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Microscopic Image Segmentation Using Fuzzy C Means For Leukemia Diagnosis

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ABSTRACT: Leukemias are cancers of the blood-forming tissues. White blood cells may be produced in excessive amounts and are unable to work properly which weakens the immune system. Careful microscopic examination of blood smear or bone marrow aspirate is the only way to effective diagnosis of leukemia. The need for automation of leukemia detection arises since the above specific tests are time consuming and costly. Morphological analysis of blood slides are influenced by factors such as hematologists experience and tiredness, resulting in non standardized reports. A low cost and efficient solution is to use image analysis for quantitative examination of stained blood microscopic images for leukemia detection. In this paper, Fuzzy c means is compared with k means for image segmentation, in which Fuzzy c means gives higher accuracy than k means, Gabor Texture Extraction method is used to extract color features from images and finally extracted features are used for classification. Fuzzy c means gives 90% accuracy whereas k means gives 83% accuracy. Support Vector Machine is used for classification. The whole work has been developed using MATLAB 7 environment.

KEYWORDS: Leukemia, microscopic images, k means, Fuzzy c means, Gabor texture extraction, SVM

I.INTRODUCTION

Leukemia is a type of cancer that affects the bone marrow causing increased production of white blood cells which influx the blood stream [1]. Leukemias are cancers of the blood-forming tissues. White blood cells may be produced in excessive amounts and are unable to work properly which weakens the immune system. The blood is made up of fluid called plasma and three types of cells and each type has special functions. Leukocytes which play a major role in diagonosis of different diseases [13]. White blood cells help the body fight infections and other diseases. Red blood cells carry oxygen from the lungs to the body's tissues and take carbon dioxide from the tissues back to the lungs. The red blood cells give blood its color. Platelets help form blood clots that control bleeding. Blood cells are formed in the bone marrow, the soft, spongy center of bones. New blood cells are called blasts. Some blasts stay in the marrow to mature. Some travel to other parts of the body to mature. Normally, blood cells are produced in an orderly, controlled way, as the body needs them. This process helps keep us healthy. In a leukemic person, the bone marrow produces abnormal white blood cells that are called leukemic cells and leukemic blast cells [19]. When leukemia develops, the body produces large numbers of abnormal blood cells. In most types of leukemia, the abnormal cells are white blood cells. The leukemia cells usually look different from normal blood cells, and they do not function properly.

A.TYPES OF LEUKEMIA

There are several types of leukemia. They are grouped in two ways. One way is by how quickly the disease develops and gets worse. The other way is by the type of blood cell that is affected. Leukemia is either acute or chronic. In acute leukemia, the abnormal blood cells remain very immature and cannot carry out their normal functions. The number of blasts increases rapidly, and the disease gets worse quickly. In chronic leukemia, some blast cells are present, but in general, these cells are more mature and can carry out some of their normal functions. Also, the number of blasts increases less rapidly than in acute leukemia. As a result, chronic leukemia gets worse gradually.

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Leukemia can arise in either of the two main types of white blood cells — lymphoid cells or myeloid cells. When leukemia affects lymphoid cells, it is called lymphocytic leukemia. When myeloid cells are affected, the disease is called myeloid or myelogenous leukemia.

The disease appears in one of four major forms [19]:

- **Acute lymphocytic leukemia** (ALL) is the most common type of leukemia in young children. This disease also affects adults, especially above 65 years and older.
- **Acute myeloid leukemia** (AML) occurs in both adults and children. This type of leukemia is sometimes called acute nonlymphocytic leukemia (ANLL) .
- **Chronic lymphocytic leukemia** (CLL) most often affects adults over the age of 55. It sometimes occurs in younger adults, but it almost never affects children.
- **Chronic myeloid leukemia** (CML) occurs mainly in adults. A very small number of children also develop this disease.

Leukemia can develop at any point in cell differentiation. The illustration below shows the development of the formed elements of the blood.

