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ANALYSIS OF BLOOD SAMPLES USING ANFIS CLASSIFICATION

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Abstract— Disorders in the blood mainly are identified through inspection of microscopic images of blood cells. Once identification of blood disorders are completed, it is possible to classify various types of blood disorder. In India, there are an estimated 5.3 per 100, 00 men and 3.0 per 100, 00 women are affected by leukemia. This paper determines the detection of different types of leukemia and their classification using Adaptive Neuro Fuzzy Interference System. Abnormal increase of white blood cells results in leukemia which begins in the bone marrow. Any changes in the texture, geometry, colour and amount of WBC of the microscopic images can be used as input for the input for the classifier. Once leukemia is detected, prevention can be done at an early stage. The entire process is simple and cost effective.

Keywords—Whitebloodcells, Microscopic images, Leukemia, ANFIS

1. INTRODUCTION

Medical image processing is a technique used to enhance and display images which are captured using x-rays, ultrasound and other optical imaging technologies. Image processing also establishes the diameter, volume, flow parameter of blood and other microscopic changes in particular images. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. This has led to a huge growth in the application of digital image processing techniques for solving medical problems [1]. The most challenging aspect of medical imaging lies in the development of integrated systems which can be used in the Health care sector. At the moment microscopic images of leukemia are used for the identification of blood disorders, it can lead to classification of certain diseases related to blood [1].

Blood cells play a vital role in carrying out various biological tasks in the body. Bloods cells are classified as Erythrocytes or red blood cells, Leukocytes also termed as white blood cells and platelets. Blood cell analysis is an important diagnostic tool because it can help to detect a wide range of diseases. Two types of blood cells analysis are performed: complete blood count and differential blood count.[2]. The cell counts for peripheral blood are obtained manually or by an automatic flow cytometer, whereas the counts for bone marrow are always obtained manually [2]. The manual counting is done via visual inspection by technicians using a microscope. An automated diagnosis system will alleviate the workload and the influence of subjective factors. Automated detection works by removal of red blood cells and platelets from the background.[2][3].In this paper, we have used a classification technique called anfis to classify the different types of leukemia. Medical images have very similar gray level and texture among the interested objects. Another problem may be lack of a sufficient number of training samples if a supervised learning technique is employed by using ANFIS. A minimum data base of at least 50 images is required. In this paper, structure element analysis along with feature extraction is applied in order to detect the abnormal cells and images are trained and anfis is used as the classification process to classify the different types of leukemia.

2. METHODOLOGY

Leukemia occurs when the bone marrow produces abnormal white blood cells called leukemia cells. Leukemia cells don't die when they become old and damaged instead, they continuously divide and crowd out normal blood cells. This leads to low level of normal blood cells and deprives the body from getting oxygen to the tissues, controls bleeding or fights infections. Leukemia's are named based on a few factors such as the quick development of the disease, severity of the disease and the type of leukocytes it affects.

2.1. ACUTE LEUKEMIA

Acute leukemia develops very quickly. The count of the abnormal leukemia cells increases rapidly and a bone marrow test will show high levels of leukemia cells and low level of normal blood cells.

2.2. CHRONIC LEUKEMIA

Chronic leukemia develops slowly and it functions as normal as the leukocytes. Initially, people may not feel sick. The commencement of the disease is indicated based on abnormal results of the blood test.

2.3.LYMPHOCYTIC LEUKEMIA

Leukemia that starts in the lymphoid cells is termed as lymphocytic leukemia . Leukemia Lymphocytic leukemia may accumulate in the lymph nodes, which becomes swollen.

2.4.. MYELOID LEUKEMIA

Leukemia that begins in the myeloid cells is termed as myeloid leukemia.Hence, the leukemia are classified into four types acute and chronic myeloid leukemia and acute and chronic lymphocytic leukemia.

3.BLOCK DIAGRAM

The proposed block diagram for this project is given as follows..

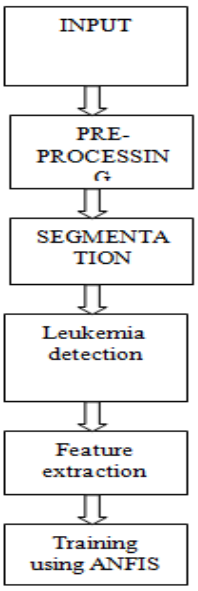


Fig 1:Block Diagram

3. 1.INPUT IMAGE:

Input images should be in *.jpg; or the *.png format the images used for this project were provided by Saravanan Scans, Chennai.

