A Deep Learning of WBC Cancer Diseases based on Lymphoblastic Leukemia Detection

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Abstract- *Medical industry is one of the most prominent industry where deep learning can play a huge role especially when it comes to medical imaging. Automated analysis of WBC cancer diseases which include Leukemia and Myeloma having similar symptoms. Therefore, from the doctor's side, they might be confused to diagnose those two diseases. The proposed methodology comprises of two stages, namely- preprocessing stage that includes image noise removal and WBC lymphoblastic leukemia detection followed by CD technique. This technique involves some filtering methods and K-Means clustering approach for image segmentation. The proposed system will produce the parameters such as circularity, solidity, mean, elongation, extent will be evaluated. Finally, neural network methodology is applied directly whether the given input image has cancer effected cell or not. The experimental result shows that the better accuracy in the parameter values and also reduce the noise of an image.*

Keywords- white blood cell, color detection, deep learning, neural network.

I. INTRODUCTION

The malignancy of the cancer is considered as subsequent driving reason for death in the world and has killed 8.8 million individuals in 2015 [3]. There are various types of cancers presents in this world. The WBC cancer are important part in human beings' immune systems. WBC plays a major role in human body. It is protecting our body from various infections. It is also called as white corpuscle. Cancer cells have the ability to spread other parts of the body using blood [2]. This cancer cell affects our entire white blood cell. This is classified into two types. These are given by, Leukemia and Myeloma. It may be acute or chronic. Acute Myeloid Leukemia (AML) is sub classified to (M0, M1, M2, M3, M4, M5, M6, M7). Acute lymphoblastic leukemia (ALL) is sub categorized to (L1, L2, L3) [4].

Image is defined as the 2D light intensity function which is f (x, y) where x and y are spatial co-ordinates. The value of 'f' at any point 'x' and 'y' refers the grey level or intensity level of an image at that point. An image stored in raster form [5].

In the last few years image processing play a crucial function. The medical images received from various systems which are taken into one of the most important equipment and techniques used in analysis of many cancer diseases and making the decision, as the principle goal of image processing is to discover the ROI and extract the useful statistical news for correct diagnosis, results in fee saving and offer fine tracking and estimation in the treatment of illnesses [10-15].

II. LITERATURE SURVEY

S. Mohapatra et al delivered Acute lymphoblastic leukemia (ALL) are a set of hematological neoplasia of youth that's characterized by way of a large wide variety of lymphoid blasts in the blood move. ALL makes around 80% of formative years leukemia and it normally occur within the age institution of 3-7. Support Vector Machine (SVM) is employed for classification. [8].

N.M. Salem et al proposed the Effectiveness of an automated morphological technique to identify the Acute Lymphocytic Leukemia with the aid of peripheral blood microscope snap shots. The proposed device first off individuates inside the blood picture the leucocytes from the others blood cells, then it selects the lymphocyte cells. [6].

M. Subrajeet,et al described WBC segmentation from coloration snap shots of blood smear observed by way of relevant characteristic extraction for leukemia detection. It evaluates morphological indexes from the one's cells and in the end, it classifies the presence of the leukemia [9].

Yu. C. Yang and Z. Hanget al proposed the features may be used with any classifier for leukemia detection. Furthermore the system must be robust to immoderate staining and touching cells. Segmentation partitions an image into distinct. Segmentation of images are performed in two stages for extracting WBC nucleus cells from the blood microscopic images by the use of color-based clustering.[1].

K. D. Hung and D. C. Huang et al delivered the genetic algorithm-based k-means clustering approach is used to classify the different types of leukocyte in the medical field. The experimental results show that only leukocyte some of the nucleus features are used for classification and achieve a highest accuracy of the system better than the other systems[7].

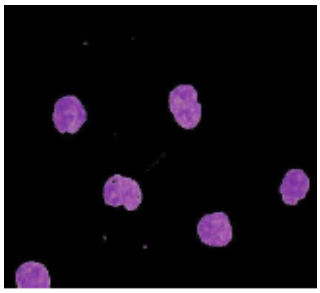

Fig1. K- Means output

Automated leukemia detection in blood microscopic images is performed using statistical texture analysis. By using the deep learning classifier, the features are extracted and classified. Segmentation in blood images is done by using K means algorithm. Gaussian distribution is applied on the input blood images. Normalization is applied by adaptive threshold algorithm.

