Texture Metric Driven Acute Lymphoid Leukemia Classification Using Artificial Neural Networks

M. Anto Bennet, G. Diana, U. Pooja, N. Ramya

Abstract:One of the human body's most important part is blood. Blood has terribly important functions for the body among others. In recent years, the incidence of many blood diseases such as leukemia, anemia and some malignant tumors are increasing. Leukemia is a disease, which suppress the production of normal blood cells. Here, we propose a method to increase the accuracy of classification of WBC cells using Artificial Neural Network classifier. DWT based transformations are used for removing the redundant information. Shape, statistical and GLCM based features are extracted from the segmented regions of Blood Microscopic Images. RGB to L*a*b conversion is used as pre-processing step so that classification of cells based on color can be more concentrated. Rotational and scale invariant texture based texture classification is used for texture segmentation to get the region of interest. Thus, we employ the concept of Artificial Neural Network for analysing the Blood related diseases.

KEY WORDS: ANN (Artificial Neural Network) classification, WBC's (White Blood Cells), CIELAB color space

I. INTRODUCTION

Leukemia is a type of cancer that attacks the blood, tissue, bone marrow and lymphatic system. Blood is composed of three sections, namely red blood cells (RBC-red blood cells), white blood cells (WBC-white blood cell) and platelets [1].The immune system is the third line of defense of human beings while leukocytes play an import role in the immune system. In recent years, the incidence of many blood diseases such as leukemia, anemia and some malignant tumors is increasing [2].

Revised Manuscript Received on March 25, 2019.

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Leukemia may be a hematological pathological process illness that attacks the blood, tissue, bone marrow and lymphatic. The characteristics of leukaemia square measure the proliferation of white blood cells that aren'ttraditional within the affected bone marrow while not inhibiting cell growth [1]. Many researchers tries to concentrate on the automated system as they're quick, less error rate as compared to human and not even tiresome, as in manual segmentation and classification in many subtypes, the first task is to crop the nucleus from the blood smears and perform any further analysis on these cropped nucleus and also the most important thing is that the instruments that square measure used for blood analysis square measure terribly pricey and additionally could also be attainable that they're not out there all told the hospitals and clinics [3]. Leukemia and chronic leukemia and other subordinate types. Because of categorization, some types of this disease show similar blood cell characteristics are hardly distinguishable for this reason, the idea of studying the differentiation of acute leukemia with image processing techniques is applied. The performance evaluation of the system based on the parameters extracted[5-11]. The method have been evaluated using K-Means clustering. Features extracted from the metameric living substance and nucleus, square measure motivated by the visual cues of form and texture. Various classifiers have been explored on different combinations of feature sets [4] In this paper we proposed a, RGB to L*a*b conversion is used as pre-processing unit. Rotational and scale invariant texture based texture classification will be used for texture segmentation. To achieve better optimization 20 GLCM features will be used alongside with shape feature set in feature extraction. The unique PCA feature selection will be sorted out to reduce complexity and computational time for ANN based classifications. In Figure 1 It is an example of a blood smear from a person without (Figure 1a) and with cancer (Figur

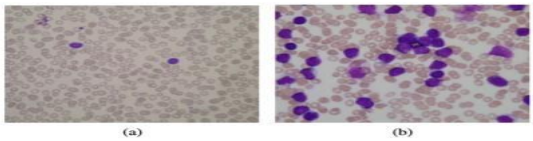

Fig 1: BLOOD SMEAR SAMPLE

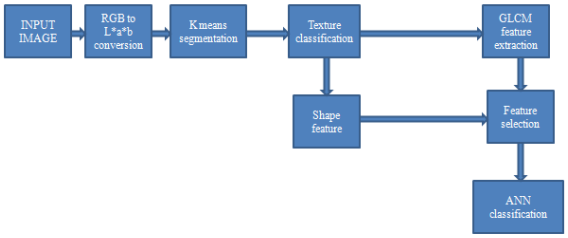

Fig 2: BLOCK DIAGRAM OF LEUKOCYTE CLASSIFICATION

PRE-PROCESSING AND SEGMENTATION OF IMAGE:

Preprocessing is a process, which is used to boost the precision and interpretability of an image. Image preprocessing is a noteworthy and challenging task in the CAD system. In medical image processing, preprocessing of an image is very important so that the extracted image does not have any impurities, and it is accomplished to be better for the forthcoming process such as segmentation, feature extraction, etc. The preprocessing is to enrich the visual look of the images. Preprocessing mainly aims to remove the clamor, stabilizing the intensity of the images and clear the artifacts. Image preprocessing is the technique of enhancing the image data prior to computational processing.

