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**International Journal of Computer Science and Mobile Computing**

**A Monthly Journal of Computer Science and Information Technology**

**ISSN 2320–088X**

***IJCSMC, Vol. 3, Issue. 3, March 2014, pg.104 – 111***

**REVIEW ARTICLE**

# REVIEW: DETECTION OF TYPES OF ACUTE LEUKEMIA

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**Abstract:-**

**The proposed system uses features of microscopic images by examining changes like texture, geometry, color and statistical analysis of images. These changes will be used as a classifier input. The presented method shows how effective an automatic morphological method to identify the Acute Lymphocytic Leukemia (ALL) by microscope images of blood samples. At first the system individuates the leucocytes present in others blood cells, after that it recognizes the lymphocyte cells (cells that causes acute leukemia), evaluation regarding morphological indexes from those cells is done and finally classification for the presence of the leukemia is done. This also includes 2D PCA for the feature extraction along with separation of nucleus and cytoplasm and other cellular features.**

**Keywords:-**

**Acute Lymphoblastic Leukemia(ALL); Acute Myloid Leukemia(AML); Local Pixel Grouping(LPG); Principal Component Analysis(PCA); Otsu's Thresholding; Lymphoblast, Leucocytes**

 

## I. INTRODUCTION

Microscopic cell images are prone to have errors due to lack of efficiency, difficulties in cell nature and problems related to preparation of staining of blood cell slides[1].Leukemia is a kind of blood cancer that involves white blood cells. It also known as a bone marrow disorder which is diagnosed when replication of abnormal white blood cell continuously begins [1]. Acute leukemia spreads rapidly and due to this most of the cells that are not yet fully developed or differentiated[2] are affected. Acute Lymphoblastic Leukemia (ALL) is most common in children.

Image processing and segmentation are very important sectors in terms of detecting feature from blood cell images. Manual detection and counting of abnormal blast cells is necessity now days. Acute Myloid Leukemia (AML) can occur in children and youngsters but mainly affects adults but. In 2009, it is expected that approximately 31,490 individuals will have leukemia and 44,510 individuals will die due to this in the United States [3]. The premature and hasty identification of the leukemia type, greatly helps by providing the proper treatment for the particular type. Detection of this disease started with a term known as complete blood count (CBC). If there are abnormalities counting process, the patient have to perform bone marrow biopsy. Hence, for confirmation of the presence of leukemic cells, morphological bone marrow study and analysis of peripheral blood slide is done. For classification of the abnormal cells with their particular types and subtype of leukemia, observation will done and that is the nucleus or cytoplasm of the cells consists abnormalities are presented in. For prediction of the clinical behavior of the disease, this classification is very important and the diagnosis in order to determination about the treatment that should be given to the patient [5].

A typical blood microscope image is plotted in Fig. 1. The principal cells present in the peripheral blood are red blood cells(RBCs), and the white blood cells (WBCs,leucocytes). Granules are contained in Leucocyte cells called granulocytes (collected by neutrophil, basophil, eosinophil). Rest of the cells which are without granules are called a granulocytes( composed of monocyte and lymphocyte ). The percentage of range of leucocytes in human blood have following values: Eosinophils 1-5%, neutrophils 50-70%.Basophils 0-1%. monocytes 2-10%, lymphocytes 20.45% [6].

Conventionally, manual counting done under the microscope to count the white blood cells in leukemia slides. This way is bothersome and time consuming if the process of counting is interrupted, it must be started all over again. Hence, the conventional method of manual counting prone to have errors in procedure and put an insupportable amount of pressure on the medical laboratory technicians. Though there are many hardware solutions such as the Automated Hematology Counter to perform counting, certain developing countries are not capable to set up such expensive machines in all hospital laboratories in all over country [7]. Furthermore, hematologists still succeeding manual counting based on slide of blood and bone marrow samples for confirmation. So, here proposed methodology provide an alternative solution to the problem of white blood cell counting by designing an automated system to count white blood cells (WBCs)in leukemia slides.

