Leukocyte Segmentation And Cancer Cell Counting Based On Microscopic Blood Images

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Abstract : There are three types of blood cells in human. The cells are: Red blood cell (RBC), White blood cell (WBC) and platelets. They perform their separate function in human body. The oxygen supply is done by RBC, to fight against infection is by WBC and platelet helps in clotting of blood. The leukocytes or leucocytes the other name for White blood cells(WBCs), which involve in defensing the body against infectious disease and forign invaders. The cell in the bone marrow called as multipotent cells produces white blood cells. Leukocytes are found all through the body, in the blood, lymphatic system etc,. To perform the segmentation, this project uses the techniques such as Green Plane Extraction, Arithmetic operations, Linear Contrast Stretching, Histogram Equalization and Global Thresholding and GLCM is used for classification. This project describes the results of fast and accurate cancer cell segmentation of white blood cells.

Index Term : Cancer cell, GLCM , Leukocytes, MatLab, Segmentation, WBC.

1. INTRODUCTION

The evaluation and diagnosis of many disease can be analysised by counting and classification of blood cells under microscopic images. Analysis of WBCs or leukocytes. Leukemia can be of two types: acute and chronic. As per the FrenchAmerican- British (FAB) categorization model, acute leukemia is split into two sub types: acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML). In this paper we consider only the ALL, that affects a group of leukocytes called lymphocytes. . The ALL can be serious if left untreated for children and adults for more than 50 years abd cause fast expansion in the bloodstream. Therefore, it becomes crucial early analysis of the syndrome for patient's healing, particularly in the case of children. The human cell count and information about cell morphology can be identified using image processing technique. They need only one image and low cost, but at the same time more scrupulous in providing additional perfect standard. The most important aim of this work is the processing and analysis of microscopic images, in order to offer a completely automated process to sustain the medical activity, able to count and classify the WBCs affected by ALL. White blood cells (Leukocytes) are one of the cells the body makes to assist battle infections. Therefore, the method in this paper is to identify all types of WBCs present in the minute images, which require a variety of steps to attain the objective, and then classify WBCs as suffering from ALL or not. Acute lymphoblastic leukemia is most commly affected to the children who are all less than 5 year of age and for adult those who are greater than 50 years. The increased count of immature white blood cell called lymphoblastsis mainly caused by Acute lymphoblastic leukemia(ALL), that mainly slow down the White blood cells (WBCs) normal production.

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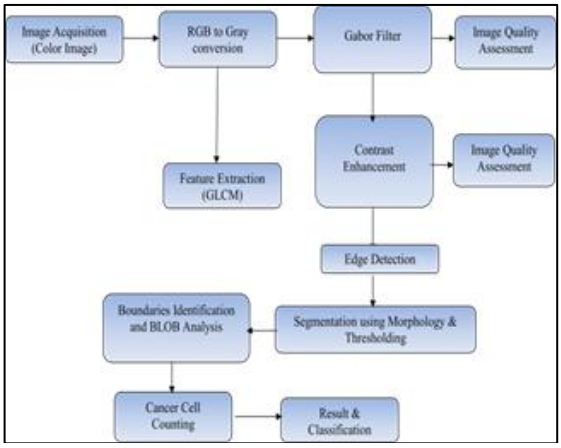
The central nervous system, spleen, liver and lymph nodes receive alarming rate through Acute ALL and they may cause danger in a few months if left untreated.The proposed method can detect paramount importance of the disease early to prevent damage in the body. The blood sample containing lymphoblasts is the best way to know that the patient has disease.The lymphoblast cell count in blood sample can be easily identified by this method,The human error can be eliminated by finding the acute lymphoblastic leukemia in earlier. The image processing toolbox in MATLAB helps in implementing the process.The 108 samples inputs images are taken from infected and healthy patient that are obtained from optical laboratory microscope. The 108 sample images are taken as input database from infected and healthy patients that are obtained from optical laboratory microscope which are taken from canon powershot G5 camera. The images are at the resolution of 2592x1944 in .JPG format with 24 bit color depth. The WBCs are segregated into neutrophils, lymphocytes, monocytes, eosinophils and basophils.

