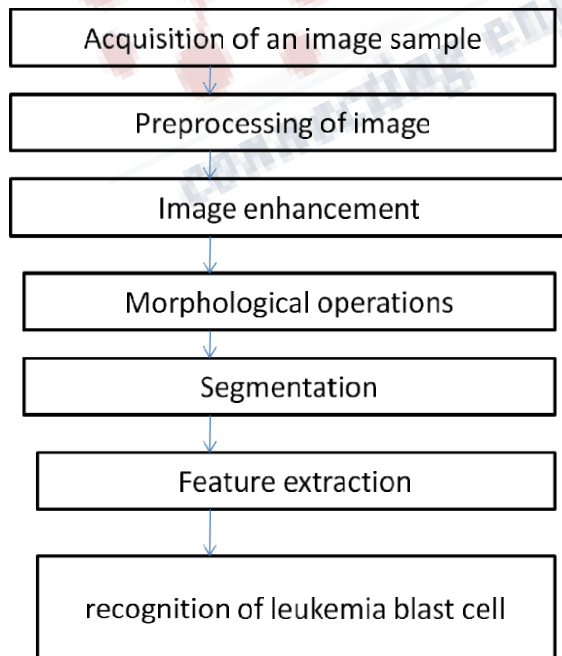
**Figure3. Framework of developed Tool**

**IV. FEATURE EXTRACTION**

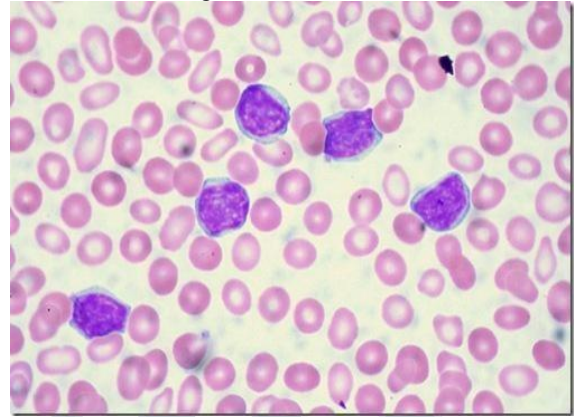
In this section, we will extract the important feature. At the initial stage, our tool takes an image or sequence of images. The image is taken from different source (image quality has different resolution). This image contains the noise. This noise highly affect the result, therefore the pre processing technique is required. In the pre processing technique, we remove the noise with the help of different filter.

**Apply filter:** Apply any filters like Guassian filter etc on the image such that the image is smoothened the darks spots or the awkward portion on the image which is considered as noise might be accumulated at a particular portion on the image causing disturbances in the process of image segmentation . Hence, we use a smoothening filter such as a guassian filter which helps in reducing the noise.

In the image enhancement section, we improve the quality of image by smoothing the image. After enhancing the image quality, we extract the color feature of the image. Color feature is one of the important features for detection of Leukemia. This color feature contains three features (red, blue and green). From that we can find the ratio. For applying the morphological, movements invariant and shape feature, we have to convert the RGB color to gray image. This gray level has 8 bit while RGB color has 24 bit. For extracting morphological, movements invariant and shape feature, it is required to convert this gray image to binary image. The detailed description and block diagram is given below:



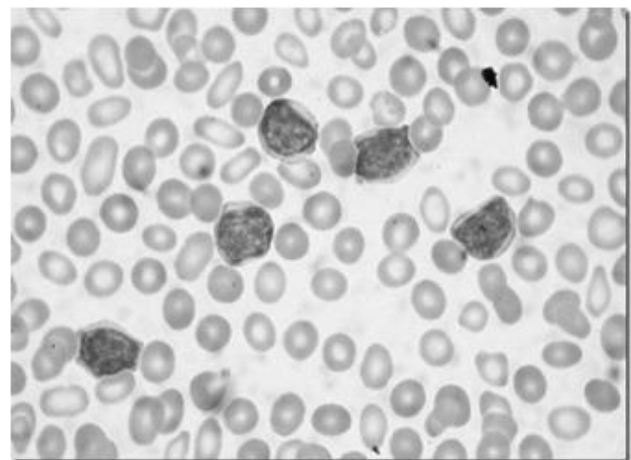
**Fig4. Block diagram of detection of Leukemia**  
**Acquisition:** Dataset has been taken from ALL IDB[1]. We have taken 6 images from ALL IDB



**Figure 5. Leukemia and normal blood cells**

**b. Preprocessing:** In the preprocessing stage, we remove the noise from image. In addition to we also do some basic operation over the Grayscale image & binary image to image contrast enhancement are among the pre-processing techniques involved in the development of this image processing system.

**c. Grayscale Image:** Original blood cells images are in colour. To ease the process of ratio determination, the original images will be converted into grayscale colour. Grayscale represents the intensity of the image. In Matlab 7.0, this can be done by using RGB2GRAY function. The RGB2GRAY converts RGB image to grayscale by eliminating the hue and saturation information while retaining the luminance.

