

# Comparison of Feedforward Network and Radial Basis Function to Detect Leukemia

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## ABSTRACT

Leukemia is a fast growing cancer also called as blood cancer. It normally originates near bone marrow. The need for automatic leukemia detection system rises ever since the existing working methods include labor-intensive inspection of the blood marking as the initial step in the direction of diagnosis. This is very time consuming and also the correctness of the technique rest on the worker's capability. This paper describes few image segmentation and feature extraction methods used for leukemia detection. Analyzing through images is very important as from images; diseases can be detected and diagnosed at earlier stage. From there, further actions like controlling, monitoring and prevention of diseases can be done. Images are used as they are cheap and do not require expensive testing and lab equipment. The system will focus on white blood cells disease, leukemia. Changes in features will be used as a classifier input.

## KEYWORDS

K-mean Clustering, Texture Features, Feed Forward and RBFNN.

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## I. INTRODUCTION

**L**EUKEMIA is one of the many types of cancers. Leukemia is caused in the white blood cells near the bone marrow region of our body. In this the white blood cells (WBCs) which get infected turns blue. Like any other cancer in this also the cell divides itself at the faster pace. Even when it is not required they multiply causing a tumor. Detected and treated at an early stage of leukemia saves a lot of lives. According to leukemia research foundation, every four minutes someone is diagnosed with leukemia. More than 176,000 are expected in U.S.

Leukemia helps in detecting blood cancer using two basic modules of image processing i.e. Image segmentation and feature extraction. After these two modules we use two techniques of neural network i.e. feed forward network and radial basis function network (RBFNN) for the detection purposes. We compare the accuracy percentage in both of them. The technique with best accuracy percentage is recorded as the more efficient technique.

## II. RELATED WORK

Athira Krishnan, Sreekumar K [2] proposed a system to detect acute myelogenous leukemia which is a type of blood cancer. In this they have used two modules i.e. segmentation and feature extraction. In feature extraction they have extracted features like fractal dimensions, local binary patterns, texture features, shape and color features. Subrajeet Mohapatra, Dipti Patra et al [5] proposed a system unsupervised microscopic blood images using the data clustering techniques. In feature extraction shape and size of the cell. Ruggero Donida Labati IEEE Member, Vincenzo Piuri IEEE Fellow et al [8] they proposed an

open database for the new researchers so that they can avail the images easily. The images are segmented using basic techniques.

## III. METHODS

The procedure for leukemia detection in the microscopic images consist of image segmentation and feature extraction. The working procedure is shown in the figure below (fig. 1). The leukemia consists of red blood cells (RBCs), WBCs and platelets. The method is based on image segmentation so that we can easily separate WBCs from rest of the blood contents from the background and finally separation of nucleus and cytoplasm. As cytoplasm is insufficient so we have considered only the nucleus as the region of interest and its essential features are extracted.

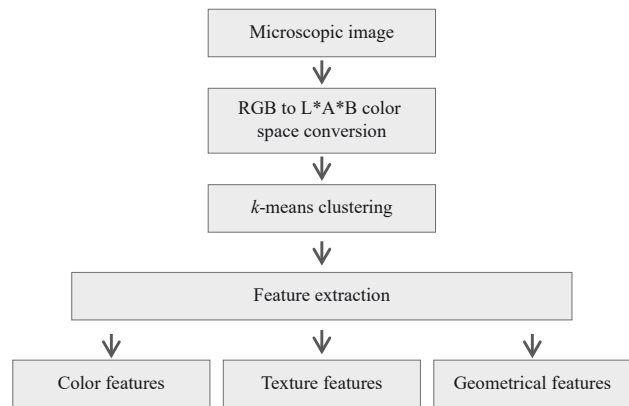


Fig. 1. Overview of the system.

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#### IV. THE DATABASE

For the diagnosis of leukemia the visual analysis of peripheral blood samples is an important task. ALL-IDB i.e. the acute lymphoblastic leukemia image database for image processing is a public dataset of blood samples specifically designed for evaluation and the comparison of algorithm for segmentation and classification for each image in the dataset, the classification of cell is given and it is provided a specific set of figures of merits to be processed in order to fairly compare different algorithm when working with the proposed dataset. It contains about 39000 blood elements where the lymphocytes have been labeled by expert oncologists.

#### V. IMAGE SEGMENTATION

Image segmentation has drawn attention from many years in the field of research. There are many algorithms used in segmentation. So, algorithm that is developed for a particular set of images can't be used for another set of images.

The techniques used for image segmentation in this paper are K mean and clustering and Lab color space.

##### A. $L^*A^*B$ Color Space:

Typically an image can be represented with the help of three color components. Images generated by the digital microscopes are usually in RGB color space which is visually difficult to segment. For better color based segmentation we map the RGB image into  $L^*a^*b^*$  color space. This color space consists of a luminosity layer  $L^*$ , chromaticity layers  $a^*$  and  $b^*$ . Since all the color information is in the  $a^*$  and  $b^*$  layers we use these two components for nucleus segmentation.

