International Journal of Future Generation Communication and Networking
Vol. 13, No. 2s, (2020), pp. 474–479

Acute Lymphoblastic Leukemia Detectionin Human Blood using Microscopic Image

Shivani Patil[1],P.P.Rathod[2] Samruddhi Patane[3], Manasi Patil[4]

[1,2,3,4] Dept. of E & TC Engg., Smt. Kashibai Navale College of Engineering, Pune ,SavitribaiPhule Pune University, Pune
[1]shivani.patil.3591@gmail.com
[2]pravinkumar.rathod_skncoe@sinhgad.edu
[3]samruddhipatanesp@gmail.com
[4]manasi.patil.566148@gmail.com

Abstract

This paper is designed to provide fast and cost effective product of patient diagnosis. Acute lymphoblastic leukemia is cancer of white blood cells (WCBs) also known as lymphoblastic. Acute lymphoblastic leukemia is type of leukemia which is more common in children and adult of older than 50 yrs.The term acute means the leukemia can progress quickly and if it is not treated properly may lead to fatal death within a few months.There is no specific nature of symptoms and signs of ALL leads wrong diagnosis.It is difficult to classify leukemia cells. The manual classification of the cells is time consuming and may be inaccurate.Therefore earlier detection of leukemia leads in providing appropriate treatment to patients.The solution to this problem is using various image processing technique to get a desired information from a blood images of individuates. In the blood image the leucocytes are separated from these blood samples and then it selects lymphocytes cells.

Keywords— *Acute lymphoblastic leukemia, Discrete orthonormal S-transform,Support vector machine.*

I. INTRODUCTION

The major criterion for the analysis of leukemia is a visual examination of blood sample. There are two different types of Leukemia which can lead to death if not treated at the right time are acute lymphoblastic leukemia and acute myeloid leukemia.ALL is detected in bone marrow and AML affects myeloid organs.Abnormal collection of white blood cell generates ALL.ALL is significant hematopoietic disease. The fighting capability of body with the foreign material gets diminished with increases in the number of malignant WBCs. Another important step for detection of ALL is recognition of blast cell in bone marrow. For detecting proper stage of ALL percentage of blast cell is measure concern that will be also help full for giving proper treatment to patients.

The perfection of the haematologists and pathologists is important of detection of disease.To support the haematologists for accurate earlier detection of ALL, a computer-aided diagnosis (CAD) system is used the feature of white blood cell(WBC) are generation it main step of CAD system which classify the cells into healthy or affected cell . The classification normal blood cell feature can be categorized as morphological,texture,statistical and colourthe smooth, rough, bumpy or silky as a function of the spatial variation in pixel intensities is suggested by this feature that define the characteristics by the image.

The term ‘Acute’ means that leukemia can progress quickly that may lead to fatal death within few month if not treated properly. Dueto its nonspecific nature of symptoms and signs of Acute Lymphoblastic Leukemia leads to wrong diagnosis.Even haematologists find it difficult to classify the leukemia cells & classification of blood cells is time consuming & it can be inaccurate.For this early classification of leukemia cells using blood sample may yields in providing the appropriate treatment to patient

The percentage of blasts is a major concern for detecting the proper stage of the ALL and is also helpful in the proper treatment of the patients. Leukemia is the most critical blood disease common in child and adults. A majority of cancer cell begins in body parts but leukemia is type of cancer which begins and grows in blood cells.ALL occurs when abnormal white blood cells produced by bone marrow. The detection of these blood cells depends on perfection of haematologists and pathologists,

ISSN: 2233-7857 IJFGCN

process is time consuming and difficult to get consistent results and may be inaccurate which may lead to the dead of the person.so early identification is necessary.The technique used for detection of leukemia cell using microscopic image using mat lab.

