Acute Leukemia Blast Counting using RGB, HSI Color Spaces

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ABSTRACT
Computer analysis of images usually starts with segmentation, which reduce pixel data information about the objects and their structures which are present in the system. The recognition of acute leukemia blood cell based on color image is one of the most challenging tasks in image processing. Also, the conventional method of manual counting using a microscope is a time-consuming, produces errors and put an intolerable amount of stress to technicians. As a solution to this problem, this paper proposed an image processing technique for color segmentation of acute leukemia images using HSI and RGB color spaces and the evaluation of color spaces is carried out using a segmentation algorithm. And to count the number of blasts with their size which are present in the image of leukemia. The technique segments each leukemia mage into two regions; blast and the background. The blast contains white blood cells. The experimental result shows that the proposed system has provided recognition of acute leukemia blasts and to counting blast.

General terms: Pattern Recognition.

Keyword: Image segmentation, acute leukemia, RGB, HSI, Blast.

1. INTRODUCTION
The image processing is a part of computer sciences; it is applying in many domains like in space, in speech recognition, handwritten recognition, in document classification, in industry, optical character recognition in search engine, in detecting cancer. In the area of image analysis, computer vision, and pattern recognition Image segmentation is one of the most challenging tasks and is a very important pre-processing step.
The field of computer vision is concerned with information extraction from images. Image segmentation has applications separate from computer vision. Segmentation refers to the process of partitioning a digital image into multiple segments pixels, It is frequently used as an aid in isolating or removing specific portions of an image as well as it serve to simplify the problem by grouping the pixels in the image in logical ways. The result of this is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. The research in the area of image segmentation has led to many different techniques, which can be broadly classified into histogram based, edge based, region based, clustering, and combination of these techniques.
Several algorithms and techniques have been developed for blood cells recognition. The segmentation of color images requires more information about the scene while less attention is required to develop the algorithms than the gray scale images. Color images allow more reliable image segmentation and are also very rich source of information as well as they will provide a better description of a scene than grayscale images.[9] In general, there are two requirements to be fulfilled for color image enhancement. The first one is to keep the color structure of the original image. This can be done by simply keeping the ratios between R, G, and B components of every pixel. The second requirement is to present as much information as the original. This can be achieved by using the information in the luminance component as well as color components.[9] In several different applications segmentation is used, one of them is for identifying blast in leukemia. As for the blood cell images, due to the complex nature of cells and overlapping between these cells, it still remains a challenging task to segment and count them [11].

The term “leukemia” refers to a group of cancers of the blood cells.[12] In leukemia, white blood cells become abnormal, divide and grow in an uncontrolled way. 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. Typically taking months or years to progress. Abnormal white blood cells or blasts play important role for hematologists in their diagnostic process and accelerating diagnosis of leukemia diseases. Hence, for proper treatment management early detection of the disease is necessary. Digital image processing technique could help them in their analysis and diagnosis by enhancing the visibility of the interested features of the WBC.

Image enhancement is very important to increase the visual aspect of blast cells. There are several different contrast stretching methods are available.[4]The proposed technique helps to improve the image visibility and has successfully segmented the acute leukemia images into two main components: blast and nucleus. Information gain from the resultant images would become useful for hematologists for the further analysis. The proposed system removes the human errors in detection, number of steps involved in this are also less. And more importantly it is cost effective.

2. METHODOLOGY
The primary goal of acute leukemia blood cell image segmentation is to extract morphological component such as blast from its complicated blood cells background using RGB and HSI color spaces. The proposed algorithm for acute leukemia image segmentation is given below.

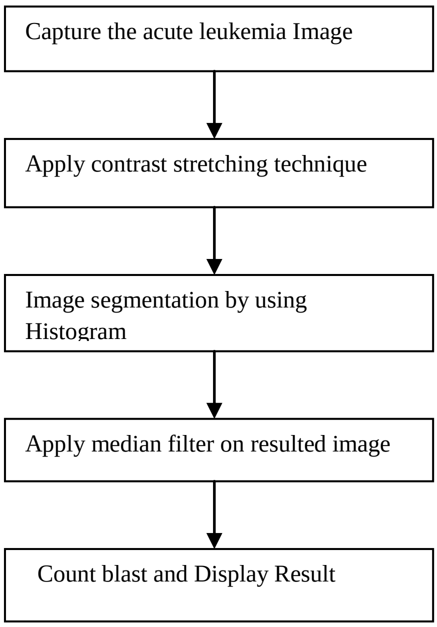

Fig1.Proposed system for acute leukemia Image segmentation.