The goal of segmentation is to modify and/or amendment the illustration of a picture into one thing that's additional significant and easier to investigate. Each of the pixels throughout a district unit of measurement similar with connection some characteristic or computed property, like color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s) [6] Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More exactly, image segmentation is that the method of assignment a label to each picture element in a picture specified pixels with an equivalent label share bound characteristics. [7]

RGB TO L*a*b CONVERSION:

Digital illustration of color pictures is accomplished by storage of color intensity values. In this color house, we've got one channel is for light (Lightness) and alternative 2 color channels ara and b called hue layers. The a* layer indicates wherever the colour falls on the red inexperienced axis, and b* layer indicates where the color falls along the blue-yellow axis. a* negative values indicate inexperienced whereas positive values indicate magenta; and b* negative values indicate blue and positive values indicate yellow. Lab color is designed to approximate human vision. It aspires to activity uniformity, and its L part closely matches human perception of lightness, though it doesn't take the Helmholtz–Kohlrausch impact into consideration. Thus, it may be wont to create correct color balance corrections by modifying output curves within the a and b elements, or to adjust the lightness contrast using the L component.

In this proposed work we are using an l*a*b conversion instead of using HSV which is used in the existing system. The affected WBC's are mainly depend on the color of the cells than the intensities. Here we convert Color information's into L*a*b three dimensional vectors, whose components largely depend on the applied color space. It is used to remove the undesired region and get the obtained region of the nucleus for classification. the L* coordinate ranges from 0 to 100. The attainable vary of a* and b* coordinates is freelance of the colour house that one is changing from, since the conversion below uses X and Y, which come from RGB.

II. K-MEANS SEGMENTATION

Divide the input image of objects into K groups (clusters).

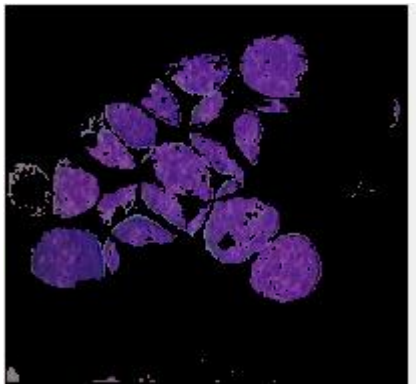

Fig 3: SEGMENTED CELL IMAGE

In K-means clustering is based on intensity or color.

- determine the mean of each cluster.
- determine the distance of each point from each cluster by computing its distance from the corresponding cluster mean. Assign every purpose to the cluster it's nearest to.
- After the above two steps it will iterate till the sum of squared within group errors cannot be lowered any more.

Need to pick optimum K value highly sensitive to initialization of process & iterative approach. Only through attempts of partial/fully cell segmentations based automated systems for leukemia detection are present in literature but they are still at prototype stage.

DWT DECOMPOSITION:

DWT is used to decompose the input image into several sub-bands with corresponding frequency distribution.In addition, both approximate & detailed coefficients are extracted to have maximum description with finest details.

A, D1, D2, D3 < Input image.<div id="art-7">The wavelet transform has gained widespread acceptance in signal processing and image compression.Recently the JPEG committee has released its new image-coding standard, JPEG-2000, which has been based upon DWT. Wavelet rework, decomposes a symbol into a collection of basic functions. These basis functions are called wavelet. Wavelets are obtained from a single prototype wavelet called mother wavelet by dilations and shifting [11]. The DWT has been introduced as a highly efficient and flexible method for sub band decomposition of signals. In separate wave rework, signal energy concentrates to specific wave coefficients. This characteristic is useful for compressing images [12]. Wavelets convert the images into a series of wavelet that can be stored more efficiently than pixel blocks. Wavelets have rough vedges;they are ready to render photos higher by eliminating the ―blackness‖. In DWT, a timescale illustration of the digital signal is obtained mistreatment digital filtering techniques. The signal to be analyzed is skillful filters with very completely different cut-off frequencies at different scales. It is simple to implement and reduces the computation time and resources needed [12]. A 2-D DWT can be seen as a 1-D wavelet scheme, which transform along the rows and then a 1-Dwavelet transform along the columns, the 2-DWToperates in a straightforward manner by inserting array transposition between the 2 1-D DWT. The rows of the array are processed initial with only one level of decomposition. This essentially divides the array into two vertical halves, with the first half storing the average coefficients, while the second vertical half stores the detail coefficients. Image consists of pixels that ar organized in two-dimensional matrix, each pixel represents the digital equivalent of image intensity. In spatial domain adjacent pixel values are highly correlated and hence redundant. In order to compress pictures, these redundancies existing among pixels needs to be eliminated. DWT processor transforms the spacial domain pixels into frequency domain info that ar described in multiple sub-bands, representing completely different duration and frequency points. One of the distinguished options of JPEG2000 commonplace, providing it the resolution scalability, is the use of the 2D-DWT to convert the image samples into a more compressible form. The JPEG 2000 commonplace proposes a riffle rework stage since it offers higher rate/distortion (R/D)performance than the normal DCT.