 

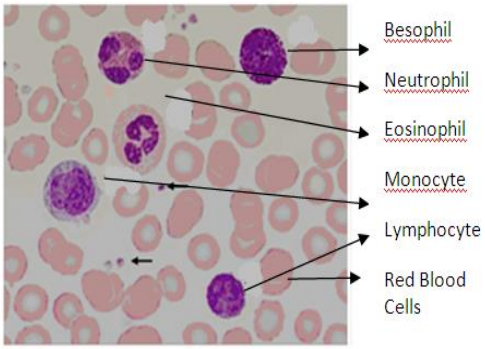


Figure1.White blood cells

## II. RELATED WORK

Some research in automating the blood cell identification procedure and next to diagnose the patient correctly has been done. Tracking the movement of representative cells in for determination of the activity of the cell when certain medical substances have been injected is discussed in paper[8]. The mathematical morphology and the median filter operation such as dilation and erosion are compliant and optimized to improve the segmentation result. The presentation of this method is comparable with several edge detection methods such as Roberts, Laplacian of Gaussian, Sobel and Prewitt.

In [9] an iterative thresholding algorithm is used for segmentation purpose specially from noisy images. This algorithm overcomes the problem of cell extraction and segmentation from heavy noisy images. This algorithm works over the adjusted threshold of images iteratively providing robustness to image.

Paper[10] discusses about the a malarial image processing system. This system detects and classifies malaria parasites in Giemsa stained blood slides images. Then after parasitaemia evaluation is done. Morphological approach to cell image segmentation is more precise than the classical watershed-based algorithm is shown in this paper. Grey scale granulometries are applied based on opening with disk-shaped elements, flat and non-flat. Non flat disk shaped structuring element enhances the roundness and the red cells compactness.

In [11] a system classify and identify malaria parasite by using microscopic images of blood cells. Morphological approach and the major necessities in developing this system is the best techniques for blood cell images segmentation.

In [12] research work on an Automated Cell Count method is described. A precise method of segmentation for counting white blood cells automatically is presented here. First a simple thresholding approach is applied and the algorithm is derived about blood smear images from priori information. The labels are adjusted then in order to produce meaningful results. This approach uses of knowledge of the blood cell structure. This method is more influential as compared to traditional methods which uses information of local context. It can perform accurate segmentation of white blood cells though they have unsharp boundaries.

In [13] using a filter bank of a' trous wavelet filters, curvelet transform implements curvelet subbands and uses a ridgelet transform as a component step, and idea throughout is that transforms should be over complete, more willingly than critically sampled. In this digital transforms are applied for de-noising of some standard images rooted in white noise.

 

A combination of geometric distance and an enhanced distance transform combining intensity gradients is used for the watershed step in [14].An explicit mathematical model for characteristics of cell nuclei like size and shape measures is included. For each detected nucleus, a confidence score is computed by measuring suitability of nucleus in the model.

Paper [15] shows the usefulness of an automatic morphological method to recognize the Acute Lymphocytic Leukemia(ALL) with the help of images of peripheral blood microscope. The presented methodology individuates the leucocytes from the others blood cells, after that it selects the lymphocyte cells (the cells causes acute leukemia), morphological indexes from those cells are evaluated then after and at last classification is performed whether the presence of the leukemia is there or not.

[16] built a system to detect leukemia cells of images of bone marrow. Using Support Vector Machine (SVM)classifier and blood cell images features that are related to geometry ,texture, and statistical analysis, the system was built. The pressure is on selection and generation of features for getting out the best recognition. Textural parameters such as entropy, contrast ,mean value and angular second momentum have been used .Geometrical parameters are compactness, perimeter, concavity points and symmetry radius, area and filled area. For statistical analysis parameters are mean value and for nucleus standard deviation and for gradient matrix cytoplasm, mean and standard deviation are considered . Kurtosis and Skewness for image and gradient matrix.