II. RELATED WORK

Monica Madhukar and Anthony T.Chronopoulos [1]conducted study that due to imitation of similar signs diagnostic confusion occur they had done much work due to complex nature of blood smear to meet clinical demands. These system includes colour correlation, segmentation of nucleatedcell, classification and validation. Feature exploit feature of colour and texture parameter. They use watersheetsegementation algorithm to segement the nucleus the common drawback is classify only sub images .Cell energy and Hausdorff dimension are the new feature used..Preprocessing step involves over come background nonuniformility. K- mean clustering algorithm is used to bring out nucleus of each cell.to enhance the boarder the boarder of memorance and cell sobell operator is used . accuracy of these method is 98%.Sonali Mishra and Pankaj Kumar Sa[2] they purpose technique of diagnosis number of lymphoblast in a bloods smear. Fnding out malignancies in blood ,the changes in nucleus and cytoplasm plays important role.The CAD is used here and divided into two categories .First applies genetic information ,while second uses information from the image modelled by using different ML techniques.It uses disceteorthogonaql S-transform for feature extraction.Followed by feature reduction using hybrid approach.DOST is used to characterized the texture of image and its accuracy is 98.67%.Random Forest is used for classification.This system accuracy is 94.61%.Banshidar Majhi and Lokesh Sharma[3] .Have purposed work to used CAD for classification and detection of ALL.Seperating Lymphoblast from microscopic image they have employed effective segmentation scheme.For feature extraction Gray level co-occurrence matrix is used.That extract texture feature.For classification Random Forest is used.Segmentation used here is the Watershed Segmentation.Accuracy of this method is 96%.Lokesh Sharma and Sonali Sharma[4] Purposed a method to make granules visible during analysis.Very low accuracy, slowness of analysis,drawbacks are improves in this system.For detection of Leukemia CAD is used.The better quality of image is generated by using Weiner Filtering followed by contrast enhancement with histogram equalization.

III. PROPOSED WORK

The proposed method includes steps like pre-processing, sub-imaging, feature extracting, feature reduction and classification. Techniques used are DOST for feature extraction and PCA+LDA for feature reduction. AdaBoost based Random Forest for classification.Figure1 shows block diagram of this purposed scheme.

A. Pre-processing and sub-imaging

Cancer affected blood sample dataset have been collected comprised of noise andbackgroundeffects.The RBCs and platelets present in the smear are unwanted for the detection of disease. To extract the WBCs from the blood smear, background subtraction is performed. Microscopic blood images are relatively larger in size and consist of more than one WBCs per image. However, the region of interest must contain only one WBC for the detection of ALL. Though all the WBCs require being examined for the detection of disease, bounding box method is applied to crop the image around each WBC. The next process is to clean the image that helps in removing some WBCs present on the edge of the image as well as the number of abnormal components. It can be done by evaluating the solidity of an object as per equation (1). Solidity measures the density of the object.A solidity value of 1 signifies a solid object whereas the solidity value less than 1 signifies the presence of holes in the object. Itcanbedefinedas,

$$\text{Solidity} = \frac{\text{area}}{\text{Convex area}} \quad \ldots\ldots\ldots\ldots(1)$$

which is used as a threshold for each leukocyte to be included for classification watershedsegmentation is used to calculate solidity value each WBC sub image After extracting the leukocytes from the peripheral blood smear, the next level segmentation is per- formed, which selects the nucleus and cytoplasm.

ISSN: 2233-7857 IJFGCN

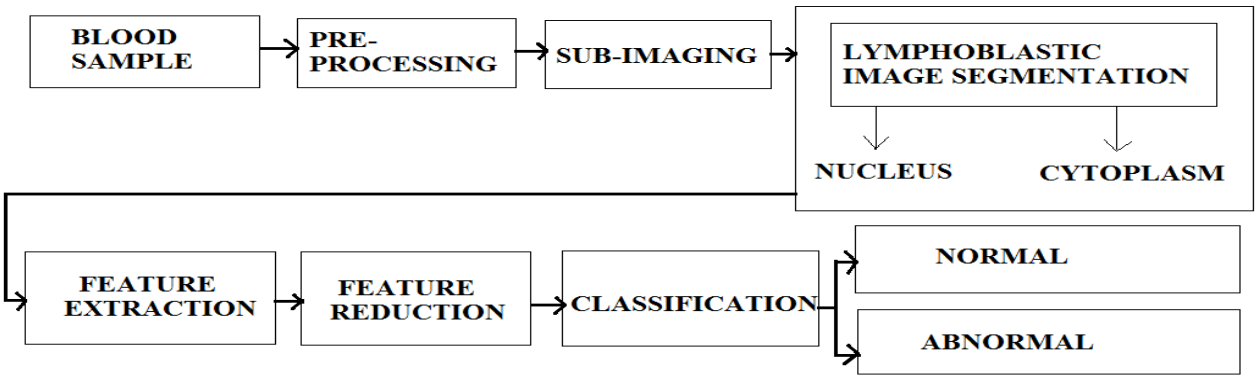

Fig1. Block diagram of an automated diagnosis of ALL.

