A Novel Approach to Detect Acute Myelogenous Leukemia in Blood Microscopic Images

Yogesh Ambadas Gajul[1] Mrs. R.J. Shelke[2]
[1,2]Department of Electronics Engineering
[1,2]Walchand Institute of Technology, Solapur

Abstract— Acute myelogenous leukemia (AML) is a subtype of acute leukemia which is a type of cancer where the blood cells and bone marrow get affected. This type of cancer is mostly observed among adults with an average age of 65 years. The present method for the detection of acute myelogenous leukemia (AML) is not efficient, as this method needs manual observation of blood smear under the microscope which depends on observer's fatigueness, which is not good for patient. This paper presents a simple method that automatically detects AML cells in the blood smear. The proposed approach mainly comprises of four stages, viz. pre-processing stage, segmentation stage, feature extraction stage and classifier stage respectively.

Key words: Blood Microscopic Images, Acute Myelogenous Leukemia

I. INTRODUCTION

Many diseases can be found out by examining the blood cells. The blood cell gives lot of information by which we can identify the type of disease caused to a particular person. These blood cells are diagnosed under the microscope. The microscopic images of the blood cells are analyzed by the expert doctors and depending on that analysis and observation conclusion is made. Also the changes in the blood condition can show the development of disease in an individual person.

Blood contains many cells such as WBC (leukocytes), RBC (erythrocytes) and platelets. Leukemia is detected only by observing the WBC's. So, our project is focused only on WBC's. Leukemia is categorized into chronic leukemia and acute leukemia. These are further classified into four types, viz. Acute Lymphocytic Leukemia (ALL), Acute Myeloid Leukemia, Chronic Lymphocytic Leukemia (CLL) and Chronic Myeloid Leukemia (CML). In this paper we develop an algorithm that will automatically classify the Acute Myelogenous Leukemia. AML is a fast growing cancer of the blood and bone marrow. In this the bone marrow produces many unformed cells called blasts. Blasts are developed mostly in the white blood cells that are used as a defense mechanism in the body. However, the blasts are not fully formed in the blast due to this it cannot fight completely with the infections. Acute Myelogenous Leukemia is difficult to diagnose because the main cause of AML is still not known. Most of the symptoms and signs of AML are caused by the replacement of normal blood cell with the leukemia cells. Susceptibility to infections is caused due to lack in the production of normal white blood cells. Decrease in red blood cell count can cause fatigue, platelets, and shortness of breath. Similarly, lack of platelets may lead to bleeding with minor trauma.

Many times there is confusion during diagnosis due to the similarities in the signs of other disorders. In recent years cells are analyzed accurately because of the improvement in the field of digital imaging. But still the required information cannot be properly extracted from WBC due to many complications. The proposed system will help to detect the AML cells in the blood smear automatically. Section II gives a brief idea about the work that has been carried out previously. Section III will explain the overview of the proposed work.

II. PREVIOUS WORK

In last few years many researchers are putting their efforts to classify AML cells from the blood smear. S.Serbouti proposed the use of classification and regression trees (CART) statistical software for the classification of malignancies using the cell markers that are extracted from the images, but he did not mention the scheme used for segmentation and feature extraction. D.J. Foran developed a prototype of distinguishing the malignancies. His system used two major components such as distributed telemicroscopy system and an intelligent image repository for discriminating among lymphoma and leukemia. F.Scotti proposed a method for automatic classification of ALL in gray level peripheral blood smear images. From his experiments it has been concluded that lymphoblast recognition is feasible from blood images using morphological features. But the recognition rate is low due to the use of Otsu thresholding in image segmentation and feed forward neural network for feature classification. T.Markiewicz used SVM as a classifier and exploits the features of the image of the blood cells related to texture, geometry and histograms. Myeloblast is recognized with this system but the work for lymphoid series is still remaining. Hazwani reported a system which automatically counts blasts for acute leukemia detection in blood microscopic images. J.Angulo used watershed transformation for lymphocyte image segmentation. After this morphological features are extracted for the classification of lymphocytes.

Madhloom included in his research some arithmetic and threshold operations for finding the white nuclei. He faced problem while selecting the thresholding method, due to which the results obtained are not satisfactory. Kovalev came up with the system that classifies five types of leukocytes from the images of blood smear. But he classified the system only for sub images. Rangayyan explains about the unsupervised segmentation algorithm for the separation of white blood cells. Nallaperumal[11] presented a watershed segmentation algorithm for the separation of the nucleus from the surrounding cytoplasm.

After studying all the systems we can conclude that these systems are designed only for sub images. So, there is a need to develop a system that will work on whole image. In the proposed system classification is done on the entire image. Linear Support Vector Machine is used for the classification and finally the results will be compared with the existing system.

III. PROCESS OVERVIEW

Figure 1. depicts the overview of the system. It shows the sequence of steps that are to be followed for the efficient classification of Acute Myelogenous Leukemia. The system has four main stages viz. pre-processing stage, segmentation stage, feature extraction stage and classification stage. In pre-processing stage the unwanted noise content present in the image is removed. Also the RGB image is converted into L*a*b color space image. Pre-processing stage is followed by the segmentation stage which uses k-means clustering. After that features are extracted in feature extraction stage which majorly uses LBP and HD. This is followed by the classification stage which uses SVM. Finally validation is performed.

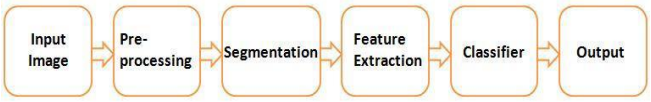

Fig. 1: Overview of system.

A. *Input Acquisition:*

American Society of Hematology (ASH) is a web based library which provides images of high quality that contains collection of AML images. These obtained images are in RGB color format.