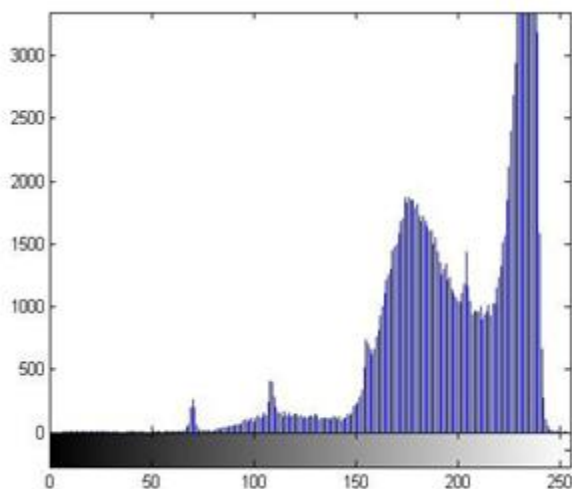


**Figure 6: Converted gray image from color**



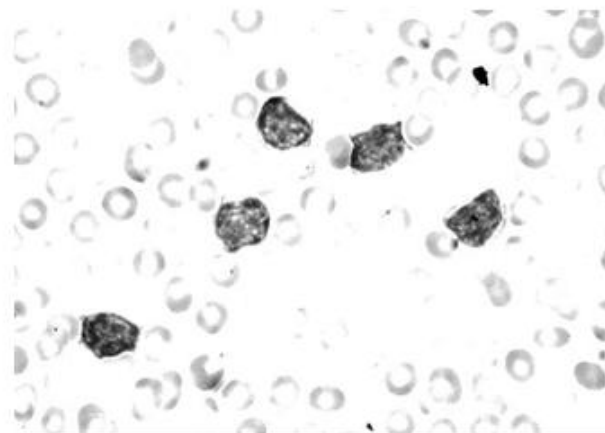
**d. Histogram and Thresholding:** After the input image of blood cells has been converted into grayscale, the intensity distribution of that image can be presented through the gray level histogram. The bin of all the intensity levels can be seen, and the image can be analysed based on the gray level histogram [7]. In this study, the gray level histogram is important to distinguish between.

In the image, there are Red blood cells and White blood cells and background areas present. There are two approaches for converting the gray image to binary image. One of the easy methods is, to define a threshold value. This threshold value generally 127, while this method cannot give the better result. Therefore, we have taken Otsu method for converting the gray to binary image. This method is already implemented into Matlab 7.0. Thresholding is a method of converting a grayscale image to a binary image so that the objects (WBC and RBC) are separated from the background [7]. Threshold value is applied on each image in order to obtain image with either RBC or WBC.



**Figure7: Intensity histogram of image**

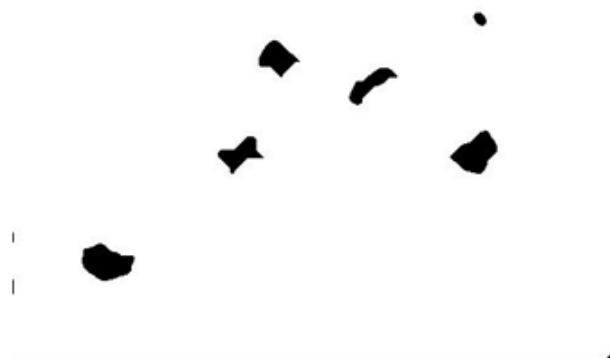
**e. Binary Image:** After converting the gray image to binary image, it is observed that all the pixel value is either 0 (black pixel) or 1 (white pixel). In this paper, we convert the white blood cells into white and red blood cells & background area into black. The reflected result may not be satisfied; therefore we again apply pre processing technique by determining the new threshold values.



**Figure8: converted image from gray to binary**

**f. Image Enhancement:** In the first method, image enhancement technique will be applied after the blood cell image has been converted into binary image. Normally, the original binary image consists of small spots within the image. These small spots are assumed as noise and need to be removed from the image. Hence, we proposed paper and salt noise filter in addition to Gaussian filter to remove noise. Gaussian provides smoothing and preserves edges better than other filters.

**g. Segmentation:** Segmentation is the important and rigorous step in digital image processing which directly affect the result. In the segmentation we divide each object for counting the number of blood cells. In this paper, we use 8 neighbors for finding the boundary of object. Segmentation parts going to improve the visualization and observe blood cell under blood smear process.



**Figure 9: Segmented image**

**h. Ratio calculation:** After proper segment the image, First of all, we have to calculate gray thresh then convert it into binary image then we will calculate the difference between other then the binary image

- 1)  $i5 = im2bw(i4, graythresh(i4));$
- 2)  $i5 = ~i5;$
- 3)  $[l, num1] = bwlabel(i5, 8);$
- 4)  $diffnum = num - num1;$
- 5)  $ratio = num1 / diffnum;$

Where

Num1  $\square$  number of white pixels of segmented WBC image

Num  $\square$  number of white pixels of original binary image

## V. CONCLUSION:

In this paper, we have presented an automatic detection of leukemia blood cancer disease by using the digital image processing technique. First of all, we apply the preprocessing technique for extracted the required feature (color and shape). The main aim is to calculate ratio between RBC and WBC. If the result is more than 0.1 the leukemia is detected otherwise normal report found. This result is shown and generated by our tool.

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