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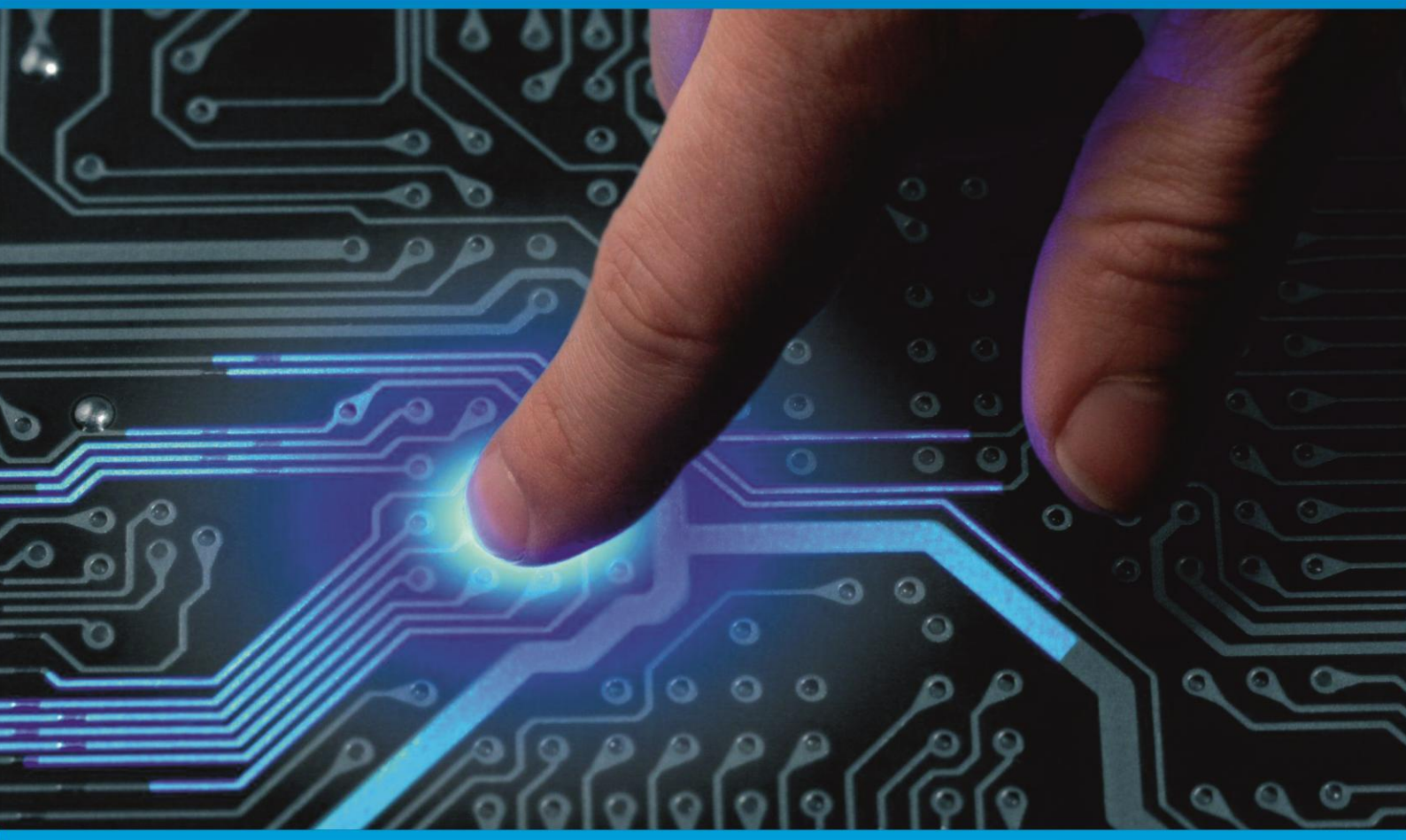

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Neural Network Classification of Blood Cell Images using Multiperceptron Backpropagation

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ABSTRACT: with the technological advancement in the medical field, the need for faster and more accurate analysis tools becomes essential. In this work, the image recognition problem of blood cell is investigated. Two types of white blood cells are classified into granular and non-granular cells using a feed forward back propagation neural network which is further classified. After segmentation, blood cells are obtained from microscopic images, the most 16 significant features of these cells are given as inputs to the neural network.

KEYWORDS: Neural Networks, Image analysis, feature extraction, white blood cell, segmentation

I. INTRODUCTION

The fields of hematology and infectious diseases, classifying different kinds of blood cells can be /used as a tool in diagnosis. By counting certain cells' of relative frequencies and comparing to what is normal, we can conclude about the possible blood diseases. Blood consists of several elements which are white blood cell (WBC), red blood cell (RBCs), platelets, and plasma. The quantity of blood cells plays the important role to ensure the healthiness of a person.

