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Classification of Blood Cells into White Blood Cells and Red Blood Cells from Blood Smear Images using Machine Learning Technique

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ABSTRACT

The classification of blood cells from peripheral blood smear (PBS) images is an important step in diagnosing blood-related illnesses such as leukemia, anemia, infection, malignancy, and polycythemia. Hematologists always use a microscope to count, shape, and distribute the cells before making a judgment in blood cell-based analysis. Hematology analyzers and flow cytometry give an accurate and precise Complete Blood Count (CBC) that detects abnormalities in blood smear slides. The techniques being employed are highly costly, time-consuming, manual, and unavailable in many hospitals. As a result, a reliable, affordable, and automatic method for identifying different diseases from any PBS image is required. The automatic categorization model optimizes hematological operations, speeds up the diagnosis process, and increases the accuracy of evaluation. Therefore, in this research, we classified and segmented blood cells into Red Blood Cells (RBC) and White Blood Cells (WBC) using a semi-automated method. Gray Level Co-occurrence Matrix (GLCM) is used to extract texture information from a cell. The recovered texture features are then fed into classifiers such as logistic regression, ANN, SVM, K-nearest neighbors, decision trees, and K-means clustering. After comparing the performance metrics, it is determined that the logistic regression method is the most appropriate for the task at hand.

Index Terms—Microscopic blood smear images, White blood cells, Red blood cells, Feature extraction, Machine learning

I. INTRODUCTION

In medical diagnostics, separating blood cells into red blood cells (RBCs) and white blood cells (WBCs) from blood smear images is a crucial task. Medical personnel may find it easier to diagnose a variety of illnesses and ailments by quickly and accurately identifying blood cell types with the help of automated picture analysis via machine learning techniques[6,7,8]. This gives a general idea of the significance of the assignment and the approaches taken to ensure correct classification. This research project uses digital images from blood smear samples to develop and evaluate machine learning-based techniques for the automated classification of blood cells into red blood cells (erythrocytes) and white blood cells (leukocytes). Blood cell analysis plays a pivotal role in medical diagnostics, aiding in the detection and understanding of various hematologic disorders and diseases. Among the crucial components of blood, white blood cells (leukocytes) and red blood cells (erythrocytes) serve distinct physiological functions and exhibit characteristic morphological features. The classification and differentiation of these cells from microscopic blood smear images are essential for accurate diagnosis and monitoring of blood-related ailments. Manual examination of blood smears by hematologists or trained technicians is time-consuming and subjective,

relying on visual inspection to differentiate between various cell types. The integration of machine learning techniques in analyzing these images offers a promising avenue for automating this process, potentially improving accuracy, consistency, and efficiency in blood cell classification.

LITERATURE SURVEY

There has been a substantial body of research dedicated to the application of machine learning in the context of blood smear classification, with many studies emphasizing the utility of convolutional neural networks (CNNs) in this domain.

Transfer learning, a well-established technique in machine learning, has found resonance in the field of whale detection as well. This technique involves leveraging knowledge or features acquired from one related task to enhance the performance of a distinct yet interconnected task. The application of transfer learning has demonstrated its efficacy in a range of applications, including the domain of blood smear image classification.

In "*Detection of RBCs, WBCs, Platelets Count in Blood Sample by using Deep Learning*" [1] In this paper, In this work, a machine literacy system learning the system of automated motorized counting of blood cells is proposed. By using machine literacy and deep literacy ways, the blood cells and their counts can be linked with the stylish delicacy compared to the other being ways. The Convolutional Neural Netwok (CNN) is used for the image bracket. One of the stylish ways for achieving the stylish delicacy in the least quantum of time for the blood cells dataset is Visual Geometry Group (VGG- 16) fashion. The proposed system is a combination of the Convolutional Neural Network (CNN) and Visual Geometry Group (VGG- 16) styles. In general, this computer- backed system of detecting the blood cells is more useful for practical operations.

[2]. Blood Cell Bracket using Neural Network Models. Author Jagrit Mitra, Kartik Vijayran, Kartikeya Verma, Anurag Goe. Blood cells bracket is a pivotal aspect in medical opinion. Several machine literacy models have been proposed under colorful inquiries for bracket of blood cells in recent times. still, the traditional machine learning algorithms are limited in the accurate discovery of abnormal cells. In this study, we propose deep literacy grounded approach for blood cell bracket and estimate the effectiveness of multi-layer neural network model erected for the bracket of the colorful types of White Blood Cells using Convolutional Neural Networks(CNN) and intermittent Neural Networks(RNN) in combination. The proposed system leverages the strengths of both CNN and RNN and gives better results.