Training data error is 11.87%, errors of testing data is21.13%. 30 best features are selected and this produce error rate of training data upto 13.07% and errors of testing data to 18.71%.

For image de-noising [17] uses a wavelet-based multiscale linear minimum mean square-error estimation (LMMSE) scheme and the way to determine the optimal wavelet basis with respect to the proposed scheme is also specified. The over complete wavelet expansion (OWE) which is better as compared to orthogonal wavelet transform (OWT) in noise reduction is also included in this methodology. To walk around the strong interscale dependencies of OWE, the pixels at the same spatial location are combined and supposed to be a vector and LMMSE is applied to the vector.

Preprocessing of kidney disease detection is done by extracting kidney region. Abdominal X-Ray CT images are used. Q-learning is used within the kidney shape edge and rough kidney region is identified. However, there are a little error margins with an actual shape which is corrected by snake method. The success prospect is quite low that is53%.

[19] Use Reinforcement Learning(RL) approach to segment prostate and Q-learning ultrasound images. Applying reinforcement learning in medical segmentation shows high potential. The method controls the local threshold using a RL agent.

A method based on software is cost effective and an efficient for recognizing and analyzing blood cell is used in paper[20].In this performance evaluation is done at last by analyzing manual counting verses interactive counting on both WBC and RBC. Results shows that interactive method reduces error rate from 0.054% to 0.009%.

In paper[21] for the leukocyte segmentation an iterative Otsu's approach is used which is based on circular histogram.

In [22] the shape-adaptive discrete cosine transform (SA-DCT) transform is uses with the Anisotropic Local Polynomial Approximation-Intersection of Confidence Intervals technique is used. The attenuated and thresholded SA-DCT coefficients are used for reconstruction of a local estimate of the signal included in the adaptive-shape support.

 

Another RL application is used by [23]. CT images of lung are used to classify lung nodules either malignant or benign. 3D geometric nodules characteristics are also used for classification. The obtained results are very hopeful and prove that the RL classifier is very effective in order to classify the malignant or benign nodules that are based on CT images.

[25]use EM-Algorithm to identify types of leukocyte. First, using principal component analysis ,the image pattern is changes into a lower dimensional space. To obtain the Gaussian functions parameters to model the each class probability distribution function of cells, EM-algorithm is used. Classification of the images are done by using Bayes' theorem and finally by choosing the class with the highest probability.

[26] have detected ALL by using fractal features i.e. hausdorff dimension for lymphocytic cell classification into normal lymphocyte(Lymphoblast).

Fuzzy based segmentation technique is used to extract WBC nucleus from blood microscope images using color based clustering. At last, they use SVM for classification. The accuracy of this classification was observed to be 93%.

Methodology for analyzing morphology of the abnormal leukocytes images is presented in [27].In this using data mining techniques subtypes of acute leukemia are classified. First phase includes extraction of leukocytes, cytoplasms and nucleus from bone marrow images using color and texture information. Second phase consists of feature extraction to Segmented region in order to classify subtypes of leukemia.92% accuracy is achieved overall.

[29] use global contrast stretching for purpose of enhancement of images. Because of this, the visual aspect of blast cells may be increased and segmentation based on HSI color space is done.

[30]use Q-learning method to segment Computed Tomography (CT) images. Cranial CT images used. It is found that segmentation can be done at the same time of an image into some discrete regions. The images are subdivided into several images. An action will be chosen by Reinforcement Learning (RL) agent for sub images to update the Q matrix. There is an evaluator that compares the results after that a reward is given to the RL agent. Segmentation accuracy that they achieve is above 95%.

An image processing technique for automatic counting the number of blasts presented in [31]. In automatic process, the segmentation technique for white blood cell (WBC) is based on HSV (Hue, Saturation and Value) color space will be used in order to eliminate the white blood cells (WBC) from the background. A simple morphological operator such as erosion is used for the overlapping cells. Results show that the proposed system has provided the highest average accuracy of 97.8% for counting both ALL and AML cases.

