Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 30 (2012) 475 – 481

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Communication Technology and System Design 2011

Quality Improvement for Analysis of Leukemia Images through Contrast Stretch Methods

R.Ravindraiah[a], M.Venkata srinu[b] a*

[a,b]*ECE Dept., MITS, Madanapalle, A.P, India*

Abstract

Computer image processing develops very fast and plays an important role in wide applications of engineering and sciences. Leukemia is a malignant disease (Cancer) seen in people of any age groups either in children or adults aged over 50 years. In most of the cases microscopic images usually inadequate to identify the type of the cell. The traditional morphology test done by a hematologist to look under the microscope is a time consuming and tedious job. Diagnosis through this approach requires very costly equipment and may not be installed in all hospitals and clinics. Further the noises and blurriness effect during image acquisition often leads to false diagnosis of leukemia. An automatic image enhancement and segmentation system can make the inspection procedure of leukocytes much easier and faster and the amount of data that can be analyzed by such a clinician handle more data than they normally can handle. In this paper four contrast stretch based enhancement methods are implemented for analysis of leucocytes. A comparative analysis is done on local contrast stretching, global contrast stretching, dark contrast stretching, bright contrast stretching methods. All these methods involve threshold mapping which often useful to attain segmented results.

© 2011 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of ICCTSD 2011

Open access under CC BY-NC-ND license.

Keywords: Electron micrograph image enhancement; Acuteleukemia, local contrast; global contrast; dark contrast; bright contrast stretchin;

1. Introduction

Leukemia is the common malignancy in childhood and is second only to accidents as the major cause of most death in childhood in the age group 1-15 years [1]. It is a cancer of the myeloid line of blood cells, characterized by the rapid growth of abnormal white blood cells that accumulate in the bone marrow and interfere with the production of normal blood cells.The aspirated marrow is found to be infiltrated by

* R.Ravindraiah. Tel.: +91-9492945886.
E-mail address: ravindra.ranga@gmail.com.

1877-7058 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.proeng.2012.01.887

abnormal cells[2]. There are some signs or symptoms of leukemia that are similar to other common illnesses. The symptoms are caused by replacement of normal bone marrow with leukemic cells, which causes a drop in red blood cells, platelets, and normal white blood cells. These symptoms include fatigue, shortness of breath, easy bruising and bleeding, and increased risk of infection. Several risk factors and chromosomal abnormalities have been identified, but the specific cause is not clear. It progresses rapidly and is typically fatal within weeks or months if left untreated[3].

The objective of image enhancement is to improve the interpretability of the information present in the images for human viewers. An enhancement algorithm is one that yields a better quality image for the purpose of some particular application which can be done by either suppressing the noise or increasing the image contrast[4]. Enhancement methods are application specific and are often developed empirically. Several research expert groups have been focused on computerized system development that can screen and analyze different types of medical images to extract useful information for the medical professionals [4].

2. Methodology

A. Image Enhancement

Enhancement is the process of manipulating an image so that the result is important suitable than the original for specific applications. The word *specific* is important here because it establishes at the outset that enhancement techniques are problem oriented[5].One of the simplest piecewise linear functions is a contrast-stretching transformation. Low-contrast images can result from poor illumination, lack of dynamic range in the image sensor, or even the wrong setting of a lens aperture during image acquisition. Contrast stretching is a process that expands the range of intensity levels in an image so that it spans the full intensity range of the recording medium or display device [5]. To date, contrast stretching process plays an important role in enhancing the quality and contrast of medical images [6]. In this work 4 techniques for contrast enhancement based on local contrast, global contrast, bright and dark contrast are implemented.

B. The proposed techniques

i-Local and Global Contrast Stretching

Local contrast stretching (LCS) aims at locally adjusting each pixel value to improve the visualization of structures in both darkest and lightest portions of the image at the same time. A sliding window (KERNEL) is moved across the image and the resulting value depending on the formula given in equation(1) is appended to the initial value.

$$lp(x, y)=255*[lo(x, y) - \min]/(\max - \min) \quad \text{.....(1)}$$

Where,
$Ip(x, y)$ - output pixel(x, y) value after the contrast stretching process.
$Io(x, y)$ - input pixel(x, y) color level.
max - maximum value for color level in the input image.
min - minimum value for color level in the input image.

