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Comparative Study for Detection of Chronic Leukemia

Neha Sharma[1], Dr.Supreet Kaur[2]

M.Tech Student, Dept. of CSE, Punjabi University Regional Centre for Information Technology and Management, Mohali, Punjab, India[1]

Assistant Professor, Dept. of CSE, Punjabi University Regional Centre for Information Technology and Management, Mohali, Punjab, India[2]

ABSTRACT: Leukemia is a type of blood cancer. It occurs when excess of WBC's are produced by the bone marrow and they disrupts the normal WBC's. For the detection of leukemia it is necessary to do the proper study of blood cells. The process of blood examination by haematologist is time consuming. It is difficult to get consistent result from visual inspection. If the leukemia is not treated at early stage it can lead to death. This paper describes the various image processing methods used for detection of leukemia. The Steps for automated detection of leukemia consists of Image acquisition, preprocessing of the image, segmentation of the image, feature extraction from segmented image and last step is classification of cells into normal cell and leukemic cell. The algorithm discussed in this paper for detection are optimal thresholding, watershed algorithm, Support vector machine, K-mean clustering.

KEYWORDS: Leukemia, Chronic lymphocytic leukemia, detection, Watershed algorithm, K-mean clustering, Optimal Thresholding, SVM (Support Vector Machine), Hausdorff Dimension.

I. INTRODUCTION

Leukemia is a cancer of blood cells and starts in bone marrow. It is caused when production of immature or abnormal leukocytes increases and they replace normal blood cells. Normal Leukocytes present in our body fight against diseases but when there is increase in number of abnormal leukocytes the body is vulnerable to many diseases. Type of leukemia depends upon the type of cells which becomes leukemic.
Two types of leukemia are there i.e. Acute Leukemia and Chronic Leukemia.
1. **Acute Leukemia:-**Acute leukemia is fast growing cancer. This type of leukemia gets worse quickly. Further it is of two types:

a) Acute Lymphoblastic Leukemia
b) Acute myeloid Leukemia

2. Chronic Leukemia:-Chronic leukemia is slow growing cancer. This type of leukemia gets worse slowly. Chronic leukemia cells take more time for spreading that is why it is harder to cure.
Chronic leukemia is of two types:-

a) Chronic lymphocytic leukemia
b) Chronic myeloid leukemia

In chronic leukemia, the cells mature partly but not completely. The leukemia cells looks like normal cells but they are not. Chronic lymphocytic leukemia is hard to detect because normal and infected lymphocytes looks similar you can not differentiate in both lymphocytes. Only minor difference is there in leukemic and normal lymphocytes.

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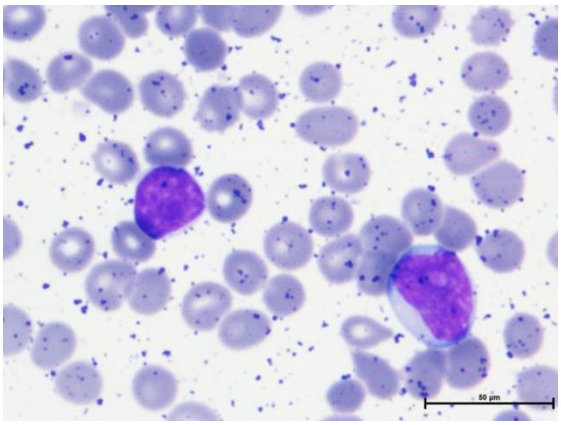

Fig. 1 Microscopic Image of Chronic Lymphocytic Leukemia

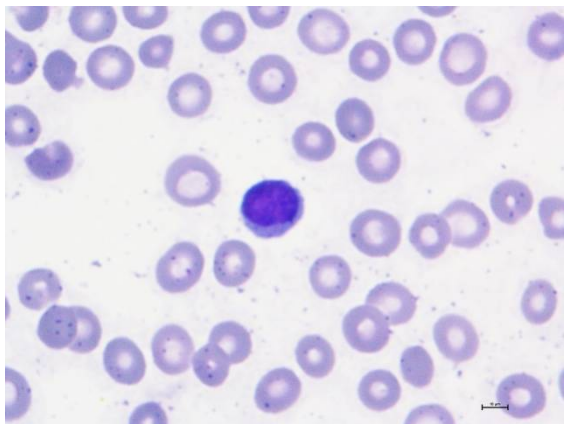

Fig. 2 Microscopic image of normal Lymphocyte

Figure 1 is the microscopic image of chronic lymphocytic leukemia and figure 2 is the microscopic image of normal lymphocytes. As we can see that there is minute difference in the normal cell and leukemic cell. So the detection of this type of leukemia is difficult task.

