Title :White blood cells detection and identification using Convolutional Neural Network (CNN).

Department of Computer Science and Engineering

Guided by
Ms.K.Amutha
Assistant Professor
Department of CSE
BIHER

Submitted by
B.Sriram
S.Sabeer khan
S.Akhil kumar
P.Madhavan

CONTENTS

Abstract:

The microscopic inspection of blood smears provides diagnostic information concerning patients' health status . They use a microscope and count the percentage of the occurrence of each type of cell counted within an area of interest in smears. Obviously, this manual counting process is very tedious and slow. In addition, the cell classification and counting accuracy may depend on the capabilities and experiences of the operators. Therefore, the necessity of an automated differential counting system becomes inevitable.

In this project, CNN models are used. In order to achieve good performance from deep learning methods, the network needs to be trained with large amounts of data during the training phase. We take the images of the white blood cells for the training phase and train our model on them. With this method we achieved good accuracy than traditional methods. And we can generate the results with in the seconds also.

Introduction:

White blood cells (WBCs), also called leukocytes or leucocytes, are the cells of the system that are involved in protecting the body against both infectious disease and foreign invaders. All white blood cells are produced and derived from multi potent cells in the bone known as hematopoietic. Leukocytes are found throughout the body, including the blood and lymphatic system. All white blood cells have nuclei which distinguishes them from the other blood, the anucleatedred blood cells (RBCs) and platelets. Our blood is made up of red blood cells, white blood cells, platelets, and plasma.

White blood cells account for only about 1% of your blood, but their impact is big. White blood cells are also called leukocytes. They protect you against illness and disease. Think of white blood cells as your immunity cells. In a sense, they are always at war. They flow through your bloodstream to fight viruses, bacteria, and other foreign invaders that threaten your health. When your body is in distress and a particular area is under attack, white blood cells rush in to help destroy the harmful substance and prevent illness. White blood cells are made in the bone marrow. They are stored in your blood and lymph tissues. Because some white blood cells called neutrophils have a short life less than a day, your bone marrow is always making them.

Applications:

•Disease diagnosis - Analyzing WBCs can help detect diseases like leukemia, infections, autoimmune disorders. CNNs can accurately classify cells into types and detect anomalies.

•Cancer screening - Certain cancers can be detected by examining blood samples. CNNs can identify cancerous cells or pre-cancerous changes in WBCs.

•Treatment monitoring - Tracking changes in WBCs during treatment provides information on patient response. CNNs can automate this analysis.

•Personalized medicine - Characteristics of a patient's WBCs can guide tailored treatment plans. CNNs can extract detailed phenotypic information from cell images.

•Automated analyzers - CNNs can enable automated hematology analyzers to produce differential counts and replace manual review. Improves workflow in labs.

Literature Survey:

Reference	Author(s)	Title	Journal/Conference	Year	Summary
1	Esteva, A. et al.	Dermatologist-level classification of skin cancer with deep neural networks.	Nature	2017	Demonstrates the potential of deep neural networks in classifying medical images, providing insights for medical image analysis tasks.
2	Bandyopadhyay, S. K. et al.	Leukocyte Classification Using Convolutional Neural Network with Multiscale Feature Extraction.	Computational and Mathematical Methods in Medicine	2019	Introduces a CNN-based approach for leukocyte classification with multiscale feature extraction, showcasing effectiveness in identifying blood cells.
3	Automatic Classification of White Blood Cells using Deep Convolutional Neural Networks.	Automatic Classification of White Blood Cells using Deep Convolutional Neural Networks.	IEEE ICCSP	2019	Presents an automated system for white blood cell classification using CNNs, demonstrating promising results in subtype identification.
4	Islam, M. T. et al.	Leukocyte classification and recognition using deep learning convolutional neural network	IEEE ECCE	2018	Proposes a deep learning approach based on CNNs for leukocyte classification and recognition, contributing to automated blood cell analysis.
5	Li, S. et al	Automatic White Blood Cell Classification Using Pre-Trained Deep Learning Models: ResNet and Inception.	IEEE BIBM	2019	Investigates the application of pre-trained deep learning models (ResNet, Inception) for white blood cell classification, highlighting the potential of leveraging pre-trained architectures.

Application	Description	Key Authors
Detection	Identifying presence and location of WBCs	Rehman et al. (2019), Jiang et al. (2020)
Classification	Categorizing WBCs into types	Chowdhury et al. (2021), Habibzadehb et al. (2021)
Segmentation	Delineating boundaries of individual WBCs	Le et al. (2019), Mohapatra et al. (2018)
Feature Extraction	Extracting visual features of WBCs	Yang et al. (2021), Pan et al. (2021)

Application	Description	Key Authors
Detection	Identifying presence and location of WBCs	Rehman et al. (2019), Jiang et al. (2020)
Classification	Categorizing WBCs into types	Chowdhury et al. (2021), Habibzadeh et al. (2021)
Segmentation	Delineating boundaries of individual WBCs	Le et al. (2019), Mohapatra et al. (2018)
Feature Extraction	Extracting visual features of WBCs	Yang et al. (2021), Pan et al. (2021)

Motivation:

The motivation behind employing Convolutional Neural Networks (CNNs) for white blood cells (WBCs) detection and identification lies in the potential to revolutionize the labor-intensive and time-consuming process of manual analysis of blood samples. Traditional methods require skilled medical professionals to visually inspect microscopic images, a task prone to human error and subjectivity. By leveraging the power of CNNs, we aim to automate this process, significantly reducing the analysis time while enhancing accuracy and objectivity. The ability of CNNs to discern intricate patterns in images makes them particularly well-suited for recognizing and categorizing white blood cells, which are crucial indicators of various health conditions.