Human blood includes five major types of WBC or what is referred to as leukocytes. The White Blood Cells types, which are depicted in Fig 1, together with their typical relative frequencies are *neutrophils*, *basophils*, *eosinophils*, monocytes, and *lymphocytes*. In a human adult, the normal average number of WBC is about 7000/micro liter, which forms about 1% of the total blood cell in the body. The increase in the number of WBC in the body is referred to as leukocytosis, while the decrease in the number of WBC is called leucopenia, but leukocytosis is most likely to occur as compared with leucopenia [1]. Due to the different morphological features manual classification of such cells is a cumbersome process of the white blood cells, which is time-consuming and susceptible to human error as it is mostly related to the hematologists' experience. This fact actually emphasizes a crucial need for a fast and automated method for identifying the different blood cells.

Implementation techniques of automated differential blood cells counting systems are of two kinds [2] One technique is based on the flow cytometer, while the other is based on image processing.

In this work, we have adopted processing of microscopic images of blood cells using neural networks as an efficient decision maker for proper white blood cell type recognition. Neural networks have powerful features in analyzing complex data, and among the wide and variant application areas of neural networks are the system identification and control, image recognition and decision making, speech and pattern recognition as well as financial applications. Artificial neural systems have likewise been effectively utilized in medicinal applications to analyze.

In this work, the multilayer perceptron back-propagation MLP-BP neural network is used to classify the most known five types of WBC which have been segmented from blood smear microscopic images with the use of most distinguishing features. The adopted algorithmic comprises three stages. The first stage is image segmentation, the second stage is labeling that returns the number and location of each WBC, and the third stage is extracting descriptive features measured from the segmented cells.

1.1. AIM/MOTIVATION

Blood cell detection emphasizes a crucial need for fast and automated method for identifying the different blood cells. Though require lot of test and experiments but results are not up to the mark.

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1.2. OBJECTIVES

With the innovative progression in the medicinal field, the requirement for quicker and more precise examination instruments winds up essential. Human blood contains five major types of WBC or what is referred to as leukocytes.

II. RELATED WORK

Mazin Z. Othman .Thabit S. ,Mohammed, Alaa B. Ali [1] In this work, neural network is used to classify the most known five types of WBC that have been segmented from blood Smear microscopic images using the most distinguishing Features.
Aimi Abdul Nasir1, Mohd Yusoff Mashor1, and Rosline Hassan2 [2] The MLP network trained by LM and BR algorithms as well as the SFAM network have been used to classify the WBC into three categories namely Lymphoblast, myeloblast and normal cell.

N. Cao, C. Wang, M. Li, K. Ren, and W. Lou [3] In this work, we propose a depth neural network architecture that combines the features of convolutional neural networks (Xception) and recursive neural networks (LSTM). We then implement the combined Xception-LSTM framework For blood cell image classification.

Suhail Odeh and Manal Khalil [5] This paper presents a method for offline signature verification and recognition by using MLP neural network that used four features; eccentricity, skewness, kurtosis, and orientation, which can be extracted by image processing.

III. EXISTING SYSTEM

Based on the significance of blood cell classification in the diagnosis, researchers have proposed many algorithms to classify blood cells. In 2003, Sinha and Ramakrishna classified cells using SVM with a recognition rate of 94.1%. In 2006, Yampri*et al.* [2] used 100 images to perform the same experiments. They implemented the automatic threshold and adaptive contour to segment cells and used the smallest error method to classify them, and the recognition rate was 96% [2]. Yampri*et al.* [2] utilized the KNN algorithm. However, the KNN algorithm does not handle unbalanced samples well. If the sample capacity of a class is large, while the sample capacity of other classes is small, some Issues arise**.**

3.1. DISADVANTAGES OF EXISTING SYSTEM

1. Linear vector quantization (LVQ) and k-nearest Classifier which produced 83.33%and 80.76% of
2. Accuracy, respectively. Which is very less compared to neural networks.

IV. PROPOSED SYSTEM

4.1. PRE-PROCESSING AND SEGMENTATION

The algorithm includes three main steps which are segmentation, labeling, and feature extraction, are illustrated in Figure 2. The next image processing step is the White Blood Cells subtype recognition which will be achieved with the help of neural networks.