[3.] Paper name Bracket of blood cells into white blood cells and red blood cells from blood smear images using machine literacy ways. Author NavyaK.T, Keerthana Prasad, Brij Mohan Kumar Singh.

Bracket of blood cells from supplemental Blood Smear(PBS) images is a pivotal step to diagnose blood related diseases similar as leukemia, anemia, an infection, cancer, and polycythemia. In blood cellgrounded analysis, the hematologists always make a decision grounded on the total number of cells, their morphology, and distribution using a microscope. Hematology analyzer, inflow cytometry give dependable and exact Complete Blood Count(CBC) indicating abnormalities in the blood smear slide. The styles being used are veritably precious, time consuming, bear homemade intervention and not accessible in numerous medical centers. Therefor there's a necessity for an automatic, affordable and robust fashion to descry colorful types of conditions from any PBS images. The automatic bracket model improves the hematological procedures, quickens the opinion process and enhances the delicacy of the evaluation process. therefore in this paper, we used asemi-automatic system to member and classify blood cells into White Blood cell(WBC) and Red Blood Cell(RBC).

[4.] Paper name point birth of White Blood Cells Using CMYK- Moment Localization and Deep literacy in Acute Myeloid Leukemia Blood Smear bitsy Images. Author Yuan Zhang, Yunlong Mao.

Artificial intelligence has revolutionized medical opinion, particularly for cancers. Acute myeloid leukemia(AML) opinion is a tedious protocol that's prone to hu man and machine crimes. In several cases, it's delicate to make an accurate final decision indeed after careful examination by an educated pathologist. How ever, computer- backed opinion(CAD) can help reduce the crimes and time associated with AML opinion. White Blood Cells(WBC) discovery is a critical step in AML opinion, and deep literacy is considered a state- of- the- art approach for WBC discovery. still, the delicacy of WBC discovery is explosively associated with the quality of the uprooted features used in training thepixel-wise bracket models. In this study, a new mongrel point birth system was developed using image processing and deep literacy styles. The proposed system consists of two way 1) a region of interest(ROI) is uprooted Plagiarised Unique Total Words: 825 Total Characters: 5393 Plagiarized Sentences: 0.53 Unique Sentences: 52.47 (99%) 1% 99% Page 1 of 2 using the CMYK moment localization system and 2) deep literacy-grounded features are uprooted using a CNN- grounded point emulsion system. Several bracket algorithms are used to estimate the significance of the uprooted features. The proposed point birth system was estimated using an external dataset and benchmarked against other point birth styles.

[5.] Paper Name Bracket of White Blood Cells A Comprehensive Study Using Transfer Learning Grounded on Convolutional Neural Networks Author Thinam Tamang 1, Sushish Baral, 2 and May Phu Paing 3.
White blood cells(WBCs) in the mortal vulnerable system defend against infection and cover the body from external dangerous objects. They're comprised of neutrophils, eosinophils, basophils, monocytes, and lymphocytes, whereby each accounts for a distinct chance and performs specific functions. Traditionally, the clinical laboratory procedure for quantifying the specific types of white blood cells is an integral part of a complete blood count(CBC) test, which aids in covering the health of people. This paper exploits a number of state- of- the- art deep literacy models and their variations grounded on CNN armature. A relative study on model performance grounded on delicacy, F1- score, recall, perfection, number of parameters, and time was conducted, and DenseNet161 was set up to demonstrate a superior performance among its counter corridor. In addition, advanced optimization ways similar as normalization, mixed up addition, and marker smoothing were also employed on thick Net to further upgrade its performance.

[6.] Paper Name Bracket of white blood cells from bitsy images using CNN
Author: J.Setu Sai Sowmya Kumari1,K.ChandraSekharaChari2,M.Leelavathi3,K.Pavan Kumar4,Mrs.N.Rajeswari5 Abstract White Blood Cells also known as leukocytes plays an important part in the mortal body by adding the impunity by fighting against contagious conditions. The bracket of White Blood Cells, plays an important part in discovery of a complaint in an existent. The bracket can also help with the identification of conditions like infections, disinclinations, anemia, leukemia, cancer, Acquired Immune Deficiency Syn drome(AIDS),etc. that are caused due to anomalies in the vulnerable system. This bracket will help the hematologist distinguish the type of White Blood Cells present in mortal body and find the root cause of conditions. presently there are a large quantum of exploration going on in this field. Considering a huge eventuality in the significance of bracket of WBCs, a deep literacy fashion named Convolution Neural Networks(CNN) will be used which can classify the images of WBCs into its subtypes videlicet, Neutrophil, Eosinophil, Lymphocyte and Monocyte[9,10]. The results of colorful trials executed on the Blood Cell Bracket and Discovery Blood Cell Bracket and Discovery (BCCD) dataset using CNN are reported in this design[11,12,13].

