Image Segmentation to Differentiate Blood Cell Affected with Acute Leukemia

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***Abstract*— Computer vision is a field concerned with information extraction from images. Computer analysis of images usually starts with segmentation. Segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics the recognition of acute leukemia cell images based on color image is one of the most challenging tasks in image processing. The use of color segmentation for acute leukemia images using HSI color space along with contrast stretching algorithm is proposed and the evaluation of color spaces is carried out using a segmentation algorithm. The technique segments each leukemia image into two regions; blast and the background. The information in nucleus and cytoplasm regions contains important information which may be useful for hematologists. The proposed system is applied to compare acute leukemia image versus normal blood smear image.**

***Keywords*— Image segmentation, Acute leukaemia, HSI, Contrast Stretching, Blast.**

I. INTRODUCTION

The image processing is a part of computer sciences. It is applied in many domains like in space, in speech recognition, handwritten recognition in detecting cancer. It covers an area of image analysis, computer vision, and pattern recognition. Image segmentation is a fundamental step in many areas of computer vision including stereo vision and object recognition. It is one of the most challenging tasks and is a very important pre-processing step. Image segmentation has applications separate from computer vision. Image segmentation [4,5] is a process of extracting and representing information from an image in order to group pixels together into regions of similarity. The goal of segmentation is to simplify and/or to change the representation of an image into something that is more meaningful and easier to analyse.

The segmentation of color images which requiring more information about the scene but requires less attention to develop the algorithms the conversion of the color image to gray level image may cause some features that are based on color to disappear. To overcome this problem, identification of blood cells based on color is proposed [5]. In medical imaging, segmentation is useful for study of anatomical structure, diagnosis, measure tissue volumes, computer-guided surgery, treatment planning, to locate tumors and other pathologies. [5]

The term “leukemia” [6] refers to a group of cancers of the blood cells. In leukemia, white blood cells become abnormal, divide and grow in an uncontrolled way. Leukemia is a broad term covering a spectrum of diseases. Leukemia is clinically and pathologically subdivided into a variety of large groups. The first division is between its acute and chronic forms. The word “acute” means the disease develop and progress rapidly, while “chronic” leukemia is characterized by the excessive build-up of relatively mature, but still abnormal, white blood cells. As Leukemia results in higher mortality due to delay in the expert opinion. Segmentation procedure can be efficiently used in medical science in acute leukemia. The image segmentation can be applied to diagnose leukemia and to find its severity by using different color spaces.

II. METHODOLOGY

Due to overlapping between the blood cells to extract morphological component such as blast from its complicated blood cells background is still a challenging task to achieve this task acute leukemia blood cell image segmentation using HSI color space is proposed along with contrast stretching technique [7,10].

The proposed methodologies are divided into two image processing parts. The first part focuses on color image segmentation based on HSI color space and enhance the area of image by applying contrast enhancement techniques on acute leukemia images [6]. The second part is to count the detected blasts from acute leukemia image [13].

- *Acute leukemia image segmentation based on HSI color space:-*

Hue, Saturation, and Intensity (HSI) model [7,8] is an ideal tool for developing image to utilize the color contents in an image, the color image segmentation for both blast and nucleus are performed based on the HSI color space image. In HSI color space Hue is a color attribute which describes pure color whereas saturation gives a measure of the degree to which a pure color is diluted by white light. Intensity component, I, is decoupled from the color information in the image.

As the H component in HSI color space contains most of the white blood cells information while the S component contains the structure information of the white blood cells nucleus. Thus, out of these three-color spaces, only the S component is used for transforming the RGB image.

The segmentation of acute leukemia images using HSI color space is based on S component. It involves following steps.

1: Capture acute leukemia slide image and save it into bitmap.
2: Extract the specific component information from original image.
3: Plot the histogram to determine the threshold value.
4: Select the threshold value using the component from HSI color space.
5: Implement N x N (N=5) the median filter to the resulted images.
6: Restore the HSI color to the resulted images.
7: Convert the resulted image to RGB & display the resulted image.
8: Count the Resulted Blast

The transformation procedure from RGB to HSI involves following equations.

