A Survey on Leukemia Cells (Leukocytes) Detection Using Image Processing Techniques

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***Abstract*----Biomedical image processing is one of the most emerging techniques in the day to day life, as diseases are increased. There are millions of cells in each images, therefore human involved clinical analysis is difficult and time consuming. Image processing is advancing every time and there are a lots of techniques and ideas in this area. Image processing techniques helps to process images in any resolution and it can efficiently handle large amounts of data. Machine learning and deep learning is able to handle these data efficiently with data mining concepts. Microscopic image analysis plays a crucial role in computerized diagnosis and treatment.**

***Keywords*----K-means, Fuzzy c-means, Marker controlled Watershed Algorithm, Otsu image segmentation, K-Region based clustering.**

I. INTRODUCTION

Human blood consists of several components such as red blood cells (erythrocytes), white blood cells (leukocytes) and platelets. RBC cells is mainly used for the transportation of oxygen throughout the body. WBC cells is mainly focused on protection against foreign bodies. WBC cells classified into several types such as lymphocytes, monocytes, eosinophils, basophils and neutrophils. Platelets helps in the clotting of blood and controls bleeding.

Leukemia is a type of cancer that affects the blood cells, an abnormal increase in the count of these cells. It is a group of cancers which affects morphological features of blood cells. It is characterized by the abnormal production of white blood cells (leukocytes) by the bone marrow. The abnormal cells is getting larger in number than normal cells. Leukemia cells are known as blast cells. Symptoms include anemia, frequent infections, tiredness, weight loss etc.

Leukemia is mainly classified into two based on the rate of propagation of leukocytes. They are acute leukemia and chronic leukemia. Acute leukemia: it is the most commonly found cancer in children. It affects the immature cells in bone marrow and thus it hinders the proper functioning of mature cells and became severe very rapidly. Acute myelogenous leukemia and acute lymphocytic leukemia are the two types of acute leukemia.

Chronic leukemia: affects the mature cells and it grows slowly and it does not show that much symptoms. Chronic lymphocytic leukemia and chronic myelogenous leukemia are the two types of chronic leukemia.

Leukemia detection is clinically diagnosed by the variation in the complete blood count (CBC). It includes cytogenetic analysis which detects any abnormalities in the chromosomes.It usually takes about 3 weeks. Immunohisto chemistry is another technique in which blood cells are treated with antibodies. Microscopic analysis is usually indicated by the color change in the blood cells. Clinical diagnosis is complex, costly and time consuming.

Leukemia detection using image processing techniques includes image preprocessing, segmentation, feature extraction and classification. Segmentation and feature extraction is the main area which affects the quality, efficiency and clarity of detection. The right choice of features clearly identifies the specific characteristics. The segmentation procedure separates the affected cells from the others. The features which are extracted from its nucleus and cytoplasm decides the different types of leukemia.

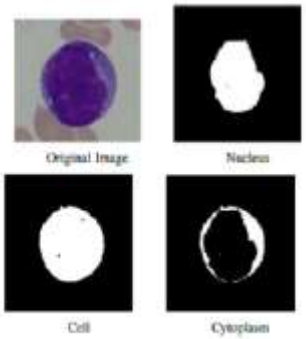

Fig. 1 Original image and segmentation parts

II. SEGMNETATION TECHNIQUES

Image segmentation is an essential part of image processing. Image is composed of several pixels and the aim of segmentation is to divide this image into pixels. Leukemia identification is done by identifying abnormal WBC cells. It involves segmentation of nucleus because nuclei of WBCs in leukemic images is abnormal.

A. Marker Controlled Watershed Algorithm

Marker controlled is an advanced version of watershed algorithm. It overcomes the problem of exactseparation of cell and nucleus. It works well in marking foreground objects and

background. The simple watershed algorithm always suffer from over segmentation problem. In order to avoid this markers are used [3].

Steps:

1. Select an image and convert it into gray scale for processing.
2. Set gradient function as segmenting function.
3. Mark foreground and background objects.
4. Calculate watershed segmentation function.

B. K-means Clustering

Segmentation of leukemic images using k-means clustering is one of the widely used clustering technique. It is simple and easy to implement [4]. It is a center based clustering technique.It divides the image into k number of sets and find the Euclidean distance between them. Then it finds the centroid by minimizing the distance between them. K-means is an unsupervised method which generates a specific number of flat disjoint clusters (globular clusters). K-means clustering is not well in handling noisy dataset.

Steps:

1. Select k number of data items from n data items and treated as centroids.

2. Do

Each data item is assigned to a cluster.

Find the Euclidean distance between them.

Determine index value of each clusters.

Choose closest centroid and calculate new mean for each cluster.

K-means clustering can be improved by considering two areas, selection of centroids and assigning data points to nearest clusters. It can improve the speed of clustering and accuracy and reduces complexity.

C. Fuzzy c-means clustering

Fuzzy c-means is an improved k-means algorithm. It is one widely used algorithm in medical image segmentation. It is sensitive to both intensity and noise heterogeneity and imaging artifacts. It does not support any information about spatial context. It is an iterative clustering method i.e. objective function is optimized iteratively.Fuzzy c-means uses a soft membership function, it supports single data to be allowed in number of clusters. Fuzzy c-means is also known as fuzzy k-means.

D. Otsu image segmentation

Otsu image segmentation is an automatic thresholding method calculated on selected region. It divides images into regions based on discontinuity and similarity. It works on both noisy images and others. It is a best method to handle real world images. The major drawback of thresholding method is the lack of sensitivity and specificity. Segmentation gets worse in multimodal histograms with no well-defined boundaries. Otsu segmentation can be applied on 1D and 2D images. It has an accuracy of 95% [1].

Otsu image thresholding along with MSER (Maximally Stable Extremely Regions) technique is used for pattern matching. It is a powerful feature extraction technique. It helps to extract global and grid features. It has limitations to process blurred or texture images.

E. K-Region based clustering

K-Region based clustering is a method which combines region based and cluster based techniques. It overcomes the problems occurred in both algorithm. Image of size N is divided into k different regions, where k and N are multiples of 2. Then clustering technique is applied in each region. Adjacent regions may have clusters with similar values and such clusters are merged to form large clusters. It can applied on any type of clusters, increases power and accuracy. The main purpose of K-Region based clustering is to increase homogeneity in a particular group and heterogeneity between different clusters [2].

Steps:

1. Select an image with size N x N.
2. Image is divided into K number of regions where K< N.
3. Apply clustering in each region.
4. Clusters are merged to form large clusters.

III. CONCLUSION

The basic goal of image processing technique is to increase the accuracy and speed in diagnosing leukemia than the traditional clinical systems. Segmentation is an important step in image processing as it helps in finding the exact portion of image. Leukemia diagnosis includes the analysis of WBCs, so other components are eliminated from the image are the key role of segmentation algorithms.Then it analyze the nucleus of WBCs and extracting and comparing the morphological and texture features to get the result. Detection of leukemia, its types and subtypes can be done efficiently by exploring more and more segmentation algorithms.

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