METHODOLOGY

This section explains the proposed model depicted in Figure.

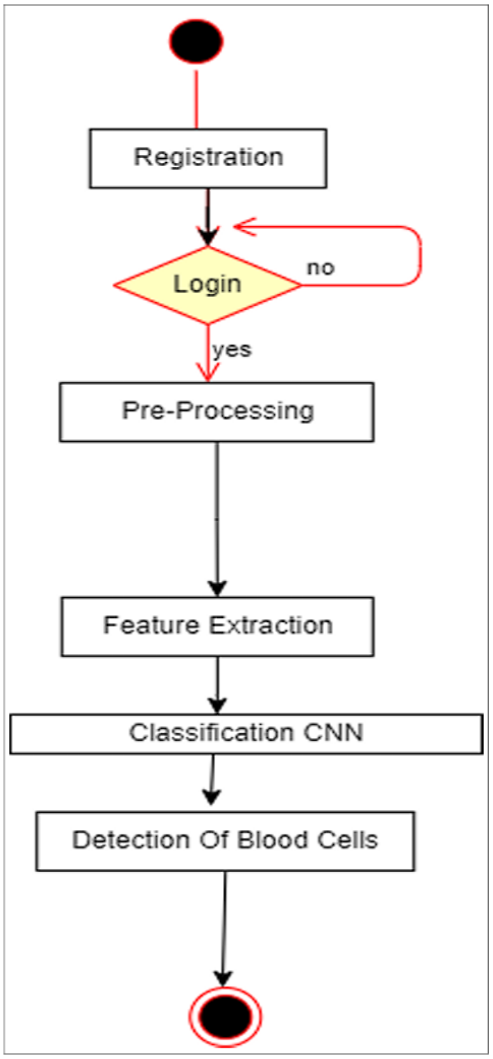

Fig. 1. A block diagram of the proposed model

A. Image Acquistion

The PBS pictures of numerous recolor are procured from the Kasturba Restorative College (KMC), Hematology division, Manipal and other web sources.

B. Pre-processing

Preprocessing is done on the obtained pictures to make strides the quality of an picture. The WBCs and RBCs from PBS pictures are physically trimmed and preprocessed utilizing neighborhood versatile histogram for uniform differentiate and light. Weiner channel with a sifting window of [3,3] is utilized to expel commotion and artifacts. At that point dark world color normalization strategy was utilized to rectify the color varieties by computing the cruel of each channel of the picture.

C. Feature Extraction

Feature extraction is the strategy of collecting particular properties from a set of tests which makes a difference in separating between the categories of input designs. The surface highlights of physically portioned pictures are extricated utilizing GLCM. It is a measurable strategy that gives an sum of the changes in escalated at the concerned pixel. Utilizing graycomatrix and graycoprops work in MATLAB, surface highlights like differentiate,

vitality, relationship and homogeneity as appeared in the conditions can be extricated from the locale of intrigued in an picture [13]. Texture equations:

$$Energy = \sum_{i,j=0}^{N-1} (P_{i,j})^2$$

$$Contrast = \sum_{i,j=0}^{N-1} P_{i,j}(i-j)^2$$

$$Homogeneity = \sum_{i,j=0}^{N-1} \frac{P_{i,j}}{1+(i-j)^2}$$

$$Correlation - \sum_{i,j=0}^{N-1} P_{ij} \frac{(i-\mu)(j-\mu)}{\sigma^2}$$

Pij = Component i,j of the normalized GLCM.
N = Sum of gray levels in the image.
μ= Cruel of the GLCM .
σ2 = the escalated change of all reference pixels.

D. Classification
Image classification analyzes the measurable properties of particular picture highlights and organizes information into classes. The Gray-Level Co-occurrence Matrix (GLCM) extricated highlights are given to the ML calculations such as Credulous Bayes classifier, K-means clustering Choice Tree Decision Tree (DT), calculated relapse irregular timberland, K-Nearest Neighbors (KNN), Artificial Neural Network(ANN) and Support Vector Machine (SVM). The Machine Learning (ML) methods utilized to classify blood cells are briefly clarified in the taking after sections.

E. Logistic Regression
Logistic regression is used for binary classification problems. It uses a logistic regression equation to measure the relationship between the discrete response variable and one or more independent variables by estimating probabilities.