Local contrast stretching will consider each range of color palate in the image(R, G and B). The range of each color will be used for contrast stretching process to represent each range of color. This will give each color palate a set of min and max values [7].

Whereas global contrast stretching will consider all color palate range at once to determine the maximum and minimum for all RGB color image. Therefore combination of RGB color will give only one value for maximum and minimum for RGB color. This maximum and minimum value will be used for contrast stretching process [7].

ii. Dark Contrast Stretching and Bright Contrast stretching

These are the two autoscaling methods in which a linear mapping function is usually used to increase the contrast and brightness levels of the image. These techniques are based on the original brightness and contrast level of the images to do the adjustment.
The mapping function is as follows [8]:

$$P_k = \frac{(max - min)}{(f_{max} - f_{min})}\left(q_k - f_{min}\right) + min \quad \text{……..(2)}$$

Dark stretching is a reverse process of bright stretching process. The KERNEL mapping is based on equation 3, [8]:

$$out(x,y) = \begin{cases} \frac{in(x,y) - TH}{255 - TH} * NewTH & for\ in(x,y) < TH \\ \left[\frac{(in(x,y) - TH)}{255 - TH} * (255 - NewTH)\right] + \min & for\ in(x,y) > TH \end{cases} \quad \text{……..(3)}$$

where,
in(x,y)-input pixel color level located at *(x,y)*
TH - threshold value.
NewTH- dark stretching factor

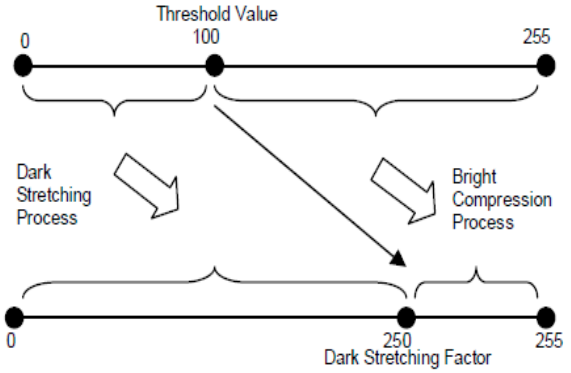


Figure 1: Dark stretching method

Figure 1shows the dark stretching process with the value of 100 is used as an example of threshold value and 250 as a dark stretching factor.

Bright stretching is a process that also used auto scaling method which is a common linear mapping function to enhance the brightness and contrast level of an image. This method is based on Equation 2. The bright stretching process is implemented based on Equation 3 [9],

$$out(x,y)=\begin{cases}\dfrac{in(x,y)}{TH}*NewTH & for\ \ in(x,y)<TH\\ \left[\dfrac{(in(x,y)-TH)}{255-TH}*(255-NewTH)\right]+\min & for\ \ in(x,y)>TH\end{cases} \qquad \text{……..(4)}$$

where,
TH - threshold value
NewTH -Bright stretching factor

*NewTH*is a new range of bright stretching pixel for the threshold value of red, green and blue. *in(x,y)* is a value of color level at pixel *(x,y)* from the input image. **Figure 2** illustrates the stretching and compression processes for bright stretching technique.

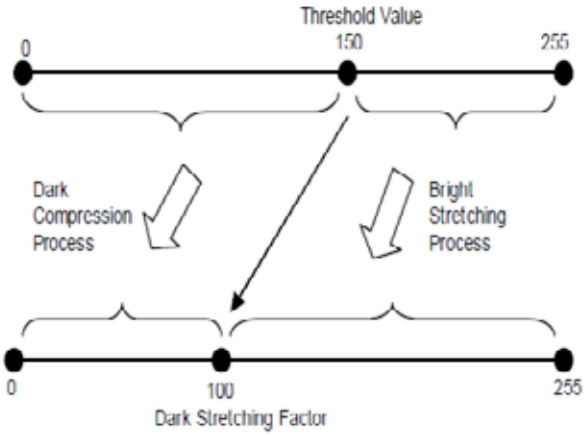
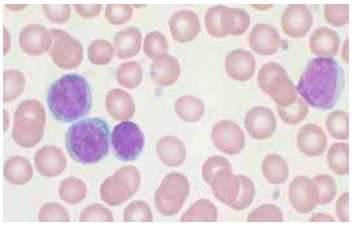