2. BLOCK DIAGRAM - MATLAB UNIT



3. MODULE DESCRIPTION

3.1 Image acquisition

The image acquisition step is the primary step of any visualization method. Different processing methods can be

applied to the image after the image has been obtained to carry out the many dissimilar vision tasks necessary nowadays. If the image has not been satisfactorily acquired, however, the planned tasks may not be attainable, yet with the aid of some form of image enrichment. Digital imaging or attainment of digital images is the formation of a digitally programmed representation of an object's visual characteristics, since a physical sight or an object's interior arrangement. A key benefit of a digital picture in opposition to an analog picture like a film photograph is the skill to digitally indefinitely create copies and copies of copies devoid of any loss of picture quality.

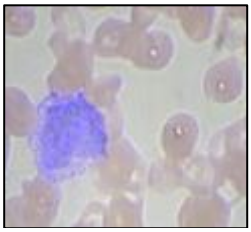


Fig.1. *Input image*

3.1.1 Gray image

Gray - scale figure is individual in which the assessment of each pixel is a solo trial on behalf of only a quantity of light, it carries information about intensity only. Grayscale images, a type of monochrome black - and - white or gray, consist wholly of shades of gray. The distinguish ranges from black at the lowest intensity to white at the strongest intensity. Grayscale images are separate from one - bit to bi - tonal black- and - white images, that are images with only two colors in computer imaging: white and black (as well known as bilevel or binary images). Grayscale images have a lot of shades of gray sandwiched between them. Based on a specific subjective grouping of frequencies (or wavelengths), grayscale images can be the end result of measuring light intensity at every pixel, and in such circumstances they are monochromatic proper when only one frequency (a narrow frequency band in practice) is taken. In principle, the frequencies can be from someplace in the electromagnetic spectrum (e.g. infrarot, visible light, ultraviolet, etc.). A colorimetric (or additional purposely photometric) gray - scale image is an image with a distinct gray - scale color space that maps the stored numeric example values to the achromatic channel of a standard color space based on measured human vision properties. If there is no defined color space in the original color image, or if the gray image is not planned to contain the similar human - supposed achromatic intensity as the color image, then there is no single mapping of such a color image to a gray image

3.2 Gabor filter

A Gabor filter named after Dennis Gabor is a linear filter used for consistency examination in image processing, which is essential to analyzes, there is a few exact frequency content in the image in exact orders in the region of the point or area of examination in a localized area. Many modern vision scientists maintain that the frequency and orientation representations of Gabor filters are similar to individuals of the human being visual system, although the idea is not supported by empirical evidence and no practical rationale. They were found to be particularly appropriate for representation of texture quality and discrimination. A 2D Gabor filter is a Gaussian kernel task that is modulated by a sinusoidal plane wave in the spatial area. A few authors argue that uncomplicated cells in mammalian brain visual cortex can be modeled on Gabor functions. Hence, image examination with Gabor filters is considered by some to be comparable to view in the human visual method.

$$Contrast = \sum_{i,j=0}^{N-1} P_{ij}\,(i-j)^2$$

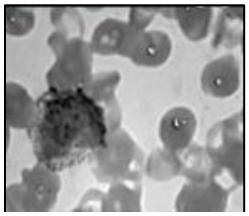


Fig.2*. Gabor Filter*

3.3 Image adjustment

Adjust image intensity values or colormap.

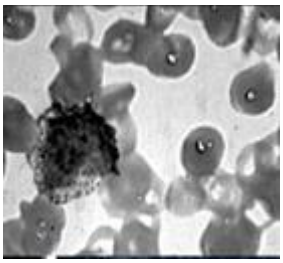


Fig.3*.Image Adjustment Image*

3.4 Gray Level Co-Occurrence Matrix (GLCM)

Removal of features involves simplifying the quantity of property needed to be exactly describe a huge set of information. One of the main trouble arises from the amount of variables occupied when analysising the complex data is done. Extraction of features is a all-purpose term for methods of constructing variables combinations to overcome these troubles at the same time as still recitation of the data with adequate exactness. A surface's tactile or visual texture quality, even as texture plays an important role in image examination and pattern detection, on - board textural feature taking out is implemented by only a a small number of architectures. The Gray Level Cooccurrence Matrix is formulated in this paper to obtain statistical texture characteristics. GLCM can extract a many number of texture features. Only four second order characteristics are calculated, specifically angular second moment, correlation, inverse moment of difference, and entropy. These four events offer the high precision of discrimination required for estimation of the motion picture.