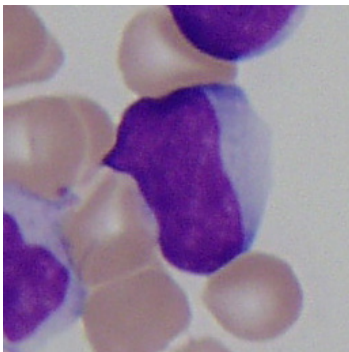


Fig. 2. Original Image.

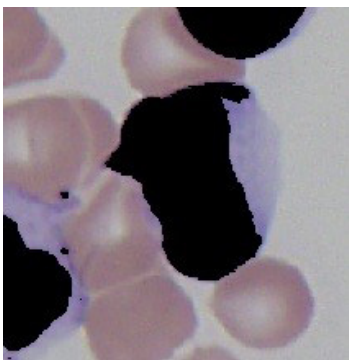


Fig. 3. Image after  $L^*A^*B$ .

##### B. K-means Clustering:

$k$ -means clustering is a renowned subdividing method. In this substances are classified as belonging to one of  $k$ -groups. The consequences of partitioning method are a set of  $K$  clusters, each body of data set belonging to one cluster. In each cluster there may be a

centroid or a cluster representative. In case where we reflect real-valued data, the arithmetic mean of the feature vectors for all objects within a cluster provides a suitable representative; alternative types of centroid may be mandatory in other cases. Clustering technique is used to create clusters from observations. It attempts to achieve partition such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible.

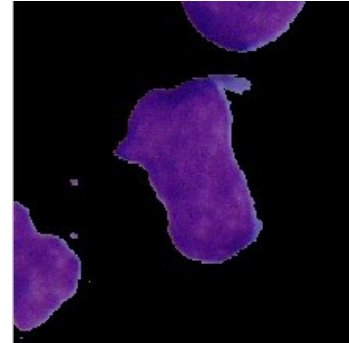


Fig. 4. Image after  $k$  mean technique.

#### VI. FEATURE EXTRACTION

Feature extraction in image processing is a system of redefining a great set of dismissed data, into a set of features of reduced dimension by transforming the input data into the set of features is called feature extraction. In feature extraction color, shape and geometrical features are observed for nucleus and the cell separately. The two clusters are made through  $k$ -mean, cluster 2 is for detecting the infected cells whereas cluster 3 is for nucleus. The basic inbuilt functions of feature extraction used in MATLAB are used.

#### VII. NEURAL NETWORKS

A neural network is an artificial system. In neural network the imitation of the activity of the brain is done. It imitates how the brain's neurons send messages through each other depending upon the work load some times. Several computing cells work in parallel to produce a result. This is usually seen as one of the possible ways artificial intelligence can work. Most neural networks can tolerate if one or more of the processing cells fail. A neural network is provided that has the capacity of "learning" to distinguish among patterns of data which may differ recognizably from idealized cases, and is able to perform pattern recognition faster while utilizing less memory and fewer clock cycles than neural networks implemented on sequential processors. This implementation is simpler and faster because of an inherent similarity between the flow of information in the brain and in data flow architecture. In this paper the comparison between two neural network techniques is done i.e. feedforward network and the radial basis function neural network (rbfn).

##### A. Feed Forward Network:

Feed forward networks consist of a series of layers. The first layer has a connection from the network input. Each subsequent layer has a connection from the previous layer. The final layer produces the network's output. There are hidden layers in between the input and the output layer. This hidden layer contains the weight on each node. The more the weight is the more work the node will do Feed forward networks can be used for any kind of input to output mapping. A feed forward network with one hidden layer and enough neurons in the hidden layers, can fit any finite input-output mapping problem. Every pattern must have the same number of elements as the net has input nodes (excluding the bias unit), and every target the same number of elements as the net has output nodes.

*Experiment results by feedforward network* : The experiment results in feedforward are basically dependent on the neural nodes we are using. The more the weightage on the nodes the more work load it will take to give the output. It was experimented through different nodes, initially 50 nodes then 80 and then 100 nodes were used on classes A and B which represents the cell and the nucleus cluster respectively. Using 100 neural nodes made the system slow and inefficient so it is not suitable to use 100 nodes. Result for 50 and 80 nodes is below:

TABLE I  
EXPERIMENTS DONE THROUGH DIFFERENT NEURONS

Classes	Using 50 neurons	Using 80 neurons
Class A	92%	94.7%
Class B	96%	94.8%

### B. RBFNN:

Radial Basis Function Neural Network is a neural network system of good performance. It is efficient in finding the exact nonlinear system's mapping till we have the enough image samples. This neural network system uses the radial basis functions as activation functions. So, it is not dependent on the weights of the neurons. The output of the network is basically a linear combination of radial basis functions of the inputs and neuron parameters. The basic MATLAB technique for RBFNN is implemented for the experiment. Using RBFNN we have 100% accuracy in detecting the leukemia infected cells and nucleus.

## VIII. CONCLUSION

The experiments were conducted using two neural network techniques that is feedforward network and the radial basis function. These two techniques were employed on the ALL-IDB images whose features were extracted after they were segmented using  $L^*a^*b$  color space technique and  $k$ -mean clustering. According to the experiments conducted above RBFNN is more efficient as it consumes less time and gives the 100% accuracy result. So, it's better to use RBFNN instead of feedforward network to detect the leukemia in the proposed system.

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