B. Feature extraction

Discriminative features from the segmented nucleus and cytoplasm region can be found out and given to classifier for differentiation between lymphocyte (healthy) and lymphoblast's (unhealthy). The criteria for diagnosisdepends on the number oflymphoblast's reside in the blood smear. A lymphoblast is morphologically defined by a large shape nucleus including an irregular shape and size, the nucleoli are present and prominent, and moreover, the cytoplasm is intensely colored. The changes in the nucleus and cytoplasm region play an important role in finding out the malignancies in blood. Different features used extraction are color,texture that differentiate between normal and malignant cells

Discrete orthonormal S-transform is used for feature extraction.it is multiresolution technique used to characterized texture of an image. Intensity variation an image is signified by texture feature. feature extraction is the process of converting the image into data so that we can check these values with standardvalues. A pixel description of texture by giving horizontal frequency spectra is provided by 2D-DOST.In this method frequency domain is calculated using dyadic sampling scheme.DOST coefficient of a lymphocyte f(a,b) of size M x N is describe in step as follow

(a)find out fourior coefficient by performing fourier transform from equation (2)shown below,

$$F(u,v)=\sum_{a=0}^{M-1}\sum_{b=0}^{N-1} f(a,b)\, e^{-j2\pi(\frac{au}{M}+\frac{bv}{N})} \qquad \text{.....(2)}$$

(b)perform and inverse fourier transform by partitioning the fourier coefficient F(u,v) and square root of number of points in partition is multiply with it from equation (3)shown below,

$$S(a`,b`,u_{a,}u_{b)}=$$

$$\frac{1}{\sqrt{2^{P}a+Pb-2}}\sum_{u=2^{P}a-2}^{2^{P}a-2-1}\sum_{v=2^{P}b-2}^{2^{P}b-2-1} F(u+u_a.v+u_b)e^{-j2\pi}(\frac{ua'}{2^{Pa-1}}+\frac{vb'}{2^{Pb-1}})(3) \qquad \text{.....(3)}$$

Where,

u_a=$2^{Pa-1}+2^{Pa-2}$(horizontal frequency)

va=$2^{Pb-1}+2^{Pb-2}$(veritcal frequency)

(c)store the obtain DOST coefficient in empty feature matrix EM

M x N coefficients are given by DOST of an M X N image as they contain frequency information each coefficient is consider as an feature

C. Feature reduction

Problems like face recognition ,cancer detection etc. linear discriminant analysis is used. To find projection F that enhance the relation between class scatter sb an within scatter sw is prime objective of LDA.it is given as in equation (4),

$$\text{argmax}(F)\frac{|FS_bF|}{|FS_WF|} \qquad \text{.....(4)}$$

ISSN: 2233-7857 IJFGCN

Numerous challenges for very high dimension data is encounter by LDA algorithm very large scattering matrix are found an it is challenging task to manage them such issue is name as small sample size in this case dimension of origin feature set is larger than sample set. For this we have to use PCA before LDA approach so that the dimension of feature vector are lesser. SW will no longer in singular form by applying PCA by doing this LDA can be easily applied to get reduce feature set Feature reduction used to reduce the size of sample set so it is less than the dimension of original feature set.

D. Classification

For classification of normal and abnormal cell to improves accuracy we propose the combination of Ada boost an random forest classifier is used. the prediction in classification task is done by AdaBoost algorithm this classifier combines many classifier having high error rat e and produce resulting classifier having low error rate AdaBoost algorithm uses base algorithm in series of cycle. each training sample is assigned a weight that symbolize the expectation of sample being used for training set during experiment weight is renewed based on the prediction result after training. The sample that are correctly classified by weak learner get lower weights and incorrect sample get higher weights. The sample with lower weight is more focused in training set and process continues for each cycle. All weak hypotheses into single final hypothesis are combine linearly by AdaBoost .Among ML algorithms the random forest is most robust technique which has greater accuracy rate. It is useful for estimating the most appropriate features required for classification.