B. *Pre-Processing:*

An input image has some unwanted noise present in it. Also there is lot of variations in image background with respect to color and intensity. These types of variations are caused due to many reasons such as camera settings, varying enlightenment and aging blemish. To overcome such kind of problems, input RGB image is converted to CIELAB/ L*a*b* color space. The L represents the lightness of the color, element a* that represents its position between red/magenta, and element b* that represents its position between yellow and blue. To make accurate color balance in the image, elements 'a' and 'b' are used.

C. *Segmentation:*

The main aim of the segmentation is to extract useful information from the image. Many researchers have implemented different segmentation methods. In this proposed system k-means clustering is used. Clustering is a way to separate groups of objects. K-means clustering treats each object as having a location in space. It finds partitions such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible. Here, the cluster corresponds to the nucleus, background and other cells. Then using the property of cluster center each pixel is assigned to one of these classes. After the segmentation is performed for preserving the nuclei of whole image, morphological operations are to be performed.

D. *Feature Extraction:*

Transforming the input data into set of features is called feature extraction. The performance of the classifier depends totally on the features that are extracted, so a correct choice of features needs to be extracted. Following features are considered.

1) Hausdorff Dimension (HD): Edges of nucleus are considered as an essential feature, so HD is used. The fractal dimension D shows how completely the space is filled by the fractals. Box-counting technique is used to detect the edge of nucleus as it is easier to implement and most widely used.
2) Local Binary Pattern (LBP): The LBP is used for the classification of texture. It has following advantages, 1) they are robust over illumination variation, 2) they can compute at a faster rate, 3) they work with minimum parameters, 4) they have a local feature, 5) they do not vary for monotonic gray scale transformations and scaling.
3) Shape Features: According to the hematologists, the important feature for classification is the shape of nucleus. The region and boundary based shape features are extracted in order to analyze the shape of the nucleus.
4) GLCM Features: One of the image analysis techniques is the GLCM feature. Using this method different texture features are extracted such as entropy, contrast, correlation and energy.
5) Color Feature: An important feature that human perceive while visualizing is color. This feature is considered for extraction from nucleus region. Hence, for each nucleus image the mean color value in RGB color space is obtained.

E. *Classification:*

This stage is considered to be very important because it decides the accuracy of the system. So, the selection of method used for classification plays an important role. The proposed methodology uses linear support vector machine (SVM) for classifying abnormal and normal cells. After the classification, a cross-validation is used for analyzing and comparing the learning algorithm.

IV. CONCLUSION

The proposed work will report an algorithm which will design, develop, and evaluate an automated screening system for AML in blood microscopic images. It uses high-quality images obtained from the American Society of Hematology [13]. The presented system will perform automated processing, including color correlation, segmentation of the nucleated cells, and effective validation and classification. A feature set exploiting the shape, color, and texture parameters of a cell will be constructed to obtain all the information required to perform efficient classification. The LBP operator and HD will also be used for this analysis. Furthermore, a color feature called cell energy will be used, and this feature may present a good demarcation between cancer and noncancer cells. The results are then compared with the results of the existing system.

REFERENCES

[1] S.Agaian, Monica Madhukar and A. T. Chronopoulos.(2014),"Automated Screening System for Acute Myelogenous Leukemia Detection in Blood Microscopic Images ", IEEE System Journal, 2014.
[2] A.Nasir, M. Mashor, and H. Rosline. (2011), "Unsupervised colour segmentation of white blood cell for Acute leukaemia images," in Proc. IEEE IST, pp. 142–145.

[3] B. Nilsson and A. Heyden.(2002), "Model-based segmentation of leukocytes clusters," in Proc. Int. Conf. Pattern Recognit., vol. 1, pp. 727–730.
[4] C. Haworth, A. Hepplestone, P. Jones, R. Campbell, D. Evans, and M. Palmer.(1981), "Routine bone marrow examination in the management of acute lymphoblastic leukaemia of childhood," J. Clin.Pathol., vol. 34, no. 5, pp. 483–485.
[5] E. Wharton, K. Panetta, and S. Agaian.(2008), "Logarithmic edge detection with applications," J. Comput., vol. 3, no. 9, pp. 11–19.
[6] F. Sadeghian, Z. Seman, A. Ramli, B. Kahar, and M. Saripan. (2009), "A frame work for white blood cell segmentation in microscopic blood images using digital image processing," Biol. Procedures Online, vol. 11, no. 1, pp. 196–206.
[7] F.Scotti.(2005),"Automatic morphological analysis for acute leukemia identification in peripheral blood microscope images," in Proc. CIMSA, pp. 96–101.
[8] F. Scotti. (2006), "Robust segmentation and measurement techniques of white cells in blood microscope images," in Proc. IEEE Conf. Instrum.Meas.Technol., pp. 43–48.
[9] G. Ongun, U. Halici, K. Leblebicioglu. (2001), V. Atalay, M. Beksac, and S.Beksac, "Feature extraction and classification of blood cells for an automated differential blood count system," in Proc. IJCNN, vol. 4, pp. 2461–2466.
[10] J. Hu, J. Deng, and M. Sui.(2009), "Color space conversion model from CMYKto LAB based on prism," in Proc. IEEE GRC, pp. 235–238.
[11] K. Nallaperumal and K. Krishnaveni.(2008), "Watershed segmentation of cervical images using multiscale morphological gradient and HSI color space," Int. J. Imaging Sci. Eng., vol. 2, no. 2, pp. 212–216.
[12] MedlinePlus: Leukemia National Institutes of Health. [Online]. Available: http://www.nlm.nih.gov/medlineplus/ency/article/001299.htm.
[13] American Society of Hematology [Online]: http://www.hematology.org