III. METHODOLOGY

Various methods are used to identify WBC cancer disease. The methods are given by,

A. Input image

Firstly, the images of blood samples are acquired using a camera and it is presented with required resolution for better quality. The input image is then resized to 100x100. The construction of an image database depends on the required applications. The picture database has to be carefully constructed in that it typically comes to the performance of the classifier and overall performance of the proposed technique.

B. Preprocessing

Preprocessing is the technique is used to enhance the quality of the image. It includes color space conversion and image enhancement. The RGB images of blood samples are converted into Y C_b C_r (Y- Luma, C_b- Chrominance, C_r- Luminance) color space. The transformation of color is done to decide the luminosity and chromaticity layers. The color space conversion is used for the enhancement of the visual analysis.

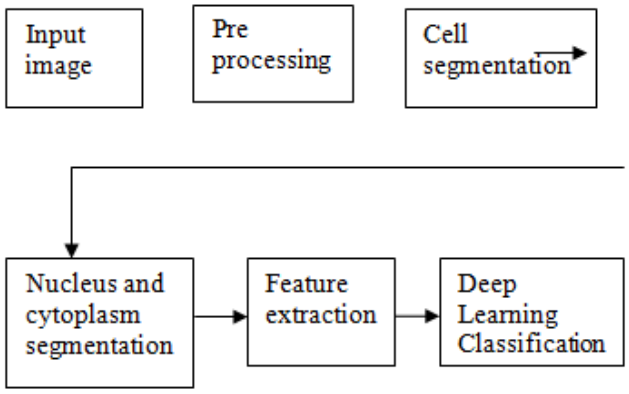

Fig2. Block Diagram

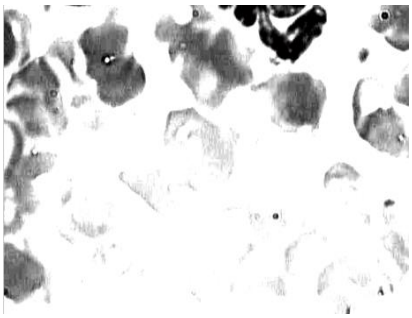

Fig 3. Preprocessing image

C. Cell segmentation

Cell segmentation is the technique that is used to simplify the presentation of an image into correct form.K-Means algorithm, or Lloyd's algorithm is an iterative algorithm that partitions the data and assigns n observations to precisely one of k clusters defined by centroids. The steps in the algorithms are given by,

1. Choose k initial cluster centers.
2. Compute point to cluster distances of all observations to each centroid.
3. Assign each observation to the cluster with the closet centroid.
4. Compute the mean of observation in each cluster to obtain k new centroid locations
5. Repeat the steps 2 through 4 until there is no change in the cluster assignments or the maximum number of iterations is reached.

D. Nucleus and Cytoplasm segmentation

Each stained picture contained one or extra leukocytes. In addition, the purple blood and different fabric inclusive of platelets are also contained within the blood smear images. To segment the leukocyte nucleus, first want to perceive the locations of leukocytes. The proposed leukocyte

nucleus segmentation processing includes steps inclusive of leukocyte nucleus improving and segmentation.

E. Feature Extraction

This phase is applied on the segmented images.After segmentation, the GLCM features are extracted from the images. Gray Scale Co Occurrence Matrix (GLCM) is a statistical method of investigating texture which considers the spatial relationship of pixels.

The GLCM functions characterize the texture of images by computing functions characterize the texture of images.by computing the spatial relationship among the pixels in the images. The Statistical measures are extracted from this matrix. In the creation of GLCMs, an array of offsets which describe pixels relationships of varying direction and distance have to be specified.In the proposed methodology, five features are extracted which includes Circularity, Solitidy, Mean, Extent and Elongation.

F. Classification

The convolution neural networks are the deep learning algorithm is particularly powerful analysis of images. Convolution neural network use the data that is represented in images. Convolution neural networks are the fundamental block of the networks. It is supervised classification algorithm.

The idea of deep learning classification is to create a hyper plane in between data set. The blood sample image is given as input to the classifier. The performance of the classifier is measure by comparing the predicted labels and actual values.