IV. PURPOSED EXPERIMENTATION RESULTS.

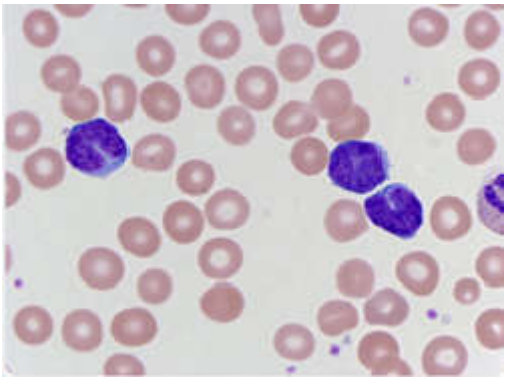

Fig 2.Sampled Input image

.

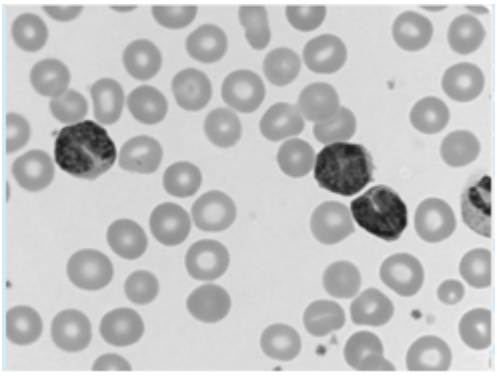

Fig 3.Gray scale image of sampled input image..

ISSN: 2233-7857 IJFGCN

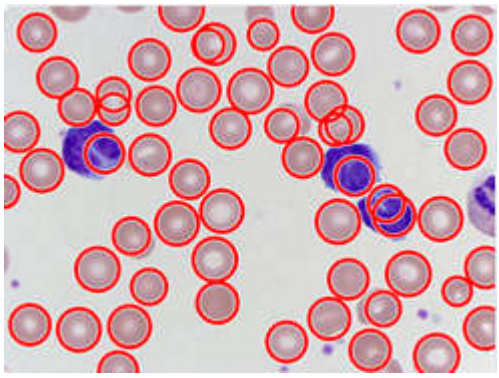

Fig 4.Output of specified stage of sampled input image.

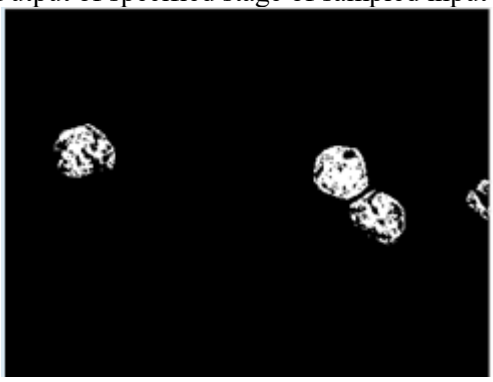

Fig 5.Image after background removal of sampled input image

V. ADVANTAGES

- More accurate.
- Required less time.
- Good Segmentation results
- Highly effective method
- Can overcome related constraints in visual inspection.
- Highly accurate classification model.

VI. CONCLUSION

In this paper, we purposed the detection of acute lymphoblasticleukemia for earlier detection of cancer using image processing Segmentation method separates nucleus from the leukocyte very simply and effectively here extraction of features from nucleus & cytoplasm helps in improving performance of the system.The dimension of extracted feature reduce by feature reduction we classified the cell abnormal and normal cells so the appropriate treatment given to patient.

ACKNOWLEDGMENT

We welcome this opportunity to express our heartfelt gratitude and regards to our project guide Prof.P.P.Rathod Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, for her unconditional guidance. He always bestowed parental care upon us and evinced keen interest in solving our problems. An erudite teacher, a magnificent person and a strict disciplinarian, we consider ourselves fortunate to have worked under her supervision. We are thankful to Honourable Principal, Smt. Kashibai Navale College of Engineering, Pune, Dr. A. V. Deshpande for the support. We are highly grateful to Dr. S. K. Jagtap Head of Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, Pune for providing necessary facilities during the course of the work .We admit thanks to Prof.S.M. Ingawale/Prof.P.G.Chilveri Project Coordinator ,Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, for giving us such an opportunity to carry on such mind stimulating and innovative project.