Figure 2 Bright stretching method

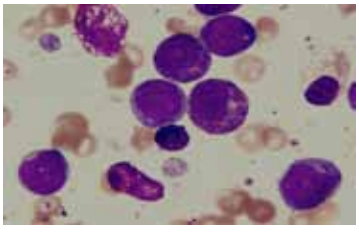
In this threshold value of 150 and dark stretching factor of value 100 is taken i.e., the bright value specified range from 0 to *TH in the input image* is compressed to 0 to Dark threshold factor while the remaining intensities are made to adjust to the remnant output intensities.

3. Results

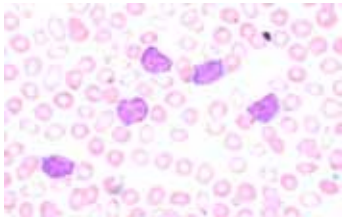
The proposed contrast enhancement techniques were applied to three leukemia images labeled as normal, dark and bright images. Those images were categorized based on the human visual interpretation.



(a.). Normal image



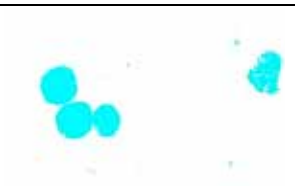
(b). Dark image



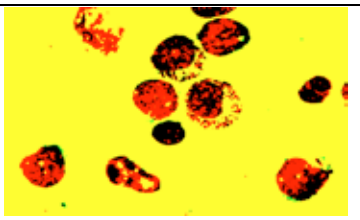
(c). Bright image

Figure 3 Original images

Figure 4 shows the result attained when local contrast stretching technique is applied on original images(Figure 3). The resultant images become clearer and the features of leukemia cells can easily been seen and improved from the original for each category. Hence, it is easy for a hematologiststo analyze the pathology as nucleus and cytoplasm of immature white blood cells are quite clear..In this technique the stretching operation is done only over a normalized range 0.1 to 0.35. Thus it leads to selection and enhancement of the immature cells which further results in segmentation of the cells too



(a) For Normal Image

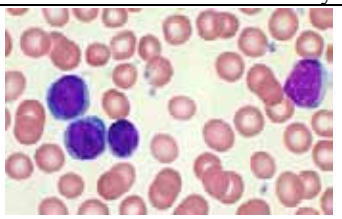


(b) For Dark Image

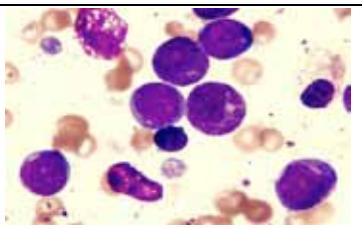
(c) For Bright Image

Figure 4 : Images after local contrast stretching

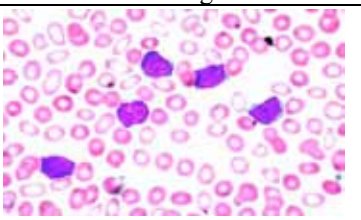
Figure 5 shows the resulting after global contrast stretching technique. Globally, for all type of images it only become brighter than the original images. In this approach the resultant images produced are not much different from the original images When compared to local contrast stretching results characteristic of nucleus and cytoplasm of the immature white blood cells are not that much good.



(a) For Normal Image



(b) For Dark Image



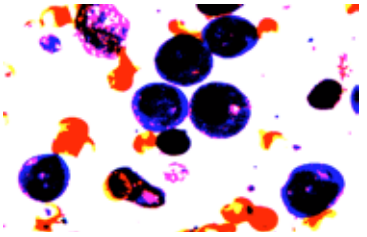
(c) For Bright Image

Figure 5 : Images after Global contrast stretching

Figure 6 shows the results after bright stretching method. In this one can observe that the image become brighter where more bright pixels are stretched towards the dark region. This way the color of the cytoplasm is enhanced.