Deep learning algorithm achieved successes in medical field as its one the most powerful algorithm that is widely used in different applications. It is effective in high dimensional space where number of dimensions is greater than the number of training data. The color detection algorithm is used to identify the pixels in an image that match a specified color. The color of the detected pixels can then be changed to distinguish them from the rest of image.

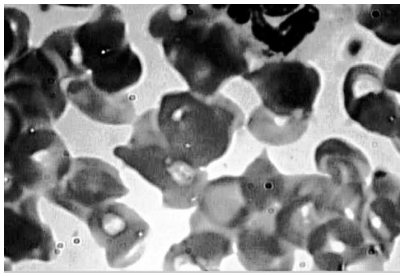

Fig 4. Deep Learning Patch extraction

The neural network Classification is applied for shape, color, and texture.In this phase it is possible to control the selection process. The nucleus area must be smaller than the external membrane. In this classification section following features will be classified,

a) Circularity

It is the measure of the complexity in an object.

$$cicularity = \frac{Area}{Perimeter} \qquad (1)$$

b) Solidity

It is proportion of ROI area to the area of convex hull.

$$Solidity = \frac{Area}{Convex\ Area} \qquad (2)$$

c) Mean

It is average value of pixels intensity od the ROI.

$$Mean = \frac{pixel\ intensityof\ ROI}{total\ intensity} \qquad (3)$$

d) Extent

It is the proportion of ROI area to area of its bounded rectangle.

$$Extent = \frac{Area}{Width * Length} \qquad (4)$$

e) Elongation

It is the ratio of Length of smallest rectangle (LSR) to the width of smallest rectangle (WSR).

$$Elongation = \frac{LSR}{WSR} \qquad (5)$$

This algorithm is a simple method used to set up the hidden understanding in the facts to permit category and prediction. The construction of the algorithm is simple and fast, and does not need any domain knowledge and hence appropriate for exploratory knowledge discovery. Neural networks are used for classification and the classification rules can be easily generated from them. It is very fastest algorithm compared than others.

The nucleus and cytoplasm are separated by using the threshold segmentation. Cytoplasm and nucleus are uniform

area. The threshold level is used to separate the nucleus from the cytoplasm in the cell. The separated images are given by,

Fig 5a. Cytoplasm Fig 5b. Nucleus

WBC cancer destroy a significant immune challenge in the current era. Myeloma is a leading cancer it affects the bone marrow of human beings.

The K-Means clustering algorithm performs the segmentation by minimizing the squares of distances between the image intensities and the cluster. K-Means clustering method was used to create initial markers in our algorithm. K-Means clustering methods partitions the objects into k clusters based on minimum square error.

It is effective and iterative clustering technique which partitions large amount of data until intra-cluster variance is lesser than inter-cluster variance.Automated detection of ALL and its classification, that is, L1, L2, L3, and Normal which are detected by using Deep Convolutional neural network. Last layers of the pretrained network were replaced with new layers which can classify the input images into 4 classes.

To reduce overtraining, data augmentation technique was used. We also compared the data with different models to check the performance over different color images. For acute lymphoblastic leukemia (ALL) detection, we achieved a sensitivity is 100%, specificity is 98.11%, and accuracy is 97.85%.

Table 1. Various methods and its results

S. No	Detection	Segmentation	Classifier	Accuracy
1	ALL &AML	Gaussian Distribution	Random forest	93%
2	ALL	Fuzzy Clustering	SVM	93.5%
3	ALL	Watershed Algorithm	SVM	93%
4	ALL &AML	Fuzzy clustering	GMM	95%

The comparison table describes various methods and its results. The proposed method produceshighest accuracy than the previous year works because we are using neural networks for classification process and K-Means clustering method is used to segmentation process. These are the best classifier to detect and differentiate the WBC cancer and its types. The outputs are detected by using MATLAB software. The propose method results in presented in the below table,

Table 2. Our proposed methods and its results,

S. No	Detection	Segmentation	Classifier	Accuracy
1	ALL&AML	K-Means Clustering	Deep Learning Neural network	97.85%

The above table explained the detection of WBC cancer type and produce highest accuracy. It is easy to identify those diseases. Acute Lymphoblastic Leukemia (ALL) and Acute Myeloid Leukemia (AML) are the basic classifications of WBC cancer diseases. In this paper, we can identify or diagnose the difference between the types of the WBC cancer because both diseases have similar symptoms. So, the doctors confused to identify those two categories of diseases. We used best classifier in this paper. Using this classification, we can able to differentiate those two same symptom diseases. In this system we propose the method on the blood images, then it extracts lymphocyte cells and morphological indexes from those cells.