TEXTURE CLASSIFICATION:

Texture classification method involves two parts: the educational part and therefore the recognition phase. In the learning part, the target is to make a model for the feel content of every texture category gift within the coaching knowledge that typically contains of pictures with known class labels. The texture content of the coaching pictures is captured with the chosen texture analysis technique that yields a collection of textural options for every image. These options, which may be scalar numbers or distinct histograms or empirical distributions, characterize given textural properties of the photographs, like spacial structure, contrast, roughness, orientation, etc. In the recognition part the feel, content of the unknown sample is 1st delineated with constant texture analysis technique. Then the textural features of the sample are compared to those of the training images with a classification algorithm, and the sample is assigned to the category with the best match. Optionally, if the most effective match is not sufficiently smart per some predefined criteria, the unknown sample will be rejected instead. An image texture can be a group of metrics calculated in image method designed to quantify the perceived texture of an image. Image texture offers U.S. data concerning the arrangement of color or intensities in a picture or hand-picked region of a picture.[6].Image textures will be unnaturally created or found in natural scenes captured in an image. Image textures are a way which will be wont to facilitate in segmentation or classification of pictures. For segmentation that is more accurate the most useful features are spatial frequency and an average grey level [13].

Basics of LBP :

LBP is a simple and efficient gray scale feature descriptor of an image which describes the spatial structure of the local image texture. A LBP code is determined by

i) Splitting the image in to 3×3 block

Fig. 1 3 x 3 Macro block

ii) Comparing the center pixel of 3×3 block with the neighborhood pixel LBP Code is generated using following equation:

$$LBP_{P,R} = \sum_{p=0}^{p=p-1} x(g_{n-} g_{c).2^p}, \quad (1)$$

$$S(t) = \begin{cases} 1, t \geq 0 \\ 0, t < 0 \end{cases} \quad (2)$$

Where,

g_n-Gray value of a neighborhood pixel.

g_c- Gr ay value of a center pixel.

P-Total number of involved neighbors.

R-Radius of the neighborhood.

$t= (g_n - g_c)$

FEATURE EXTRACTION

Feature extraction in image process may be a technique of redefining an oversized set of redundant knowledge into a group of options of reduced dimension. Transforming the input file into the set of options is named feature extraction. To extend this goal with fully automated which can detect Leukemia cells more accurately which has three basic features.

Fig 4 shown the feature extraction of the white blood cell images.

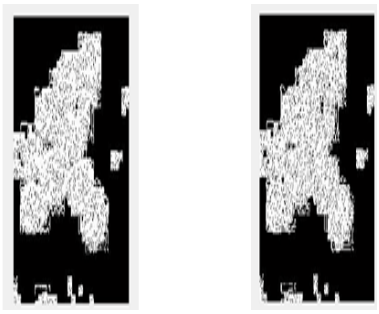

Fig 4: FEATURE EXTRACTION OF IMAGES

Texture features:

The Gray Level Co-occurrence Matrix (GLCM) method is a way of extracting second order statistical texture features.

- Energy
- Contrast
- Entropy
- Correlation

Color features:

In addition to the features aforementioned, we have used the following color-based feature.

- Mean
- Standard deviation
- Energy

Shape features.

The shape of the nucleus, according tohematologists, is an essential feature for discrimination. Region- and boundary-based form options area unit extracted for form analysis of the nucleus.

Statistical features:

In the whole images, the number of nuclei under the field of view was much higher for a cancerous case as opposed to the noncancerous case.

HD =log(R)log (R(s)) (1)

where R is the number of squares in the superimposed grid, and R(s) is the number of occupied squares or boxes (box count). Higher HD signifies higher degree of roughness.