Automated recognition of blood samples consists of different steps. The steps are

1) Microscopic images of blood sample
2) Pre-processing of images
3) Segmentation
4) Feature extraction
5) Classifications of cells(Normal and Leukemic cell)

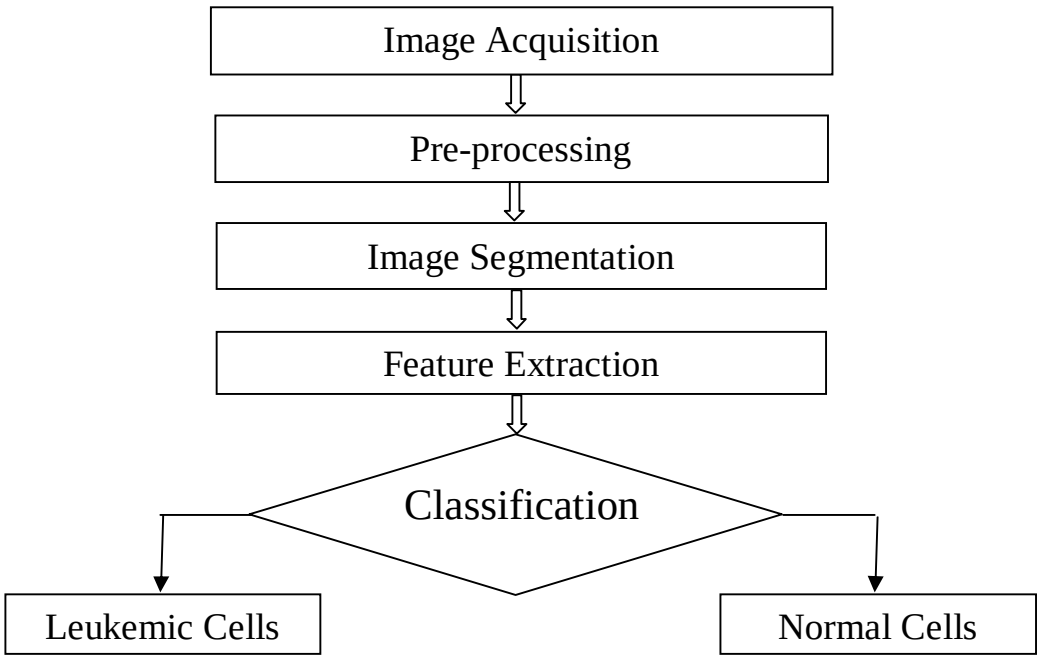

Fig. 3 Steps of automated detection of chronic leukemia

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II. RELATED WORK

In [1] authors proposed a segmentation of normal and chronic lymphocytic leukemia. They segmented the cell into two parts: nucleus and cytoplasm. The main purpose of this is to reduce the over and under segmentation error of watershed algorithm .With this effect of over and under segmentation of watershed algorithm is reduced by 1% of the local minima. The algorithm obtained 99.92% maximum accuracy for nucleus segmentation, and 99.85% maximum accuracy for cell segmentation.

In [2] authors proposed an Image processing method for the classification and recognition of leukemic cells. By using image processing method they generated features that are used to categorize different types of cell. The Different steps include: the segmentation of the bone marrow by applying the watershed algorithm, feature generation on the basis of texture, Statistical and geometrical analysis of the cells and selection of individual cells. The obtained feature is then used as an input to the support vector machine. The watershed algorithm is implemented by using MATLAB®.

Chaitali Raje and Jyoti Rangole [3] proposed an image processing method for detection of leukemia. The main purpose of this work is nucleus segmentation. They have done segmentation using different statistical parameters such as mean, standard deviation. These deviations segregates WBC's from other blood components i.e. erythrocytes and platelets .Diagnostic prediction of leukemia is done by using Geometrical features such as area, perimeter of the white blood cell nucleus. They used LabVIEW and MATLAB® for implementation.

Shailesh J.Mishra and Mrs. A.P. Deshmukh [4] proposed a method for detection of leukemia by using the microscopic images of blood cells. They perform the clear border operation to obtain edge of the leukemic cell. Then the segmentation is performed for displaying the segmented cell. They used MATLAB® for implementation.

Niranjan Chatap and Sini Shibu [5] proposed the method for analysis of blood samples for counting leukemic cells. They used various image features like texture, geometry, color etc. for analysis. Support Vector Machine and nearest neighbour concept is used in this paper. The overall accuracy with kNN classifier for leukemia detection is 93%.