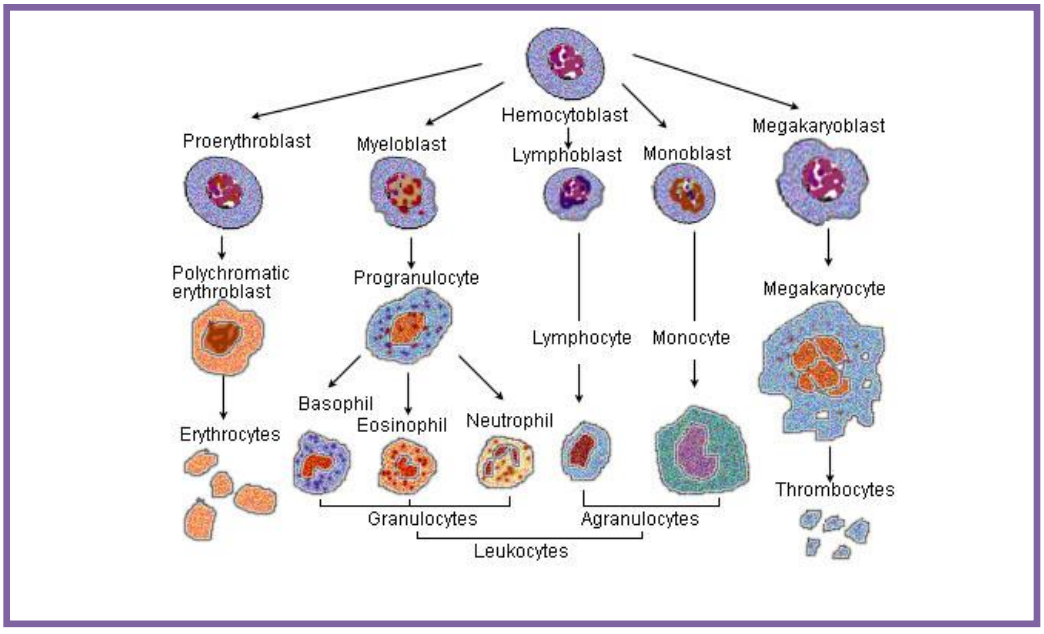

Fig 1: development of the formed elements of the blood

B. MAIN COMPONENTS OF IMAGE PROCESSING

Step1: Image Acquisition - capturing images.
Step 2. Image Enhancement - improvement of quality of images.
Step 3. Image Representation - image can be represented mathematically, graphically, and statistically.
Step 4. Image Transformation - transform the input image from one domain into another e.g an image in spatial domain can be converted into frequency domain by using Fourier transform.
Step 5. Image Restoration - analysis and modeling of different types of noise mixed in images.
Step 6. Color image processing - Various color spaces and formats are converted in it.
Step 7. Image compression - reduce the size of image or reduce redundancy without any significant change in the inherent content of the image.

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Step 8. Morphological image processing - these operations are generally used with image segmentation.
Step 9. Image segmentation, representation and description - the selected region of interests can be extracted and various boundaries, edges and other similar information could be obtained.
Step 10. Object recognition - the pattern recognition and matching [1]

II.LITERATURE REVIEW

S.Jagadeesh *et.al* proposed segmentation of bone marrow image aspirate using watershed algorithm[16]. T. Markiewicz *et.al* use Support Vector Machine (SVM) classifier[17] and exploit features in blood cell images to classify leukemic cells[3]. Khot S.T *et.al* used Support Vector Machine classifier to detect leukemic cells.[4]. Niranjan Chatap., *et.al* proposed Support Vector Machine and kNN for detecting leukemic cells[5]. Ms. Minal D. Joshi *et.al* proposed a method to detect acute leukemia. By histogram equalization method ,[7] enhance contrast of the grayscale image. K means is used for blood smear image segmentation and features are extracted and extracted features are applied to SVM classifier [13].

III.STEPS FOR PROPOSED METHODOLOGY

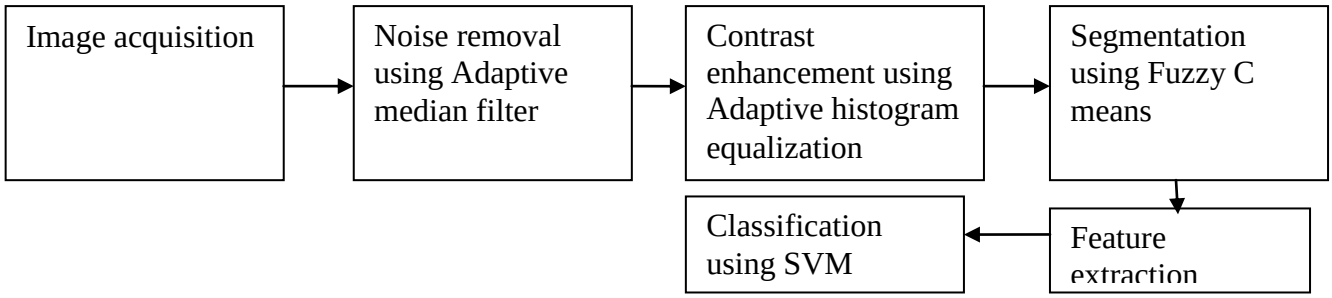

Fig 2: Proposed Framework for detecting leukemia cells.

A. Image Acquisition:

For detecting Leukemia, microscopic images are acquired. These images are taken from net. This stage includes image pre processing

B. Image Pre processing:

Noise is the undesirable effects produced in the image. During image acquisition or transmission, several factors are responsible for introducing noise in the image. This stage includes noise removal and contrast enhancement of image. Adaptive median Filter is used for noise removal and Adaptive Histogram Equalization is used for contrast enhancement.

