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Comparative Study of Detection and Classification of Leukemia Using Image Processing and ML

[1]Jyoti D. Shendage, [2]Dr. Janardan A. Pawar, [3]Dhanashri S. Kulkarni

[1]Assistant Professor, Computer Science Department

Indira College of Commerce and Science, Pune Maharashtra, India.

[2]Associate Professor, Computer Science Department

Indira College of Commerce and Science, Pune Maharashtra, India.

[3]Assistant Professor, Computer Science Department

Indira College of Commerce and Science, Pune Maharashtra, India.

Abstract: Blood is essential component in human life and is best indicator tool for determining many pathological conditions. Classification of blood cells is of great prominence for the diagnosis of haematological diseases. Hematological disorders of leukocytes (white Blood Corpuscles) are very frequent in medical practices. Every year, the number of new cases of leukemia increased with a high rate which causes delay in diagnosis and treatment of leukemia. Leukemia is a malignant blood growth that affects leukocytes. Acute leukemia can be either acute lymphocytic leukemia (ALL) or acute myeloid leukemia (AML). In case of ALL, a gathering of leukocytes called lymphocytes. It is a rapidly-progressive blood-cancer. It destroys the immune system. Hence, it leads to death if untreated in right-time.

Due to Modernization Automated Systems are developed which helps in healthcare practices for assessment and treatment. Leukemia is a form of cancer that can be fatal disease, and to rehabilitate and treat it requires a correct and early diagnosis. Advanced methods can be used to help patients detect disorders. The Blood act as the main circulating agent for hormones, enzymes, and vitamins. Cells present in blood are White blood cells (Leukocytes), red blood Cells (Erythrocytes) and Platelets (Thrombocytes). In this paper we are reviewing and comparing different techniques which are used by researchers for detection and classification of leukemia using Image processing and ML with their results.

1. Introduction:

Image Processing as a computer-based technology, plays an increasingly significant role in many fields of our day to day life. Through Image Processing we can process and interpret all the information as if it processed in the human brain. It is used in biomedical field for interpretation of X-ray images, blood/ cellular microscope images. Also used for recognition, analysis and enhancement of images.

Between All types of blood cancers, Leukemia is the most common form of malignancy in different age groups. This abnormal phenomenon is caused by excessive proliferation and immature growth of blood cells, which can damage red blood cells, bone marrow, and the defence system.

An early diagnosis of leukemia has always been a challenge to researchers, doctors, and hematologists because Leukemia diagnosis is difficult in its early stages due to the mild nature of the symptoms. As we know Leukemia is a fatal disease, that's why it is important to early diagnose it. The aim of this paper is to compare different types of methods used for detection and classification of Blood Cell by researchers for diagnosis of Leukemia.
According to worldwide statistics by the World Health Organization (WHO)'s International Agency for Research on Cancer, they reported 437,033 cases of leukemia and 303,006 deaths as of 2022 [6]

2. Comparative Study

Table 1.1 Comparative Study of existing detection and classification of Leukemia using Image processing and ML

Year	Author	Method Used for Segmentation/ Detection / Classification of Blood Cell	Remark and Research Gap
2022	Wagh K.S., Kamthe S.S., Sawant V.P., Chavan A.A., Kakde A.J.	Dense Convolutional Neural Network (DenseNet-121) and Residual Convolutional Neural Network (ResNet-34).	Advanced CNN models, such as ResNet and DenseNet, are deeper and more complex having the ability to learn better.
2022	Niranjana S., Krishnaraj C., N. Goswami,	In this research algorithm is implemented with a convolutional neural network (CNN) to predict the leukemic cells from the healthy blood cells. The custom ALLNET model was trained and tested using the microscopic images available as open-source data. The model training was carried out on Google Collaboratory using the Nvidia Tesla P-100 GPU method.	Here Maximum accuracy of 95.54%, specificity of 95.81%, sensitivity of 95.91%, F1-score of 95.43%, and precision of 96% were obtained by this accurate classifier. This type of proposed technique may be used during the pre-screening to detect the leukemia cells during complete blood count (CBC) and peripheral blood tests.
2021	Pradeep Kumar Das , Rutuparna Panda	Laplacian-of-Gaussian (LoG)-based modified highboosting operation, bounded opening followed by fast radial symmetry. A novel hybrid EF-based blood-cell segmentation approach, which may be used for detecting various hematological disorders. (BOFRS)-based seed-point detection, and (LS)-based geometric hybrid ellipse fitting (EF), respectively	The proposed methods have the ability to extract the seed points more accurately and to segment the overlapping cells more precisely, even if from the low-contrast inhomogeneous visual features. Therefore, the method is suitable for solving complex blood cell segmentation problems. LS Based geometric ellipse fitting approach helps in more localization, therefore better accuracy. Because of Combined benefits of geometric and algebraic EFMs it performs better.
2020	Pradeep Kumar Das, P. Jadoun and S. Meher	In this research paper Extraction of lymphocytes is accomplished by the color based k-means clustering technique.shape, texture, and color	The proposed method yields promising results with 96.00% accuracy and 92.64% sensitivity.