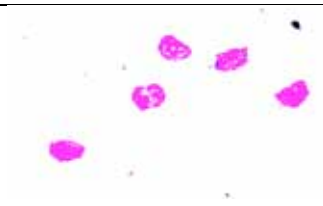
(a) For Normal Image

Threshold value=250
Bright stretching factor=150



(b) For Dark Image

Threshold value=250
bright stretching factor=100



(c) For Bright Image

Threshold value=200
Bright stretching factor=150

Figure 6 : Images after bright contrast stretching

The extreme contour limits of cytoplasm can be seen clearly. Besides that, the contrast was increased between the edge of cytoplasm and the background. Different controlled parameters called thresholds and bright stretching factors have been used for the three different types of images. The cells in the background seem to be washed away and hence more useful for a haematologist to the severity of the disease.

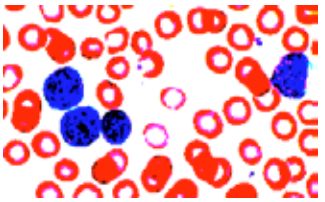
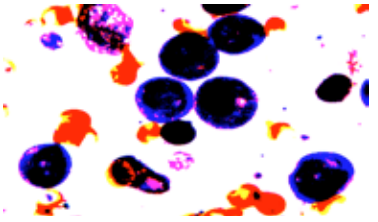
 (a) For Normal Image	 (b) For dark Image	 (c) For Bright Image
Threshold value=185 Dark stretching factor=255	Threshold value=100 Dark stretching factor=150	Threshold value=100 Dark stretching factor=150

Figure 7 : Images after dark contrast stretching

In contrast to bright stretching process, dark stretching results as shown in figure 7 below where dark areas of the image are stretched and the bright areas are compressed. In the leukemia images dark area refers to nucleus, therefore the nucleus is clearer because of the stretching step in dark stretching method. The controlled parameters called threshold value and dark stretching factor have being used. The parameters are different for each figure according to the contrast and brightness level of the original leukemia images.Here also manual adjustment of threshold values will leads segmented results while enhancing the region of interest

4. Conclusion

The presented contrast enhancement techniques are effective in enhancing the contrast of leukemia images. Each method hopefully gives extra information for nucleus and cytoplasm of acute leukemia images and thus eases further analysis by hematologist. Further the application of wavelets approach will be useful in extracting quite optimum results by application of these methods on the individual sub frequency parts.

References

[1] Lascari, A.D:"General aspects. *In*Leukemia in childhood," fifth Edition, Springfield, Illinois, Charles C Thomas, 1973; pp 3-29.

[2] Osowski Stanislaw, Markiewicz Tomasz, MarianskaBozena, MoszczynskiLeszek, "Feature generation for the cell image recognition of mylogenousleukemia." EUSIPCO 2004 : (XII. European Signal Processing Conference) (September 6-10, 2004, Vienna, Austria)

[3] Fabio Scotti, "Automatic Morphological Analysis for Acute Leukemia Identification in peripheral blood microscope images." CIMSA 2005-IEEE international Conference on Computational Intelligence for Measurement Systems and Appliccation.

[4] S. Jayaraman, S. Esakkirajan and T. Veerakumar. "Digital Image Processing", An imprint of McGraw Hill publication, 3rd edition.

[5] Rafael C. Gonzalez, Richard E. Woods and Steven L. Eddins, "Digital Image Processing Using MATLAB", An imprint of pearson publication, 3rd edition.

[6] Mat Isa, N.A.,Mashor, M.Y. & Othman, N.H. (2003). "Contrast Enhancement Image Processing on Segmented Pap Smear Cytology Images." Prof. of Int. Conf. on Robotic, Vision, Information and Signal Processing. 118 – 125

[7] N.R.Mokhtar, Nor HazlynaHarun, M.Y.Mashor, H.Roseline, R.Adollah , H..Adilah, Nazahah Mustafa, N.F.MohdNasir, "Contrast Enhancement of Acute Leukemia Images Using Local and Global Contrast Stretching Algorithms", ICPE-2008.

[8] R.W.Jr. Weeks,(1996). "Fundamental of Electronic Image Processing". Bellingham: SPIE Press.
[9] Nor HazlynaHarun, N.R.Mokhtar, M.Y. Mashor, H.Adilah ,R.Adollah,Nazahah Mustafa, N.F.MohdNasir , H.Roseline, "Color image enhancement techniques based on partial contrast and contrast stretching for acute leukaemia images", ICPE-2008.