III. RESULTS AND COMPARISON

We need to develop developing ANN component for classifications. ANN network builds the optimal separating neurons based on a kernel function. Feature vectors extracted lies on one side of the each vector plane, are belong to one class and the others are belong to class another class.

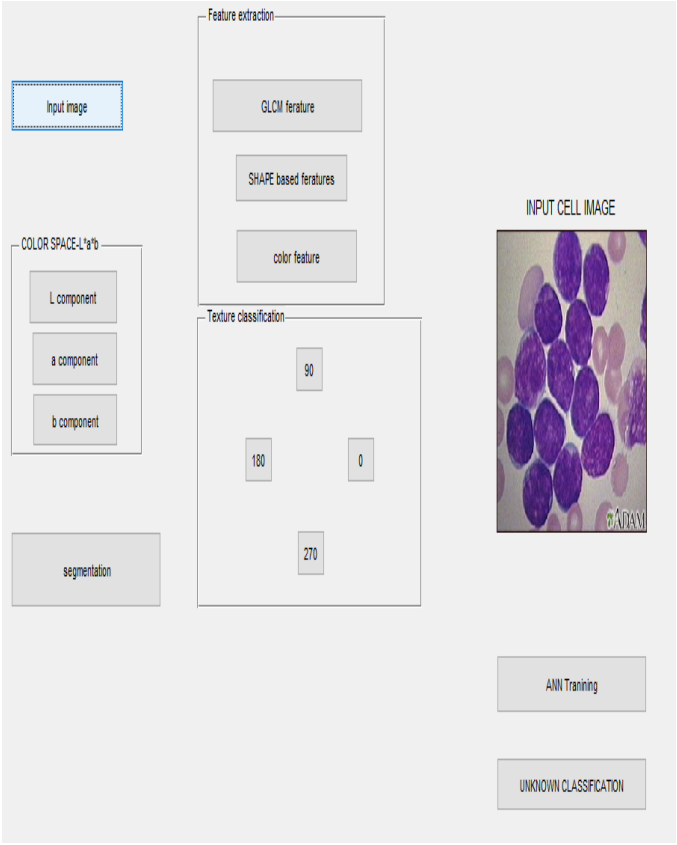

Fig 5:CLASSIFICATION OF LEUKEMIA CELLS BY USING MATLAB

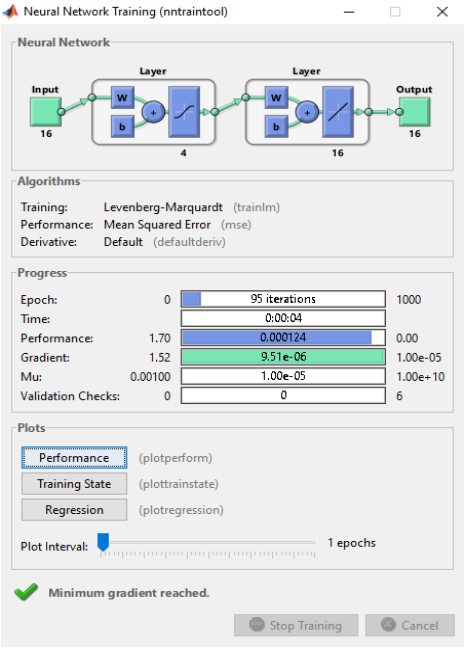

Fig 6:ANN CLASSIFICATION

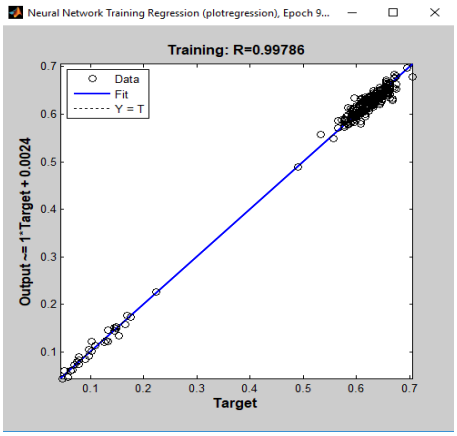

Fig 7:FINAL CLASSIFICATION

IV.CONCLUSION

The proposed leukocyte classification method can be used for the preliminary diagnosis of hematological diseases. In the past, leukocyte recognition has largely relied on the morphology of the cell or the color channel of the image while the proposed method can effectively eliminate the impact of cell segmentation on subsequent classification. To make the classification result more reliable and to improve the accuracy of the segmentation by using K-means Algorithm. The spatial features are extractedusing morphological expression and the uniform & rotation invariant LBP and the results are successfully drained into the ANN so the affected images can be easily differentiated from normal images spontaneous by using Artificial Neural Network Classifier and the accuracy are improved than the existing system(approx95.6 %).