[32] discusses an automated method to detect Acute Leukemia blast cells from human microscopic blood images. It comprises four basic modules ,1]de-noising module performs two staged noise reduction by 2D PCA and LPG.2]The contrast enhancement section includes color space conversion and morphological filtering based on pixel intensities.3]In threshold selection module, threshold value is determined using two methods namely, Edge Sensitive Variational Thresholding and Otsu's Thresholding.4]Blast cells are segmented based on threshold value obtained from these two methods. Morphological operations and Connected Component Analysis are used to count the number of blast cells present in the images.

 

## III. APPLICATIONS

The development of a fully automated screening system prototype for blood cell segmentation and classification may provide the specialist with significant aid in the effort to detect and classify Leukemia cells more effectively and efficiently. This system will be also used for early prevention of acute leukemia.

## IV. EVALUATION AND DISCUSSION

Analysis drawn from comparative study of each of the algorithm is shown in following table.

TABLE 1.

| Sr.No | Methods | Advantages | Drawbacks |
|---|---|---|---|
| Enhancement, Segmentation and Classification:- | | | |
| [15] | 1]FAB Classification.<br>2]Sobel Image Enhancing.<br>3]Canny Image Detection<br>Structured Image Dilation and Hole Feeling. | 1]Optimal Classification<br>2]Improve accuracy. | 1]Lack of image segmentation. |
| [14] | 1]Marker controlled watershed segmentation | 1]83.2% overall accuracy | 1]Lack of better accuracy for best image quality |
| [16] | 1]support vector machine (SVM)<br>2]Naïve Bays Classification | 1]Exploits the features of the image of the blood cells related to the texture, geometry and histograms | 1]Focuses on the features generation and selection only |
| [25] | 1]Guassian mixture using the EM algorithm.<br>2]Posteriori decision rule. | 1]Accuracy over manual counting(near about 80 times more cells are contened)<br>2]Precise method for normal blood samples. | 1]Not for pathological images. |
| [27] | 1]Image grabbing<br>2]Fuzzy C clustering<br>3]Sub imaging<br>4]Color Conversion RGB to L*a*b | 1]Accuracy<br>2]Measuring nucleus boundaries along with shape, color and texture. | 1]Classification of lymphoblast using into subtypes. |
| [23] | 1]Reinforcement Learning | 1] Accuracy above 93%. | 1]Maintaining quality along with learning is quite difficult. |

 

| | | | |
|---|---|---|---|
| De-noising:- | | | |
| [17] | 1]Linear minimum mean square-error estimation (L MMSE) scheme<br>2]Over complete wavelet expansion (OWE). | 1]Classification of the wavelet coefficients into different clusters by context modeling, which exploits the wavelet intrascale dependency and yields a local discrimination of images. | 1]The performance of the proposed scheme is dependent on the selection of the wavelet bases.<br>2]Proposed scheme outperforms some existing de-noising methods. |
| [13] | 1]Ridgelet transform and the curvelet transform which implements curvelet subbands using a filter bank of a` trous wavelet filters. | 1]Offer exact reconstruction, stability ease of implementation, and low computational complexity.<br>2]Higher perceptual quality than wavelet-based reconstructions, offering visually sharper images and, in particular, higher quality recovery of edges and of faint linear and curvilinear features. | 1]Outperformance of wavelet methods in certain image reconstruction problems. |
| [22] | 1]The shape-adaptive discrete cosine transform (SA-DCT) transform.<br>2]Anisotropic Local Polynomial Approximation-Intersection of Confidence Intervals technique. | 1]Simulation experiments show a state-of-the-art quality of the final estimate, both in terms of objective criteria and visual appearance.<br>2]The adaptive support, reconstructed edges are clean. | 1]Cant able to preserve local structures of edges so well |
| [28] | 1]PCA Transform<br>2]Local Pixel Grouping | 1]Improvement vast performance in image de-noising.<br>2]Local structures preservation | 1]Time consuming process |

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