In [6] authors proposed a image processing method for prediction of cancer cell in blood samples. The different steps for cancer prediction are cell segmentation, feature extraction(texture-periodical and random texture), geometrical features(radius, perimeter, area, compactness, concavity, symmetry etc.), statistical features(histogram and gradient matrices),identification and last step is classification. In classification the geometrical features, statistical features are extracted from region segmented in segmentation step and then from this the type and subtype of acute leukemia is identified. For the final classification and recognition Support vector machine is used.

R.Yogamangalam and B.Karthikeyan [7] presented different types of segmentation technique like Edge detection, Model Based, Region based, Thresholding etc. and Markov Random Field is the strongest method of noise cancellation in images whereas thresholding is the simplest and fast technique for segmentation and it varies depending upon application.

Sivakumar. S and Ramesh. S [8] proposed a technique for automatic segmentation of WBC's. The different types of WBC's is Lymphocytes, Monocytes, Eosinophill, Basophill and Neutrophill. The main purpose of this is to segment WBC's into nucleus and cytoplasm. For segmentation they used various image processing steps like noise removal from input images using median filter, convert colored image to gray scale image, for enhancement of the image histogram equalization was applied, K-Mean Clustering is used for segmentation and then different morphological operation are performed for inverting the resultant image. The proposed method is more suitable for segmentation of complex WBC's images.

In [9] authors presented a new clustering based segmentation technique that may be able to overcome some of the drawbacks of the conventional clustering methods like dead centres and trapped centres at local minima. They also discussed the conventional clustering methods like K-Mean clustering, Moving K-mean, Fuzzy C-mean and fuzzy

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Moving K-mean for segmentation. The proposed new clustering technique OKM (optimized K-mean) reduces the problem of trapped and dead canters.

Dr. T. Karthikeyan et al. [10] presented the different types of algorithms which is mostly used for detection of leukemia. The algorithm discussed is Otsu's thresholding, watershed algorithm, Support Vector Machine (SVM) and K-mean clustering. For more accuracy the thresholding algorithm and Support Vector Machine are used.

Sulaja Sanal [11] presented the various detection techniques for acute lymphocytic leukemia. The Detection of acute lymphocytic leukemia consists of different steps: Image pre-processing, WBC's identification, Nuclei extraction, Feature extraction and last step is classification.

In [12] [15] authors presented two shape features i.e. Hausdorff Dimension and contour signature for classifying a lymphocytic cell nucleus. Feature extraction can be done by using fractal geometry i.e. Hausdorff Dimension used for calculating the perimeter roughness of nucleus. The main purpose of this work is to two stages WBC's nucleus segmentation from blood smear images followed by the feature (shape, color, texture) extraction for detection of acute leukemia. Support vector Machine is used for Classification.

In [13] authors presented a method to differentiate between Acute Lymphoblastic leukemia cells and normal lymphocytes. They also presented the applications of feature extraction, selection and cell classification to the recognition of normal lymphocytes and abnormal lymphoblastic cells by using the peripheral blood smears images. The main aim of this research was to find the important features that can strongly recognize and classify the normal lymphocytes and acute lymphoblastic leukemia cells.

N. Z. Supardi et al. [14] proposed to used k-nearest neighbour to classify acute leukemia into two major forms which are acute myelogenous leukemia (AML) and acute lymphocytic leukemia (ALL).The 12 main features were extracted from acute leukemia blood images that represents size, color and shape of the blood cells. The k-nearest neighbour approach produces the good performance in classifying the AML and ALL with accuracy up to 86%.

Mashiat Fatma and Jaya Sharma [16] proposed a technique for quick and correct classification of leukemia images and classifies them into their appropriate types. For classification of leukemia they extracted the features (statistical and color based features) from input images and based upon these features they have created the new dataset and then this dataset is provided as an input to a multilayer feed forward neural network for classification of leukemia images.

In [17] authors proposed a global contrast stretching (GCS) and segmentation based on HSI (Hue, Saturation, Intensity) color space for improving the quality of the image. Image processing techniques (Global contrast stretching, segmentation based on HSI color space) produces a good segmentation performance for Acute Lymphoblastic leukemia (ALL) and acute myelogenous leukemia (AML).With same threshold value the fully segmented nucleus can be achieved.

III. CONCLUSION AND FUTURE WORK

Leukemia begins with bone marrow. Existing process for chronic leukemia detection is very time consuming. Many times they are not able to produce consistent result from visual inspection. For the detection of acute leukemia lots of research has been already done and many algorithms are used in this research.

In this paper we have discussed various leukemia detection approaches and we conclude that very less work is done on the detection of chronic lymphocytic leukemia. In future scope the detection of chronic leukemia can be done using image processing approach. Thus it will make detection process easy and the treatment of the patient can start at early stage of the leukemia.

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