2.1 Acute leukemia image segmentation based on RGB color space

The algorithm for RGB color space is as given below. There are 5 steps involved in the method based on RGB color space[1]

1) Capture acute leukemia slide image and save into bitmap (* .bmp) extension .
2) Applying the local contrast Stretching to increase the contrast of the captured image.
3) Select the threshold value by using histogram.
4) Implement the median filter N X N (N = 5) to the resulted images.
5) Display the resulted image in RGB color space.

For RGB color space, local contrast stretching (LCS) is an enhancement method performed on acute leukemia images for locally adjusting each RGB pixel value to improve the visualization of structures in both darkest and lightest parts of the acute leukemia images at the same time. The advantages of this color space is that it works like human visual system (HVS).

$$I_{Output}(x,y) = 255.[I_{input}(x,y)-min]/(max-min)$$

Where, I_{output} (x, y) is the color level for the output pixel
I_{input} (x, y) is the color level for the input pixel
max is the maximum value for color level in the input image.
min is the minimum value for color level in the input image.

2.2 Acute leukemia image segmentation based on HSI color space

To utilize the color contents in an image, the color image segmentation for both blast and nucleus are performed based on the HSI (Hue, Saturation, and Intensity) color space image[1]. In HSI color space Hue is a color attribute which describes pure color where as 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.

The segmentation of acute leukemia images using HSI color space is based on S component. This procedure involves conversion from RGB to HSI and back conversion is required. HSI color space involves the following steps which are summarized below.

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

The transformation procedure from RGB to HSI involves following equations.

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

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

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

$$Intensity = \frac{1}{3}(R+G+B)$$

3. RESULT AND DISCUSSION

In this we study acute leukemia image segmentation based on RGB and HSI color space. following figure2 shows the original acute leukemia image with a resolution of 128*128.

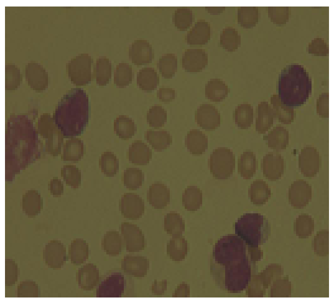

Fig2.Original Acute leukemia image

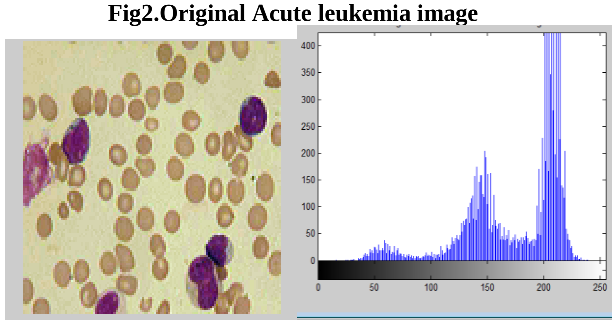

Fig3 (a)Contrast stretched image (b)LCS histogram

The above figure 3(a) shows the resultant contrast stretched image after applying local contrast stretching on RGB color space. Contrast stretched image along with the histogram is shown in figure 3(b). As the acute leukemia image which consist of: the background, red blood cell and blast (cytoplasm and nucleus). Due to this ,In this case, it is quite difficult to select the threshold value which is suitable for the image.

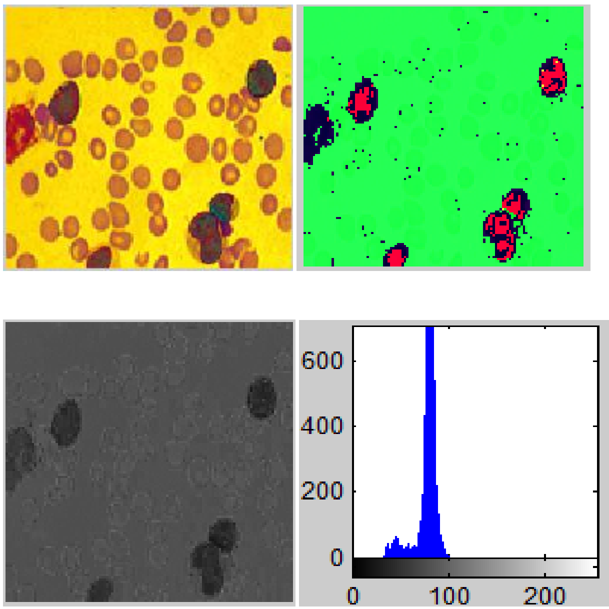

Fig4 (a)global contrast stretched image
(b) HSI image
(c) S component image
(d)S component histogram