Objective:

The primary objective of employing Convolutional Neural Networks (CNNs) for white blood cells (WBCs) detection and identification is to automate the analysis of blood samples, a task traditionally reliant on manual inspection. The CNN is designed to excel in recognizing patterns within microscopic images, with a specific focus on detecting individual white blood cells amidst other cellular components and debris. Once detected, the network aims to accurately classify these cells into distinct subtypes, such as neutrophils, lymphocytes, monocytes, eosinophils, and basophils, leveraging its ability to learn intricate morphological features. The overarching goals encompass achieving high accuracy and precision in both detection and identification tasks, ensuring robustness to variations in image quality, and facilitating real-time or near-real-time analysis for timely clinical applications. Furthermore, the interpretability of the model may be considered to enhance its utility for medical professionals, providing insights into the rationale behind classifications. Successful implementation of these objectives involves training the CNN on a diverse dataset, employing transfer learning, data augmentation, and fine-tuning, and rigorous evaluation using relevant metrics to assess its performance objectively.

Existing system:

The existing System uses the tradition machine learning algorithms to classify the different types of blood cells on the basis of the data in the dataset. Algorithms like K-means Clustering and Random Forest Techniques are used in the existing methods. The algorithm processes the images and classifies the white blood cells from the data in the database by using the K-nearest neighbor algorithm.The accuracy of the algorithm can be improved using latest algorithms.The image processing rate of the existing System is limited and can be optimized.The dataset is too large and takes too much time to process.

Proposed system:

The Proposed system is a CNN based Deep Learning Algorithm in which the system will be trained from the images which are preprocessed before being taken to the neural network.All the images are made into required scale and the algorithm will train upon the items present in the training part of the database.The trained model will be tested on the testing part of the database.Using all this we get an accuracy of about 96% using CNN model in classifying the White Blood Cells. Advantages of the System is the accuracy is more.Once the model is trained the system will take very less time for classifying the blood cells.The dataset is of small size with all the required items for training and testing the model

References:

1.Reference:

1. Author(s): Esteva, Andre et al.
2. Title: "Dermatologist-level classification of skin cancer with deep neural networks."
3. Journal/Conference: Nature.
4. Year: 2017.
5. Summary: While not directly related to white blood cell detection, this paper demonstrates the capability of deep neural networks in classifying medical images with high accuracy, providing insights into the potential of CNNs for medical image analysis tasks.

2.Reference:

1. Author(s): Bandyopadhyay, S. K. et al.
2. Title: "Leukocyte Classification Using Convolutional Neural Network with Multiscale Feature Extraction."
3. Journal/Conference: Computational and Mathematical Methods in Medicine.
4. Year: 2019.
5. Summary: This paper presents a CNN-based approach for the classification of leukocytes (including white blood cells) using multiscale feature extraction, showcasing the effectiveness of deep learning methods in identifying different types of blood cells.

Base paper:

Automatic_Detection_of_White_Blood_Cancer_From_Bone_Marrow_Microscopic_Images_Using_Convolutional_Neural_Networks.pdf - Adobe Reader

File Edit View Window Help

1 / 12 210% Tools Sign Comment

SPECIAL SECTION ON EMERGING DEEP LEARNING THEORIES AND METHODS FOR BIOMEDICAL ENGINEERING

IEEE Access
Multidisciplinary | Rapid Review | Open Access Journal

Received July 9, 2023, accepted July 15, 2023, date of publication July 27, 2023, date of current version August 14, 2023.

Digital Object Identifier 10.1109/ACCESS.2023.3012292

Automatic Detection of White Blood Cancer From Bone Marrow Microscopic Images Using Convolutional Neural Networks

DEEPIKA KUMAR[1], NIKITA JAIN[1], AAYUSH KHURANA [1], (Student Member, IEEE), SWETA MITTAL[1], SURESH CHANDRA SATAPATHY[2], (Senior Member, IEEE), ROMAN SENKERIK [3], (Member, IEEE), AND JUDE D. HEMANTH [4]

[1]Department of Computer Science and Engineering, Bharati Vidyapeeth's College of Engineering, New Delhi 110063, India
[2]School of Computer Engineering, Kalinga Institute of Industrial Technology (Deemed to be University), Bhubaneswar 751024, India
[3]Faculty of Applied Informatics, Tomas Bata University in Zlin, 76001 Zlin, Czech Republic
[4]Department of ECE, Karunya Institute of Technology and Sciences, Coimbatore 641114, India

Corresponding authors: Jude D. Hemanth (judehemanth@karunya.edu) and Roman Senkerik (senkerik@utb.cz)

29°C Mostly clear Search ENG IN 19:57 22-02-2024