3.4.1 Correlation

It pass over entire image calculation of the pixel's correlation and its neighbor means it shows a linear dependence of gray levels on the neighboring pixels. The correlation value is 1 and -1 on a perfectly positive or negatively correlated images

$$Correlation = \sum_{i,j=0}^{N-1} P_{ij}\,\frac{(i-\mu)(j-\mu)}{\sigma^2}$$

only. Its value start from -1. Range=[-1,1] for the constant image and the formula is

3.4.2 Contrast

It passes over the entire image the calculation of a pixel's correlation and its neighbor means it shows a linear dependence of gray levels on the neighboring pixels. The correlation value is from 1 and -1 in aid of a perfect positive or negative correlated image. Its value start from -1. Range=[-1,1] in aid of the constant image and the formula is

3.4.3 Energy

In view of the fact that energy is used to do work, orderliness is thereby applied. It make use of the quality texture calculating commands in the image. It provides the amount of GLCM's square elements. It is completely dissimilar from the entropy. The square root of the ASM (Angular Second Moment) quality for texture character is used as energy when the window perform orderly proficient. Its range is [0 1]. The value of the constant image is 1. The equation of energy is

$$Energy = \sum_{i,j=0}^{N-1} \left(P_{ij}\right)^2$$

3.4.4 Homogenity

It passes to the GLCM diagonal the value calculating the tightness of the allotment of the elements in the GLCM. It has the value as 1 for diagonal GLCM and its range is from 0 to 1. Homogeneity heaviness value are the opposite of contrast weight, with mass reduction from a diagonal exponentially loose. In difference, the weight used is I - j)^2 and is 1/1+(i - j)^2 in homogeneity. The equation of homogeneity is

$$Homogeneity = \sum_{i,j=0}^{N-1} \frac{P_{ij}}{1+(i-j)^2}$$

where:

Pij - Element i, j of the standardized GLCM symmetry

N – the amount of gray levels in the image as specific by Number of levels in the Variable Properties dialog box below Quantization on the GLCM texture page.

C - Correlation function sgn(x) - Real number sign

x = -1 for x < 0

x = 0 for x = 0

x = 1 for x > 0

σ 2 - Differences in the intensities of each and every one reference pixels in the relationships which contributed to the GLCM, considered as:

$$\sigma^2 = \sum_{i,j=0}^{N-1} P_{ij}\,(i-\mu)^2$$

Note: This might be rough, but it is not the same as, the discrepancy of the intensities of each and every one the pixels in the W data window (as stated by the GLCM algorithm) and depends on the selection of spatial relationship in that algorithm.

μ – the GLCM mean (an approximation of the intensity of all pixels in the relationships contributing to the GLCM), considered as:

$$\mu = \sum_{i,j=0}^{N-1} iP_{ij}$$

Note: This also approximates, but is not the same as, the mean of all the pixels in the W data window (as defined by the GLCM algorithm), and depends on the choice of spatial relationship in that algorithm.

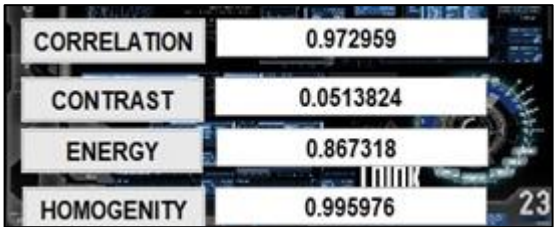


***Fig.4**. GLCM Output*

3.5 Adaptive histogram equalization

Adaptive histogram equalization (AHE) is a processing technique for computer image processing used to improve image contrast. It differs from the usual histogram equalization by calculating more than a few histograms, each matching to a separate part of the image, using the adaptive method to reallocate the precision values of the image. It is therefore appropriate for developing local contrast and enhancing edge definitions in each region of an image, but AHE tends to amplify noise which is over in relatively homogeneous area of an image

***Fig.5.** Image Quality Assessment Result*

3.6 Image quality assessment

For many image processing applications, measuring image quality is important. The difference between degraded image and original image or customized image is used for calculating image similarity assessment which is also called as image quality assessment. The Subjective or objective type of evaluation are the two types used to evaluate image quality. Subjective assessments are costly and time - consuming. Implementing them into automatic real - time systems is impossible. Objective evaluations are algorithms that are defined automatically and mathematically. It is possible to use subjective measurements to validate the utility of objective measurements. Consequently, objective methods in recent years have attracted more attention. Well - recognized objective assessment algorithms for image value measurement consist of mean squared error (MSE) and peak signal - to - noise ratio (PSNR). For many image processing systems, measuring image quality is crucial. Because of material boundaries and financial reasons, the worth of images and videos could corrupt evidently from the tip of being captured to the tip of being viewed by a person

viewer. Identifying image class procedures that are most sensitive to these distortions would help to systematically propose coding, communication and imaging methods can improve otherwise optimize image quality for the preferred service value at a least cost. Some of the current image quality measurements are scheduled below.