3.2. PREPROCESSING

Preprocessing is mainly used for the removal of noise and resizing the images to equal columns and rows if required by the images. The images are converted to gray scale to binary in order to get the region of interest and this conversion is done by tresholding.

3.3. MEDIAN FILTER:

Median filter is used to preserve edges while removing random noises present in the image. For a two dimensional image, the images are of 3-by-3 neighborhood value. The median filter replaces each entry with the median of the neighboring entries.

3.4. SEGMENTATION

- **Thresholding**

The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T or a white pixel if the image intensity is greater than that constant. The threshold value for a normal image ranges from 0.6 to 0.8 and for a leukemia image, it ranges from 0.7 to 0.8.

3.5. DETECTION OF LEUKEMIA:

Structural Element Analysis is a technique used to conclude if the shape and size fits or mises the shapes in the images. Structural Element Analysisit helps in distinguishing the radius of the abnormal cells and normal cells of the images.The values are either 0 or 1 and it is used in morphological operations such as image eroding. In image eroding, it erodes away the boundaries of region of foreground pixels. Area of foreground pixels shrink in size and holes becomes larger .There are two pieces of input, one image is the image which is eroded and the second image implies the coordinate points. Finally connected components labelling is applied where the pixels are grouped and connected based on pixel intensity values. Once the groups are deterimined each pixel is labelled with a binary images and the images are scanned from left,right,up and down to identify the connected pixel region.Once the scan is completed,the equivalent label pairs are segregated into equivalance class and a unique label is given to each class.

3.6.FEATURE EXTRACTION:

Features such as radius, growth of the leukemia, concavity, elongation of the cells. Texture features such as entropy, correlation and statistical feature such as the mean value are taken into consideration for feature extraction.

3.7.TRAINING USING ANFIS:

Once the leukemia is detected and features are extracted, we are going to classify the leukemia based on acute myeloid leukemia, chronic myeloid leukemia, acute lymphocytic leukemia and chronic lymphocytic leukemia.

Neuro fuzzy systems are fuzzy systems which use ANNs theory in order to determine their properties (fuzzy sets and fuzzy rules) by processing data samples[5]. Fuzzy neural networks retain the basic properties and architectures of neural networks and simply “fuzzify” some of their elements[6]. A specific approach in neuro fuzzy development is the adaptive neuro fuzzy inference system (ANFIS), which has shown significant results in modeling nonlinear functions. The ANFIS learns features in the data set and adjusts the system parameters according to a given error criterion. Successful implementations of ANFIS in biomedical engineering have been reported, for classification and data analysis.

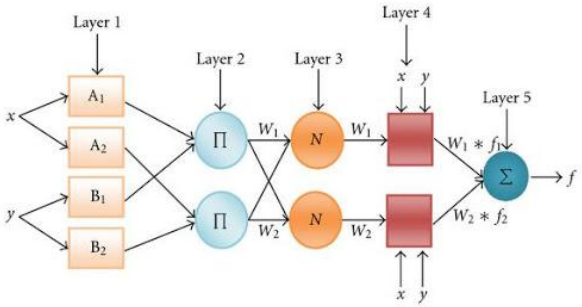


FIG 2: ANFIS ARCHTECTURE

An adaptive network is a multilayer feed forward network in

Which each node performs a particular function on incoming signals. Adaptive neuro fuzzy inference system (ANFIS) is formed which combines the advantages of neural networks and fuzzy theoretic approaches.

Rule 1: If (x is A1) and (y is B1)

Then (f1 =p1x + q1y + r1)

Rule 2: If (x is A2) and (y is B2)

Then (f2 = p2x + q2y + r2)

1) Where x and y are the inputs,

2) Ai and Bi are the fuzzy sets, fi are the outputs specified by the fuzzy region

3) pi, qi and ri are the design parameters that are

Determined during the training process.

The ANFIS architecture is a 5 layer structure. Circle indicates a fixed node, square shows the adaptive node and all the other layers have different functions. This process is done after the learning algorithms of ANFIS are complete.