Steps for segmentation as follows:-
Step 1: Read color blood slide image to the system
Step 2: Convert color image into a grayscale image.
Step 3: Enhance contrast of the grayscale image by Histogram equalization (result A).
Step 4: To adjust image intensity level apply linear contrast stretching to a grayscale image (result B).
Step 5: Obtain the image I1=result A+ result B to brighten all other image components except cell nucleus.
Step 6: Obtain the image I2=I1- result A to highlight the entire image objects along with the cell nucleus.
Step 7: Acquire the picture I3=I1+I2 to remove all other
Components of blood with min effect of distortion over nucleus.
Step 8: To reduce noise, preserve edges and increase the darkness of the nuclei implement the 3-by-3 minimum filter on the image I3.
Step 9: Apply a global limit Otsu's strategy on picture I3
Step 10: Using the threshold value in the above step convert I3 to a binary image.

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Step 11: To remove little pixel bunches utilize morphological opening.
Step 12: To form objects interface the neighboring pixels.
Step 13: By applying the size test deduction of all objects

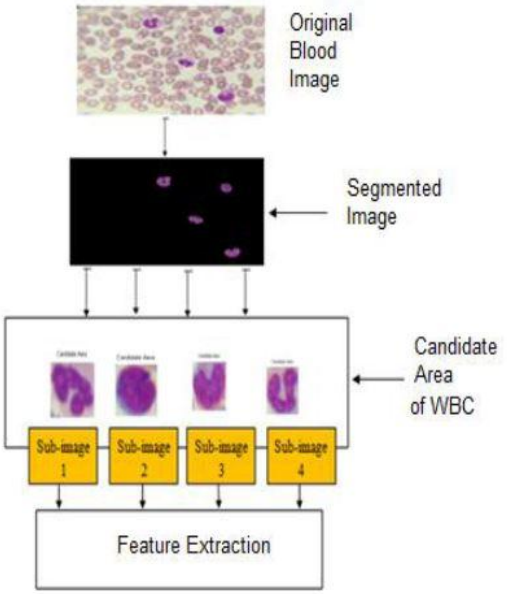

Fig 1: Pre-Processing and Segmentation

4.2. FEATURE EXTRACTION OF WBC

The selection of features immensely affects the classifier performance. For the robust classification, efficient judgment and better comparison the features must characterize each WBC subtype and must be independent of each other. Indeed, an extensive work has been focused on determining different features that crucially distinguishes each type or groups of types of WBC. These features can be classified into shape features, intensity features, and texture features.

1.Shape Feature

There are many techniques for shape description and recognition. These systems can be comprehensively arranged into two kinds: (1) boundary-based and (2) region-based. The most successful representations for these two categories are Fourier descriptor and moment invariants where moment invariants are for the usage of region-based moments, which are invariant to transformations as the shape feature.

2.Intensity Feature

The features are only based on the absolute values of the intensity measurements in the microscopic image. A histogram describes the occurrence of relative frequency depicting the intensity values of the pixels in an image. The intensity features which will be considered are the first four central moments of this histogram which are mean, standard deviation, skewness, and kurtosis.

3.Neural Network Classification

The features that are considered significant to represent an image of WBC are extracted and accumulated in the vector, which we refer to as the features vector. The features vector is then converted into a set of classes using neural networks as a technique to solve a WBC classification problem. This method receives a learning calculation to distinguish a model that best fits the connection between the list of capabilities and class name of the information. So, a main objective of the learning algorithm is to build a predictive model that accurately predicts the class labels of previously unknown records.

The feed-forward back propagation neural network, which is the most famous model in biological and biomedical systems, is used in the system. These kinds of neural network configuration don't have feedback connections, and the errors are propagated back during training using least mean squared error. The back propagation neural network is a multi-layer, feed-forward supervised learning, which requires couple of input and target vectors. A feed-forward neural network has three layers, namely, (1) an input layer, (2) a number of hidden layers, and an output layer. The input layer and the hidden layer are

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Connected by synaptic links called weights and likewise, the hidden layer and output layer also includes the connection weights.

Modules
Doctor:
A doctor analyze patient blood samples and generate blood reports accordingly
Which includes all blood relates details.

Patient:-
Patient check reports sent by the doctor and can contact doctor for any kind of medical help like advice or prescription regarding his or her medical problem.

Admin: -
Maintaining Database

V. ALGORITHMS

A. Backward Propagation

The features that are considered significant to represent an image of white blood cells are extracted and accumulated in a vector, which we refer to as the features vector. Features vector is then transformed into a set of classes using neural networks as a technique to solve a WBC classification problem. This technique adopts a learning algorithm to identify a model that best fits the relationship between the feature set and class label of the input data. Therefore, a key objective of the learning algorithm is to build predictive model that accurately predict the class labels of previously unknown records.