C. Image segmentation:

The next stage deals with image segmentation. Segmentation partitions an input image into its constituent parts or objects[1]. On one hand rugged segmentation procedure brings the process a long way towards successful solution of an imaging problem. Goal of image segmentation is to extract information from input image [13].In this paper, segmentation is done using Fuzzy c means clustering algorithm.

Image Segmentation stage aims to separate and detect white blood cells (WBC) and red blood cell (RBC). The first stage of image segmentation is to detect WBC. Image segmentation is the process of dividing the image into parts. The process of segmentation involves the severance of areas that hold similar characteristics. In the field of image processing, color plays two important roles. First, color can easily be used for simplifying the process of object identification and object extraction from a scene. Second, human can recognize thousands of color shades and intensities. Two algorithms are compared in this paper such as k means and Fuzzy c means clustering algorithm.

K means clustering:

It is a partitioning algorithm and it use an optimization function to partition the cells into successive clusters [2]. k-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The main idea is to define k centers, one for each cluster. These centers should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other [17]. The next step is to take each point belonging to a given data set and associate it to the nearest

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center. When no point is pending, the first step is completed and an early group age is done. At this point re-calculate k new centroids as barycenter of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new center. A loop has been generated. As a result of this loop we may notice that the k centers change their location step by step until no more changes are done or in other words centers do not move any more

Fuzzy C means for image segmentation:

FCM generalizes the hard c-means algorithm to allow a point to partially belong to multiple clusters. It produces a soft partition for a given dataset [8]. The FCM clustering algorithm is a soft segmentation method that has been widely used for microscopic image segmentation. FCM clustering approach could retain information from the original image than hard segmentation methods known as K-Means clustering. The clustering methods are considerable benefits especially for images which contain huge sets of pixel data.

In particular, the FCM algorithm, assign pixels to fuzzy clusters without labels. Unlike the K-Means clustering which force pixels to belong exclusively to one class, Fuzzy C-means allows pixels to belong to more than one cluster based on degrees of membership. Thus, points on the edge of a cluster may be in the cluster to a lesser degree than points in the centre of cluster. However, its main drawbacks include its computational complexity and the fact that the performance degrades significantly with increased noise.FCM is a clustering method which allows single data belong to more than one clusters.

D. Feature Extraction:

To detect leukemia, features like geometrical, texture, color, and statistical are extracted from segmented image. Gabor texture extraction method is used. In color feature, RGB color spaces will be transformed.

E. Image Classification:

Classification of cells is more important in medical image. Based on classification results we can identify whether the human is affected with leukemia or not. It is an optimization theory based classifier that finds a maximal margin surface, which separates the data into distinct classes [2]. Another name for SVM is Kernel Machines (as nonlinear SVM uses Kernel mapping). Kernel method is a popular technique to transform nonlinearly separable data to linearly separable form. Proposed framework 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. Classifier is trained with features of sample images. When the features of input image are fed into classifier, the classifier classifies output.

IV.RESULTS AND DISCUSSION

The proposed technique is applied to 19 images of blood smear. Images are taken from Google. The images are in JPG format.The results obtained are shown below. In the result, input image is added with salt and pepper noise. And noisy image is preprocessed for noise removal. Then image is used for contrast enhancement. Then the image is segmented by k means and Fuzzy c means and both are compared. Then next color and shape features are extracted from segmented image. Then classification is done.

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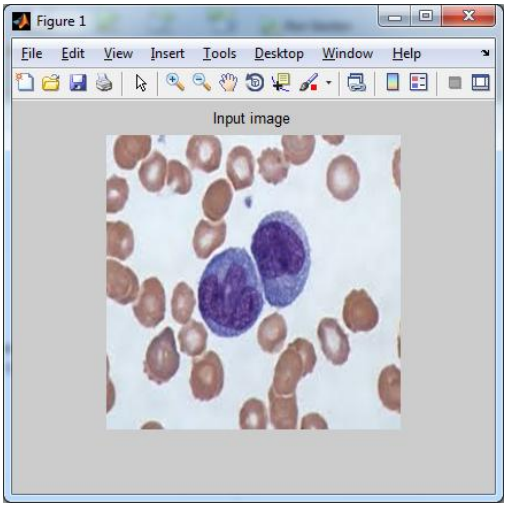