$$\text{Hue} = \begin{cases} \Theta & \text{if } B <= G \\ 360^0 - \Theta & \text{if } B > G \end{cases}$$

$$\Theta = \cos^{-1} \left\{ \frac{1/2[(R-G) + (R-B)]}{[(R-G)^2 + (R-B)(G-B)]^{1/2}} \right\}$$

$$\text{Saturation} = 1 - \frac{3}{R+G+B} \min(R, G, B)$$

$$\text{Intensity} = 1 \quad (R+G+B)$$

- *Contrast stretching*: -

Contrast stretching [8] is a process that applies auto-scaling method, which is a linear mapping function. It is usually used to enhance the brightness as well contrast level of the image. The resulting enhanced medical images may provide clearer images for better and easier disease screening process by the doctor. Thus, It is an important process for a successful feature extraction and diagnosis of leukemia. There are four different types of contrast stretching methods:

- Global contrast stretching
- Local contrast stretching
- Dark contrast stretching
- Bright contrast stretching

To develop the contrast enhancement, techniques are as follows:

1] Capture acute leukemia slide image and save as bitmap (*.bmp) format with the 128x128 resolution.
2] Apply contrast enhancement techniques to contrast the original image.
3] Develop intensity histogram from original image to obtain the threshold value.
4] Develop intensity histogram from the resultant images.

Acute leukemia is detected based on color and size of blast.

From the proposed method, following features of the blast can be observed:

i) The size and shape.
ii) Total count available in an acute leukemia image

III. RESULT & DISCUSSION

Acute leukemia image segmentation based on HSI color space is shown below. As the acute leukemia image consist of: the background, red blood cell and blast (cytoplasm and nucleus). Due to this, it is quite difficult to select the threshold value which is suitable for the image. Therefore, here we have proposed automatic thresholding algorithm i.e. Otsu Algorithm Following Figure shows the original acute leukemia image with corresponding contrast stretched image

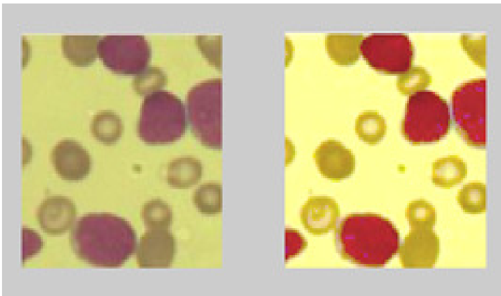

Figure 1: Bright contrast stretched image

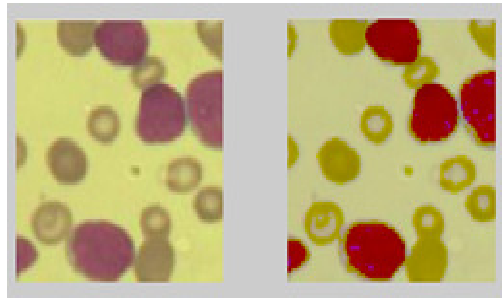

Figure 2:Dark contrast stretched image

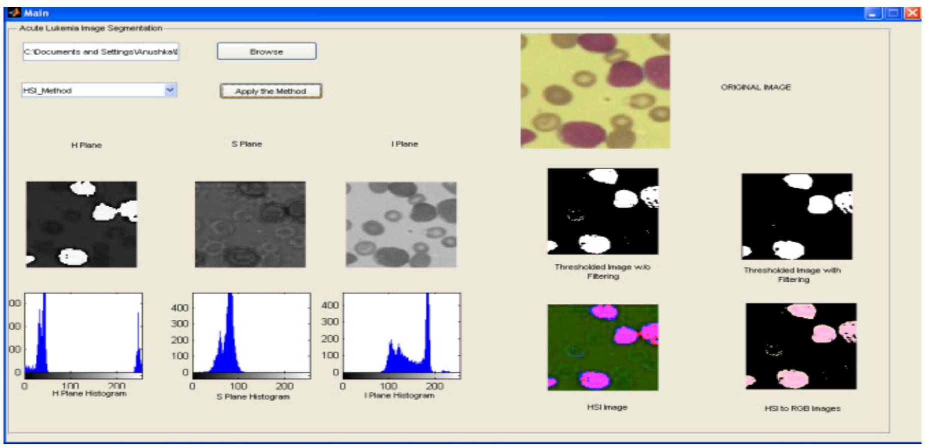

Figure 3: Acute leukemia image using HSI

Figure 3 shows HSI image by converting from RGB to HSI. Based on the s component threshold is selected for the identification of the correct size of the blast. It also shows segmented blast with filtering and without filtering.