In order to get the accurate result, the type and the parameters of the fuzzy membership functions, and rules applied are crucial. The parameters are chosen based on trial and error methods. The ultimate aim of training the ANFIS system is to determine the optimal premise and consequent parameters [5]

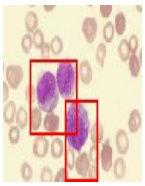
b) GRAY-LEVEL CO-OCCURRENCE MATRIX

Texture is an important characteristics used to identify the region of interest in an image. GLCM is one of the earliest method used for texture feature extraction.[7] A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix.

3.Results and discussion

4.1.ANALYSIS OF ACUTE LYMPHOCYTIC LEUKEMIA:

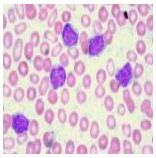
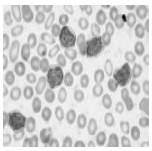
(a)Input Image (b) pre-processed image

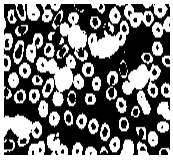
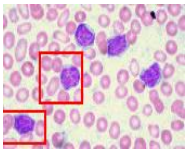
(c) Segmentation image (d) detected leukemia cells

The given input image is a microscopic image of Acute lymphocytic. This type of cancer usually gets worse if not treated properly. In figure (b) the microscopic images are pre-processed where noise and resizing of the image is done if necessary. In figure(c) Segmentation is done for the blood cells where the gray scale images are converted into binary images based on thresholding .In figure (d) the leukemia cells are detected and this type of leukemia occurs when there are uncontrolled and exaggerated growth of lymphoblast cells each with poorly defined cell boundaries.

4.2 ANALYSIS OF CHRONIC LYMPHOCYTIC LEUKEMIA

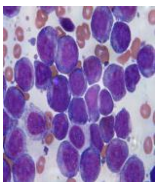
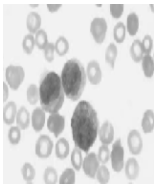
(a) INPUT IMAGE (b) PRE-PROCESSED IMAGE

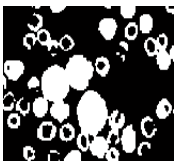
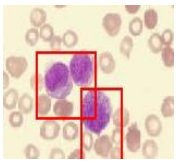
(c) SEGMENTED IMAGE (d) DETECTED LEUKEMIA

The images above are the microscopic images of chronic lymphocytic leukemia. After the images are pre-processed and segmented we can conclude from figure (d) that the leukemia affects the lymphoid cells. The chronic lymphocytic leukemia is slow growing cancer which begins in the lymphocytes in the bone marrow and slowly enters the blood.

4.3) ANALYSIS OF ACUTE MYELOID LEUKEMIA:

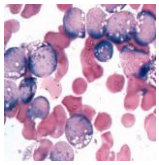
(a)INPUT IMAGE (b) PRE-PROCESSED

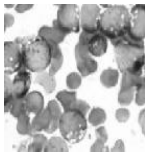
(c) SEGMENTED IMAGE (d) LEUKEMIA DETECTED

The microscopic images of acute myeloid leukemia undergo process such as pre-processing and segmentation and once the leukemia is detected we can say that this type affects the myeloid cells .Myeloid primarily consists of the leukocytes, erythrocytes and the platelets. This type of cancer affects both adults and children

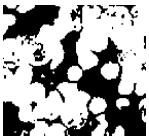
4.4) ANALYSIS OF CHRONIC MYELOID LEUKEMIA:



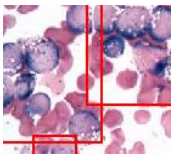
(a)INPUT IMAGE



(b)PRE-PROCESSED IMAGE



(c) SEGMENTED IMAGE



(d) LEUKEMIA DETECTED

The above images are the microscopic images of chronic myeloid leukemia. Once the pre-processing and the segmentation process are complete the leukemia detected are present in the myeloid cells. This form of leukemia occurs due to a problem with a stem cell in the bone marrow which later on becomes abnormal. Development of this type of leukemia is very slow it can take months and years when it finally affects the body.

Conclusion

In this paper, we have classified the different types of leukemia. The microscopic images of leukemia are examined by changes based on texture, geometry, color, statically analysis used as the input. We have trained and classified the microscopic images using ANFIS. This system is reliable and cost-effective.

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