IV. RESULTS ANDDISCUSSION

Blood sample image is widely used for the diagnosis of WBC cancer diseases and visualization of structures such as input image, conversion image of RGB to Y C_b C_r, Cell segmentation, Enhance contrast using Histogram equalization, Objects and borders image including cell nucleus, Feature Extractionimage, Deep learning patch Extraction image, Extraction ofleukemia image, and the non-affected cancer cell image. The segmentation is performed on the blood sample images using K-Means clustering. A sample blood input image is shown in the Fig.6

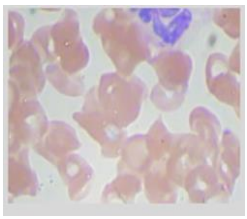

Fig 6.Input image

Color Detection (CD) method removes the noise effectively in the medical images. By using the CD denoising

method the noise in the blood images can be reduced. The de-noised image is shown in theFig.7,

Fig.7. Denoised image

The second step of the preprocessing is the blood sample images. K-Means clustering is used for segmentation process. The de-noised image is gives as input to the K-Means clustering based segmentation. The output of the K-Means clustering segmentation method is below,

In this proposed methodology, it has been tested using blood images and these images extracted using preprocessing and Cell segmentation.

In the proposed method, deep learning classificationis used because it is extradinary tool for classification. The processing of image is faster. No processing or chemicals are needed to take digital images.It has been tested using sample blood images and these images extracted using preprocessing, cell segmentation, Feature extraction and classification. The dataset consists of 105 cell images of three types of WBC cancer diseases including ALL, AML, Myeloma. Our goal of the system was to create the classifier and test the subsystems of this paper.

Neural network algorithm is used to segment the regions. It is used tosegmentsanimagebydetectingthe WBC cancer classification.

Fig 8. Cell segmentation image

The below figure is the segmented image from the given input image. It is segmented by using K-Means clustering and it is converted it to contrast histogram equalization. It is one of the contrasting methods. The domain of the catchment basins from the input image. The histogram output is shown in Fig.9.

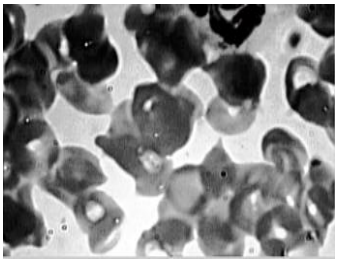

Fig 9. Contrast histogram

Then finally the output was obtained by using the neural network deep learning classifier. It is the best classifier to diagnose the WBC cancer and its major type. The final output is given by,

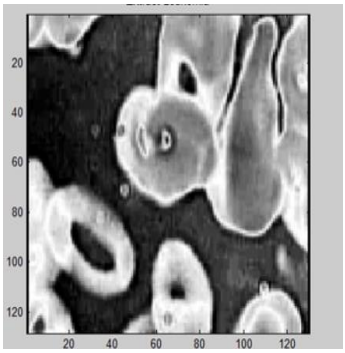

Fig 10. Extracted Leukemia

V. CONCLUSION AND FUTURE WORK

This work presents preprocessing stage that includes image noise removal and WBC lymphoblastic leukemia detection followed by color detection (CD) technique. This technique involves some filtering methods and K-Means clustering approach for image segmentation. This method is customized for ROI area segmentation by utilizing denoised blood images to train it from scratch. The main contributions of this work are the WBC cancer and its subtypes are automatically identified. The denoising method using CD successfully removed the AWGN and preserved the texture features. As a result, the classifier performance was improved using denoised blood images. The proposed algorithm was computationally more efficient and required less post-processing compared to traditional algorithms. The proposed algorithm out performed k- means, neural network deep learning classifier and other some various techniques. Further enhancement of blood images improved the results by preserving gradient for segmentation function.

Future efforts can be directed towards the implementation of such modified proposed architectures for the detection of WBC.

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