The feed forward back propagation neural network, which is a very popular model in biological and biomedical applications, is used. This type of neural network configuration does not have feedback connections, but errors are propagated back during training using least mean squared error. The back propagation neural network is a multi-layer, feed-forward supervised learning, which requires pairs of input and target vectors. A feed forward neural network can consist of three layers, namely, (1) an input layer, (2) a number of hidden layers, and an output layer. The input layer and the hidden layer are Connected by synaptic links called weights and Likewise the hidden layer and output layer also have connection weights.

The input layer contains 16 neurons representing the 16 extracted features. The output layer contains 5 neurons which represents the WBC types. It was found that 10 nodes in a single hidden layer are adequate to reach a minimum error (less than. The learning rate is 0.35 and number of epochs is set to 1000

B. Naïve Bayes
Naive Bayes Classifier -
It is a classification dependent on Bayes' Theorem with a suspicion of freedom among indicators. In straightforward terms, a Naive Bayes classifier accept that the nearness of a specific element in a class is disconnected to the nearness of some other component. For instance, a natural product might be viewed as an apple on the off chance that it is red, round, and around 3 crawls in distance across. Regardless of whether these highlights rely upon one another or upon the presence of alternate highlights, these properties freely add to the likelihood that this organic product is an apple and that is the reason it is known as 'Guileless'.

VI.RESULT AND DISCUSSION

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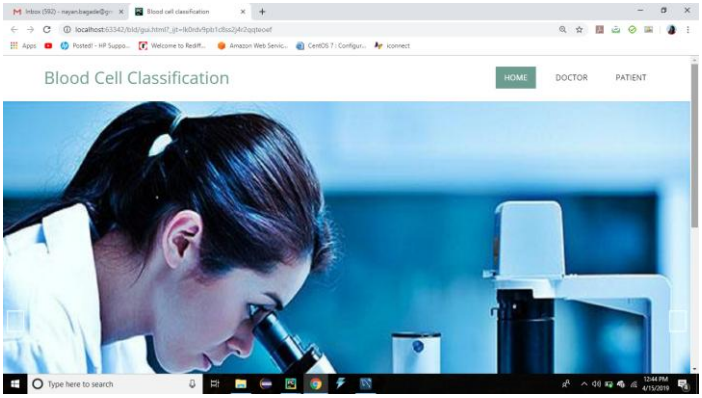

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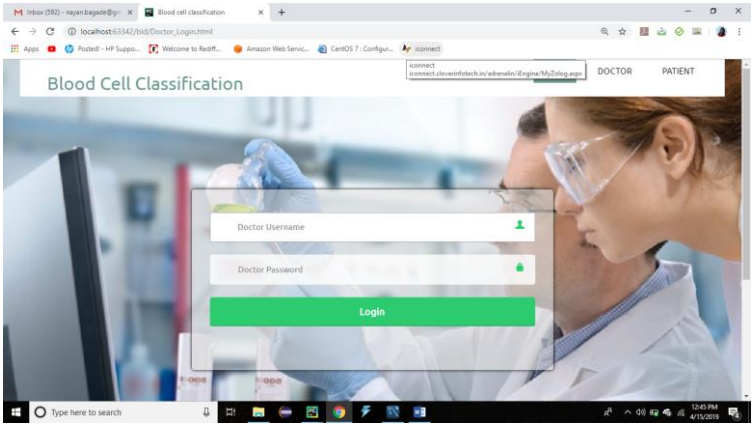

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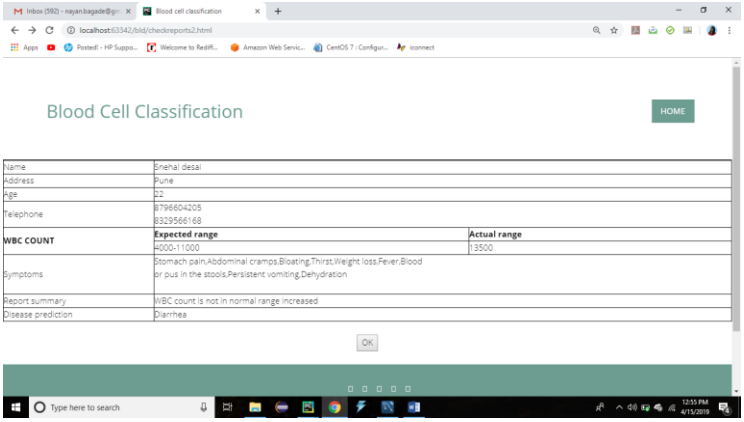

VI.CONCLUSION

In this work, we propose a backward propagation neural network architecture that uses WBC features for image classification which gives 96% correct image classification result. We hope that this highly accurate blood cell classification method can be used to develop medical-aided diagnostic systems for blood-related diseases in the future.

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