1) **Mean Squared Error (MSE)**

One noticeable way to measure this resemblance is to calculate an error signal by subtracting from the reference the test signal and then calculating the error signal's average energy. The mean - squared - error (MSE) measurement of image quality is the simplest and most widely used. This measurement is often used in signal processing and is clear as follows

Where x(i, j) is unique (reference) image and y(i, j) is indistinct (modified) image and i and j are the pixel position of the M×N image. MSE is 0, when x(i, j) = y(i, j) .

2) **Peak Signal to Noise Ratio (PSNR)**

The PSNR is assessed in decibels and the Mean Squared Error is inversely proportional. It is known by the equation.

3) **Average Difference (AD)**

AD is simply the average difference between the test image and the reference signal. This metric is regularly used in handling of signals and is clear as follows

4) **Maximum Difference (MD)**

MD is the maximum difference in the error signal (reference signal difference and experiment image difference).

5) **Mean Absolute Error (MAE)**

MAE is standard of absolute dissimilarity among the reference signal and experiment image. It is specified through the equation as.

$$MAE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left|(x(i,j)-y(i,j)\right|$$

6) **Normalized Cross-Correlation (NK)**

In conditions of correlation function, the proximity among two digital images can also be quantified. Standardized cross - correlation (NK) measures the resemblance of two images and is specified through the equation

$$NK = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j)\times y(i,j))}{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j))^2}$$

7) **Structural Content (SC)**

SC is moreover relationship based evaluation which measures the two images relationship. Structural Content (SC) is specified through the equation

$$SC = \frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(y(i,j))^2}{\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j))^2}$$

Where x(i, j) is unique (reference) image and y(i,j) is distorted (modified) image. MSE and PSNR are the simplest and most widely used measure of full - reference image quality. They are attractive since they are easy to work out, have clear physical meanings and are precisely suitable in the optimization context. There is no critical feature for MSE and PSNR: the capability to evaluate image similarity across types of distortion. Both have low computational complexities MSE and PSNR are satisfactory measurements of image resemblance when the images in question differ by simply increasing a certain type of distortion. These arithmetic measurements be unsuccessful to capture image quality when measuring across types of distortion. The advantage of

$$MSE = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j)-y(i,j))^2$$

MSE and PSNR is that they can be implemented quickly and easily. They quantify the error signal simply and objectively, though. Higher values indicate higher image similarity with PSNR.

$$PSNR = 10\log_{10}\frac{(2^n-1)^2}{\sqrt{MSE}}$$

4. SOFTWARE DESCRIPTION

$$AD = \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(x(i,j)-y(i,j))$$

MATLAB was developed by MathWorks and it is a

$$MD = MAX\left|x(i,j)-y(i,j)\right|$$

programming language. It is a matrix programming language where linear algebra encoding is easy. It can run under both interactive sessions. MATLAB is a 4th generation high-level programming language and interactive platform for visualization, numerical computation and programming. It allows creation of user interfaces, matrix manipulations, plotting of functions and statistics, execution of algorithms such as C, C++, Java, and FORTRAN, analyze data, build up algorithms, and generate models and applications. It has numerous commands built in it and mathematics functions that help out us in math calculations, generating plots and performing numerical methods.

5. RESULT

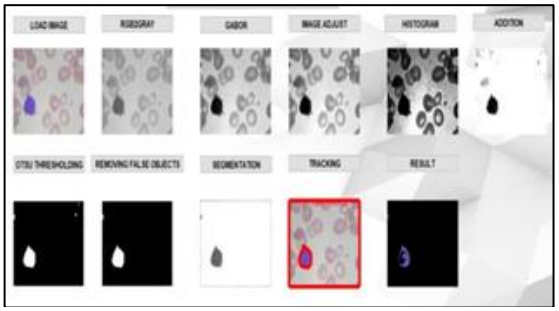


Fig.6. *Result*

6. CONCLUSION

In this project, cancer cells can be detected using morphological operations. We conclude that cancer cells can be identified at the initial stage itself through this above method. By that the affected patients should have longer life span.

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