REFERENCES:

1. R.G Bagasjvara, IkaCandradewi, Sri Hartati, and AgusHarjoko "Automated Detection and Classification Techniques of Acute Leukemia using Image Processing: A Review "DOI:10.1109/ICSTC.2016.78773442nd International Conference on Science and Technology (ICST), Yogyakarta, Indonesia 2016.
2. L.B. Dorini, R. Minetto, N.J. Leite, Semiautomatic white blood cell segmentation based on multiscale analysis, IEEE J. Biomed. Health. Inf. 17 (2013) 250–256.
3. H.T Madhloom, S.A Kareem, H. Ariffin, A.A. Zaidan, H.O. Alanazi and B.B. Zaidan, "An Automated White Blood Cell Nucleus Localization and Segmentation using Image Arithmetic and Automated Threshold", Journal of Applied Sciences 10(11), pp. 959-966, 2010©.
4. 4. JakkrichLaosai and KosinChamnongthai "Acute Leukemia Classification by Using SVM and K-Means Clustering "Proceedings of the International Electrical Engineering Congress King Mongkut's University of TechnologyThonburi,Bangkok,Thailand,DOI:10.1109/iEECON.2014.6925840, 2014.
5. 5.Dr. AntoBennet, M, SankarBabu G, Natarajan S, "Reverse Room Techniques for Irreversible Data Hiding", Journal of Chemical and Pharmaceutical Sciences 08(03): 469-475, September 2015.
6. 6..Dr. AntoBennet, M , Sankaranarayanan S, SankarBabu G, " Performance & Analysis of Effective Iris Recognition System Using Independent Component Analysis", Journal of Chemical and Pharmaceutical Sciences 08(03): 571-576, August 2015.
7. 7.Dr. AntoBennet, M, Suresh R, Mohamed Sulaiman S, "Performance &analysis of automated removal of head movement artifacts in EEG using brain computer interface", Journal of Chemical and Pharmaceutical Research 07(08): 291-299, August 2015.
8. 8.Dr. AntoBennet, M "A Novel Effective Refined Histogram For Supervised Texure Classification", International Journal of Computer & Modern Technology , Issue 01 ,Volume02 ,pp 67-73, June 2015.
9. 9.Dr. AntoBennet, M, SrinathR,RaishaBanuA,"Development of Deblocking Architectures for block artifact reduction in videos", International Journal of Applied Engineering Research,Volume 10, Number 09 (2015) pp. 6985-6991, April 2015.
10. 10.AntoBennet, M &JacobRaglend, "Performance Analysis Of Filtering Schedule Using Deblocking Filter For The Reduction Of Block Artifacts From MPEQ Compressed Document Images", Journal of Computer Science, vol. 8, no. 9, pp. 1447-1454, 2012.
11. 11.AntoBennet, M &JacobRaglend, "Performance Analysis of Block Artifact Reduction Scheme Using Pseudo Random Noise Mask Filtering", European Journal of Scientific Research, vol. 66 no.1, pp.120-129, 2011.
12. Rajesh, M., and J. M. Gnanasekar. "Path Observation Based Physical Routing Protocol for Wireless Ad Hoc Networks." Wireless Personal Communications 97.1 (2017): 1267-1289.
13. Rajesh, M., and J. M. Gnanasekar. "Sector Routing Protocol (SRP) in Ad-hoc Networks." Control Network and Complex Systems 5.7 (2015): 1-4.
14. Rajesh, M. "A Review on Excellence Analysis of Relationship Spur Advance in Wireless Ad Hoc Networks." International Journal of Pure and Applied Mathematics 118.9 (2018): 407-412.
15. Rajesh, M., et al. "SENSITIVE DATA SECURITY IN CLOUD COMPUTING AID OF DIFFERENT ENCRYPTION TECHNIQUES." Journal of Advanced Research in Dynamical and Control Systems 18.
16. Rajesh, M. "A signature based information security system for vitality proficient information accumulation in wireless sensor systems." International Journal of Pure and Applied Mathematics 118.9 (2018): 367-387.
17. Rajesh, M., K. Balasubramaniaswamy, and S. Aravindh. "MEBCK from Web using NLP Techniques." Computer Engineering and Intelligent Systems 6.8: 24-26.