Fig 1:Input image

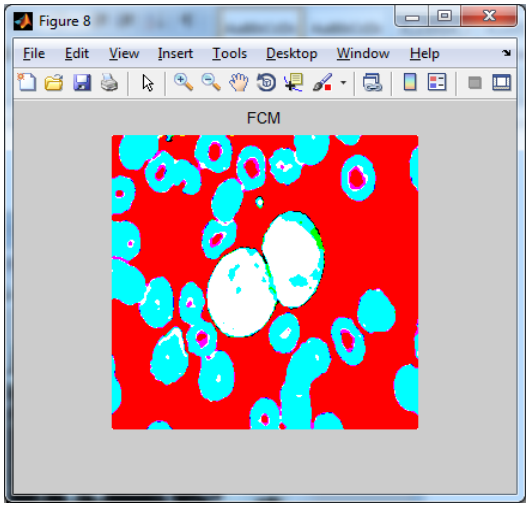

Fig 2: Fuzzy c means segmentation

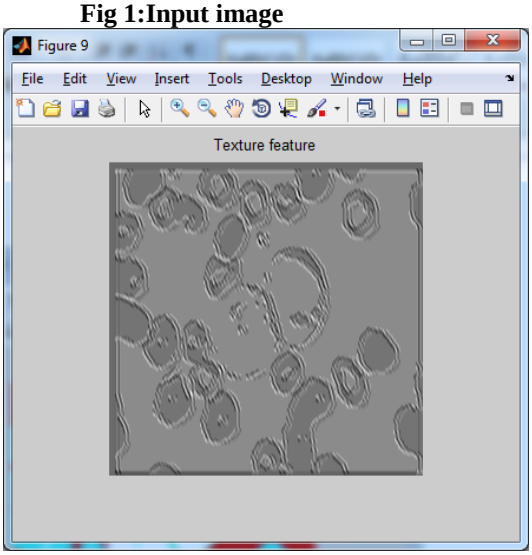

Fig 11: Feature extracted image

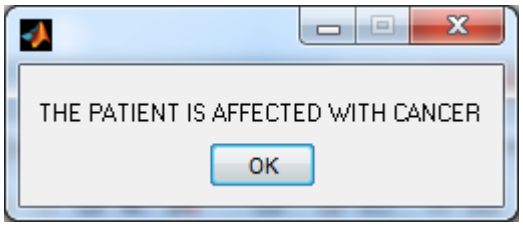

Fig 12: Leukemia Classification

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PERFORMANCE CHART:

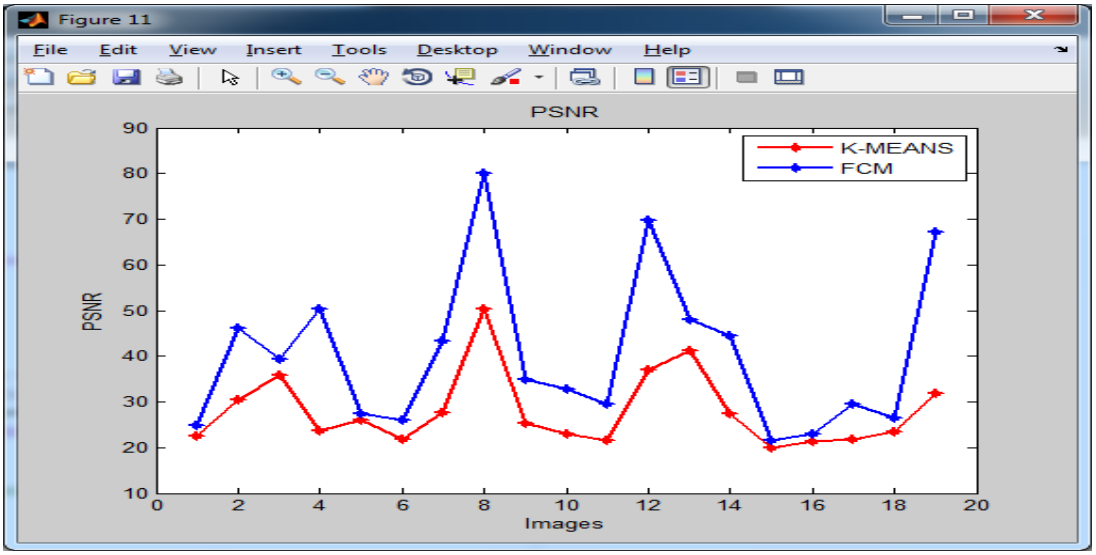

Fig 13: Performance chart for k means and fuzzy c means

V.CONCLUSION

Leukemia is a severe disease which affects blood cells of bone marrow. It leads death if left untreated. A low cost and efficient solution is to use image analysis for quantitative examination of stained blood microscopic images for leukemia detection. In this paper, Fuzzy c means is compared with k means for image segmentation, in which Fuzzy c means gives higher accuracy than k means, Gabor Texture Extraction method is used to extract color features from images and finally extracted features are used for classification. Fuzzy c means gives 90% accuracy whereas k means gives 83% accuracy. Based on segmentation result, color and shape features are extracted. Then the extracted values are fed into SVM classifier. Finally the classifier classifies the segmented image based on its features and produces the results.

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