Following figure shows normal blood cell image by applying HSI color space

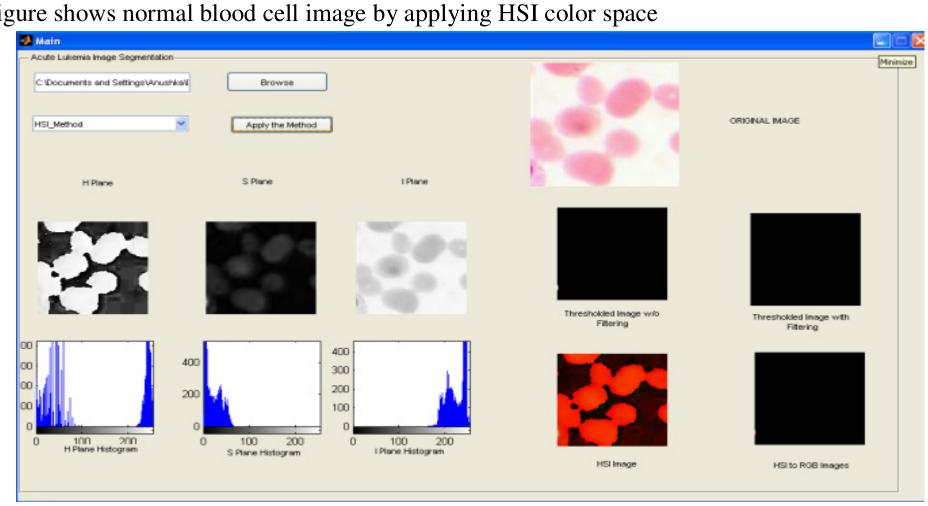

Figure 4: Normal Blood cell image using HSI

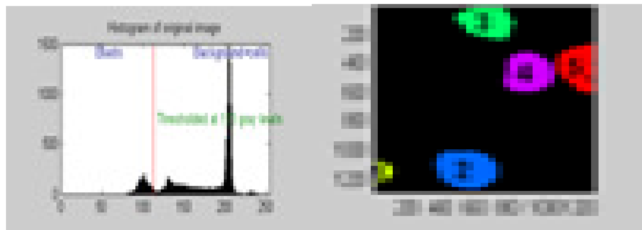

Figure.5(a) (b): Resulted blast image with histogram for acute leukemia image

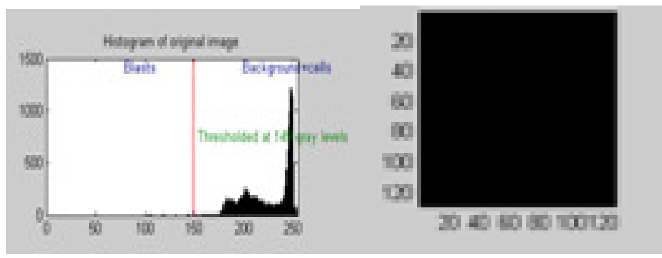

Figure5. (c) (d): Resulted blast image with histogram for normal blood cell image

In figure 5 we see that (a)(b) the resulted blast image histogram for the corresponding acute leukemia image while in figure (c)(d) shows the result with respect to normal blood smear image so no blasts are detected.
This acute leukemia segmented image detected 5 blasts, while if we apply HSI method on normal blood cell image it shows 0 blast. Table 1 below shows that the value for original blast after applying S component based on HSI color space from Figure 3

Table1. Different parameter value for the segmented image.

Blob #	Mean	Intensity	Area	Perimeter	Centroid	Diameter
# 1	103.3	126.0	43.0	5.1	115.1	12.7
# 2	101.5	754.0	105.3	54.5	113.1	31.0
# 3	95.1	566.0	94.2	66.2	11.5	26.8
# 4	97.4	626.0	94.2	90.7	46.5	28.2
# 5	105.1	543.0	105.4	119.6	42.7	26.3

IV. CONCLUSION

The focus of this paper is to develop automated system. This paper shows a performance comparison of acute leukemia image and normal blood cell image segmentation using HSI color spaces and counts the number of blast (WBC) which are available in an image. For image segmentation using HSI color space for acute leukemia images found that the method has performed well. While the method applied on normal blood cell image gives also accurate result Finally the proposed system gives the count of the blast which are present in an acute leukemia image along with their different parameters. For proper treatment management, early detection of the disease this information is necessary hence this result will be used for haematologists in their diagnostic process and accelerating diagnosis of leukemia diseases. This system removes the human errors in detection, number of steps involved in this are also less and more importantly it is cost effective. In future this can be further extended to determine the total white blood cell count after detecting the blast.

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