CONCLUSION

The application of machine learning techniques for the automated classification of blood cells from blood smear images presents a promising avenue in medical diagnostics. This study aimed to develop an efficient and accurate system capable of distinguished between white blood cells (WBCs) and red blood cells(RBCs) using digital image analysis. The integration of machine learning algorithms for blood cell classification from blood cell classification from blood smear images holds immense potential in revolutionizing medical diagnostics. The developed automated system showcases promising results in accurately identifying and categorizing blood cells, offering significant advancements in clinical diagnostics, pathology analysis and medical research.

REFERENCES

[1] Manwatkar, A. Deshmukhe, S. Dagade, N. Deshmukh, N. Jadhav “Machine Learning Based Blood Cell Categorization in Semar Images” vol. 10, No. 6[2023] : nov-dec

[2] M. Jagannathan-Bogdan and L. I. Zon, “Hematopoiesis,” Development, vol. 140, no. 12, pp. 2463–2467, 2013.
[3] K. W. Jones, “Evaluation of cell morphology and introduction to platelet and white blood cell morphology,” Clinical Hematology and Fundamentals of Hemostasis, pp. 93–116, 2009.
[4] M. M. Alam and M. T. Islam, “Machine learning approach of automatic identification and counting of blood cells,” Healthcare technology letters, vol. 6, no. 4, pp. 103–108, 2019.
[5] Kokane, C., Babar, S., & Mahalle, P. (2023, March). An adaptive algorithm for polysemous words in natural language processing. In Proceedings of Third International Conference on Advances in Computer Engineering and Communication Systems: ICACECS 2022 (pp. 163-172). Singapore: Springer Nature Singapore.
[6] Kokane, C. D., Mohadikar, G., Khapekar, S., Jadhao, B., Waykole, T., & Deotare, V. V. (2023). Machine Learning Approach for Intelligent Transport System in IOV-Based Vehicular Network Traffic for Smart Cities. International Journal of Intelligent Systems and Applications in Engineering, 11(11s), 06-16.
[7] Kokane, C., Babar, S., Mahalle, P., & Patil, S. (2022). Word sense disambiguation: A supervised semantic similarity based complex network approach. Int J Intell Syst Appl Eng, 10(1s), 90-94.
[8] Kokane, C.D., Babar, S.D., Mahalle, P.N., Patil, S.P. (2023). Word Sense Disambiguation: Adaptive Word Embedding with Adaptive-Lexical Resource. In: Chaki, N., Roy, N.D., Debnath, P., Saeed, K. (eds) Proceedings of International Conference on Data Analytics and Insights, ICDAI 2023. ICDAI 2023. Lecture Notes in Networks and Systems, vol 727. Springer, Singapore. https://doi.org/10.1007/978-981-99-3878-0_36
[9] Kokane, C. D., & Sachin, D. (2021). Babar, and Parikshit N. Mahalle." Word Sense Disambiguation for Large Documents Using Neural Network Model.". In 2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT). IEEE.
[10] Kokane, C. D., & Sachin, D. (2020). Babar, and Parikshit N. Mahalle." An adaptive algorithm for lexical ambiguity in word sense disambiguation.". In Proceeding of First Doctoral Symposium on Natural Computing Research: DSNCR.
[11] Kokane, C.D., Babar, S.D., Mahalle, P.N. (2021). An Adaptive Algorithm for Lexical Ambiguity in Word Sense Disambiguation. In: Patil, V.H., Dey, N., N. Mahalle, P., Shafi Pathan, M., Kimbahune, V.V. (eds) Proceeding of First Doctoral Symposium on Natural Computing Research. Lecture Notes in Networks and Systems, vol 169. Springer, Singapore. https://doi.org/10.1007/978-981-33-4073-2_11
[12] Kokane, C., Babar, S., Mahalle, P. (2023). An Adaptive Algorithm for Polysemous Words in Natural Language Processing. In: Reddy, A.B., Nagini, S., Balas, V.E., Raju, K.S. (eds) Proceedings of Third International Conference on Advances in Computer Engineering and Communication Systems. Lecture Notes in Networks and Systems, vol 612. Springer, Singapore. https://doi.org/10.1007/978-981-19-9228-5_15
[13] D. Kokane, S. D. Babar and P. N. Mahalle, "Word Sense Disambiguation for Large Documents Using Neural Network Model," *2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, Kharagpur, India, 2021, pp. 1-5, doi: 10.1109/ICCCNT51525.2021.9580101.