By observing the figure 4 (a),(b),(c)and (d) which shows global contrast stretched image Figure (b)shows HSI image by converting from RGB to HSI. Figure (c) shows S plane image and their corresponding histogram is shown in figure(d).Based on the s component threshold value is selected and used to segment the background from the image. This is used for the identification of the correct size of the blast and it is shown in figure5(b)

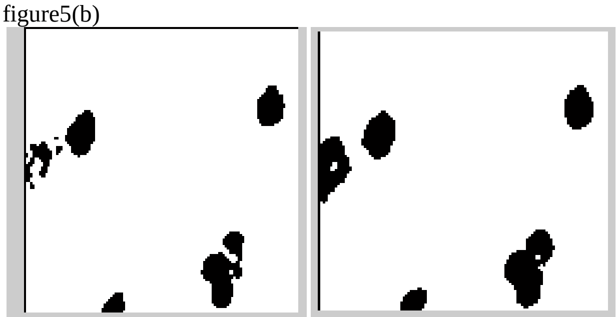

Fig5:(a) Segmented image of RGB with median filter
(b) Segmented image of HSI with median filter

For Figure 5 (a),shows the segmented image after applying RGB based local contrast stretching, and also applying the median filter this will result on the elimination of all cytoplasm blast .By applying S component from HSI color space shown in figure5(b). The successfully segmented blast are appeared as black color.
Counting of this blast are shown in figure 6(a) and (b).which is used for the analysis. The analysis is done in order to determine the capability of the system for counting the blood samples accurately.

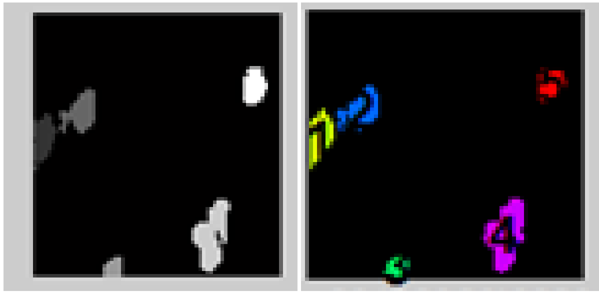

Fig6: (a)Labled image from bwlable().
(b) Counting blast of the resulted image.

Meanwhile, Table 1 below shows that the value for original blast (refer to the selected blast) from Figure 2, blast (refer to the selected blast) after applying S component based on HSI color space from Figure 5 (b) and blast after applying RGB color space base on local contrast method from Figure 5 (a).The segmented image gives 2540 total number of pixels.

Table1. Different parameter value for the segmented image.

Blob	Mean	Intensity	Area	Perimeter	Centroid	Diameter
# 1	67.5	231.0	78.2	6.2	61.7	17.1
# 2	59.0	236.0	91.4	26.1	48.6	17.3
# 3	57.6	89.0	33.9	42.6	124.0	10.6
# 4	55.8	404.0	107.8	93.3	108.4	22.7
# 5	55.0	189.0	53.5	114.8	36.1	15.5

4. CONCLUSION

This paper shows a performance comparison of acute leukemia image segmentation using HSI and RGB color spaces and also counts the number of blast (WBC) which are available in an image. For image segmentation using RGB and HSI color space observation it is found that the method based on RGB color space has not performed well .Means it should not gives accurate result, Besides that ,the shape of the blast after the segmentation process is not quite similar to the original blasts. While the method based on HSI color space using S component can provide almost similar pixel values and shape to original blasts. The results also show that the histogram is also useful for the selection of the threshold value using HSI color space. 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 hematologists in their diagnostic process and accelerating diagnosis of leukemia diseases.

5. REFERENCES

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