ISSN: 2233-7857 IJFGCN

REFERENCES

[1] Sos Agaian, Senior Member, IEEE, Monica Madhukar, and Anthony T. Chronopoulos, Senior Member, IEEE, "Automated Screening System for Acute Myelogen Leukemia Detection in Blood Microscopic Image." 1932-8184 2014 IEEE
[2] S.Mishra,B.Majhi,P.K..Sa, ,"Texture feature based classifaction on microscopic bloodsmear for acute lymphoblastic leukemia detection".Biomed.Signal Process Control 47 (2019) 303-311
[3] S.Mishra,B.Majhi,P.K..Sa,L.Sharma,"Grey level co-occurrence matrix and random forest based acute lymphoblastic leukemia detection".Biomed.Signal Process Control 33(2017)272-280
[4] S. Mishra, L. Sharma, B. Majhi, P.K. Sa, "Microscopic image classification using DCT for the detection of acute lymphoblastic leukemia (ALL)", in: Proceedings of International Conference on Computer Vision and Image Processing, Springer, 2017, pp. 171–180.
[5] Escalante, H.J., et al.: "Acute leukemia classification by ensemble particle swarm model selection". Artificial intelligence in medicine 55.3 163–175 (2012)
[6] Scotti, F.: "Automatic morphological analysis for acute leukemia identification in peripheral blood microscope images". IEEE International Conference on Computational Intelligence for Measurement Systems and Applications. (2005)
[7] S. Mishra, L. Sharma, B. Majhi, P.K. Sa, "Microscopic image classification using DCT for the detection of acute lymphoblastic leukemia (ALL)", in: Proceedings of International Conference on Computer Vision and Image Processing, Springer, 2017, pp. 171–180.
[8] M. Bishop, "Pattern recognition", Mach. Learn. (2018) 128.
[9] S. Mishra, B. Majhi, P.K. Sa, F. Siddiqui, "GLRLM based feature extraction for acute lymphoblastic leukemia ALL detection", 2018.
[10] S. Mishra, B. Majhi, P.K. Sa, "A survey on automated diagnosis on the detection of leukemia: a hematologicaldisorder", in: 2016 3rd International Conference on Recent Advances in Information Technology (RAIT), IEEE, 2016, pp. 460–466.
[11] L. Faivdullah, F. Azahar, Z.Z. Htike, W.Y.N. Naing, "Leukemia detection from blood smears", J. Med. Bioeng. 4 (6) (2015).
[12] Y. Zhang, S. Wang, P. Phillips, Z. Dong, G. Ji, J. Yang,"Detection of Alzheimer's disease and mild cognitive impairment based on structural volumetric MR images using 3D-DWT and WTA-KSVM trained by PSOTVAC".Biomed. Signal Process. Control 21 (2015) 58–73.
[13] Z. Liu, J. Liu, X. Xiao, H. Yuan, X. Li, J. Chang, C. Zheng, "Segmentation of white blood cells through nucleus mark watershed operations and mean shift clustering", Sensors 15 (9) (2015) 22561–22586.
[14] L. Putzu, G. Caocci, C. Di Ruberto, "Leucocyte classification for leukaemia detection using image processing techniques", Artif. Intell. Med. 62 (3) (2014) 179–191.
[15] S. Arslan, E. Ozyurek, C. Gunduz-Demir, "A colorand shape based algorithm for segmentation of white blood cells in peripheral blood and bone marrow images", CytometryA 85 (6) (2014) 480–490.
[16] L. Putzu, G. Caocci, C. Di Ruberto, "Leucocyte classification for leukaemia detection using image processing techniques", Artif. Intell. Med. 62 (3) (2014) 179–191.
[17] T.-C. Lin, R.-S. Liu, Y.-T. Chao, S.-Y. Chen, " Classifying subtypes of acute lymphoblastic leukemia using silhouette statistics and genetic algorithms", Gene 518 (1) (2013) 159–163.
[18] S. Mohapatra, D. Patra, S. Satpathy, "Unsupervised blood microscopic image segmentation and leukemia detection using colorbased clustering", Int. J.Comput. Inf. Syst. Ind. Manage. Appl. 4 (2012) 477–485.
[19] H.T. Madhloom, S.A. Kareem, H. Ariffin, "An image processing application for the localization and segmentation of lymphoblast cell using peripheral blood images", J. Med. Syst. 36 (4) (2012) 2149–2158.
[20] A. Agarwal, O. Chapelle, M. Dudik, and J. Langford, "A reliable effec- tiveterascale linear learning system," arXiv:1110.4198, 2011, preprint, Cornell University Library.

ISSN: 2233-7857 IJFGCN