		features are extracted from the segmented image. Gray-level co-occurrence matrix (GLCM) and gray-level run-length matrix (GLRLM) algorithms are used to extract the features of nucleus. Moreover, Principal component analysis (PCA) is applied for dimensional reduction. Also, an SVM (support vector machine) with an RBF kernel is employed to classify WBCs.	For KNN classifier it gives 91.20% Accuracy. For BPNN classifier it gives 93.50% Accuracy. For SVM classifier gives 96.00% Accuracy.
2019	Abdullah Elen , M. Kamil Turan	In this study, 350 microscopic blood smear images were tested with 6 different machine learning algorithms for the classification of white blood cells and their performances were compared. 35 different geometric and statistical (texture) features have been extracted from blood images for training and test parameters of machine learning algorithms. **ML Algorithms used** 1. Decision Tree Classifier. 2. Random Forest 3. k-Nearest Neighbors (k-NN) 4.Multinomial Logistic Regression (MLR) 5.Naïve Bayes 6.Support Vector Machine (SVM)	According to the results, the Multinomial Logistic Regression (MLR) algorithm performed better than the other methods with an average 96.55% test success. All Datasets are trained and tested at different rates for each ML algorithms 1. Decision Tree Classifier. - 81.61% 2. Random Forest- 91.38% 3. k-Nearest Neighbors (k-NN)-81.61% 4.Multinomial Logistic Regression (MLR)-96.55% 5.Naïve Bayes-82.76% 6.Support Vector Machine (SVM)-84.48%
2019	Md. Nuruddin Qaisar Bhuiyan, Shantanu K., Razwan A.	**ML Algorithms Used are** Random Forest (RF). Support Vector Machine (SVM). Logistic Regression (LR). Decision Tree (DT).	Random Forest (RF)- 98.00% Accuracy. Support Vector Machine (SVM) - gives 99.20 % Accuracy. Logistic Regression (LR)-97.18 Decision Tree (DT)- 98.18% Accuracy.
2018	Subhash Rajpurohit, Sanket P., Nitu C., Shreya G.	Researcher uses OpenCV and skimage for image processing to extract relevant features from blood image. Classifiers:-CNN,FNN,SVM and KNN	Results obtained are as follows CNN gives highest accuracy of 98.33%. CNN and FNN uses TensorFlow framework. FNN gives 95.40% accuracy SVM has 91.40% Accuraccy KNN shows 93.30% accuracy.

3. Conclusion:

An Efficient Blood-Cell Segmentation for the Detection of Hematological Disorders proposed method performs better than the existing methods because of the combined benefits of geometric and algebraic EFMs. It detects the cells more accurately due to proper EF. It is a computationally efficient technique since it hybridizes no iterative-geometric and algebraic methods. The noise problem is solved by employing a LoG-based modified high boosting operation. The proposed algorithm does not need any training and hence does not need any training data; making it a very suitable approach than a deep learning-based technique when there is very less or no data available for training.

The use of image processing with Computer-Based algorithm makes possible the classification of very easy. The system should classify Leukemia accurately on the basis of blood smear images. To classify Dense Convolutional Neural Network (DenseNet-121) and Residual Convolutional Neural Network (ResNet-34) are used. The early and fast identification of Leukemia greatly aids in providing the appropriate treatment.

Above Reviewed methods are used for early diagnosis of cancer from Blood Smear Images of white blood cells using CNN Image processing and ML techniques.

After reviewing these papers which gives an automated system to detect the Acute Lymphoblastic Leukemia (ALL) from the microscopic blood. The Convolutional Neural Network (CNN) classifier model achieves the highest accuracy of 98.33%. Shows highest accuracy rate.[7]

In case of Machine Learning Algorithm Support Vector Machine (SVM) is recommended to classify blast cells as it provides higher precision and accuracy i.e. 99.05%. [8]

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