A Blood Cell Classification Using a Deep Learning Algorithm CNN

[1]Sai Srinivas Vellela, [2]Khader Basha Sk, [3]Venkateswara Reddy B
[1, 2]Assistant Professor, Dept. of CSE, Chalapathi Institute of Technology, Guntur, AP, India-522016
[3]Assistant Professor, Dept. of CSE, Kakinada Institute of Technology and Science, Kakinada, AP

1. ABSTRACT

The objective of the study is to evaluate the efficiency of on a multi layer neural network models built by combining Recurrent Neural Network(RNN) and Convolutional Neural Network(CNN) for solving the problem of classifying of different kind of White Blood Cells. This can have applications in the pharmaceutical and healthcare industry for automating the analysis of blood tests and other processes requiring identifying the nature of blood cells in a given image sample. It can also be used in diagnosis of various blood related diseases in patients.

Deep Learning has already shown power in many application fields, and is accepted by and more people as a better approach than the traditional machine learning models. In particular, the implementation of deep learning algorithms, especially Convolutional Neural Networks (CNN), brings huge benefits to the medical field, where a huge number of images are to be processed and analysed.

This project aim is to develop a deep learning model to address the blood cell classification problem, which is one of the most challenging problems in blood diagnosis. A CNN-based framework is built to automatically classify the blood cell images into subtypes of the cells. Experiments are conducted on a dataset of 13k images of blood cells with their subtypes, and the results show that our proposed model provide better results in terms of evaluation parameters

KEYWORDS: Recurrent Neural Network, Convolutional Neural Network, Blood Cell.

2. INTRODUCTION

White Blood Cells are an important component of our immune system. The concentration of various WBCs play an important role in determining the health of our body. Automating the process of detection of these blood cells accurately can help expedite various medical processes. Each class of White Blood Cell is unique. They have differences in texture, color size and morphology. Our approach attempts to classify the WBCs based on the latent features of their image.

The two main segments of the architecture of our proposed neural network are a Convolutional Neural Network and a Recurrent Neural Network, both trained using the same image data. Convolutional Neural Network (CNN) is a type of neural network containing cells that extract features from an input by moving over it with a small window, called a kernel. The kernel moves over the entire input, and the portion of the image captured in the kernel window is checked for features corresponding to the one the cell has learned to detect. Applied sequentially, Convolution Neural Networks are capable of extracting both high- level and low-level features. They are typically applied to images, where the usage of a simple feed forward network would make the hidden layers unnecessarily large and computationally expensive, and also prone to over fitting.

A Recurrent Neural Network (RNN) is a variation of standard feed forward networks where the output of a layer is dependent not only on the current input, but also the set of inputs that has come before. This is useful for sequence detection and generation. They provide a significant advantage when the inputs obtained before can be used to predict what kind of output comes later.The blood test plays imperative part in recognizing infections. It gives the points of interest approximately the common state of a person's prosperity conditions. Based on information from blood test pros, they select the treatment for the quiet required. White blood cells (WBC) are an imperative component of blood framework. It is fundamental for great wellbeing and security

against malady.

WBC contains in a general sense five parts and depends on its assortment of measure, number and shape. Based on variety in these highlights there can happen numerous illnesses Blood passes on basic substance to all standard of the body, it could be a transporting fluid. The white blood cell accept basic portion in immunity of the body. The white blood cell is something else called leukocytes which are nucleated cell conveyed from bone marrow. The major obligation of WBC is to battle disease and cancer. Monocytes, neutrophils, basophils, eosinophil's, lymphocytes are basically sorts of leukocytes. Each kind of leukocyte has there on properties for ID like tally, shape, morphological changes.

When a person's advise with master for check-up or sickness concern you've got, your master may approach critical information from your blood test .About 90 rate of the data within the normal therapeutic chart comes from research facility information. Within the occasion of developments and distinctive perilous maladies, blood tests deliver strong signs around how the body is working. To recognizing the contaminations take more noteworthiness of blood testing is legitimately basic. Pros see the total blood tally for tall or moo tallies of diverse blood cells additionally for irregular blood cells.For recognizable confirmation of sicknesses most commonly utilized two frameworks, they are include up to WBC check and check of each kind of WBC, which is known as differential number or diff test. WBC number can be discovered by utilizing manual strategy and laser based cytometer.

3. LITERATURE SUREVEY

White Blood Cell Classification Using CNN

AUTHORS: M.Mayank Sharma, S. Aishwarya Bhave

The density of white blood cells in bloodstream provides a glimpse into the state of the immune system and any potential risks such as heart disease or infection. A dramatic change in the white blood cell count relative to your baseline is generally a sign that your body is currently being affected by an antigen. A variation in a specific type of white blood cell generally correlates with a specific type of antigen. Currently, a manual approach is followed for white blood cell classification; however, some semi- automated approaches have been proposed which involves manual feature extraction and selection and an automated classification using microscopic blood smear images. In this work, we propose deep learning methodology to automate the entire process using convolutional neural networks for a binary class with an accuracy of 96% as well as multiclass classification with an accuracy of 87%.

Detection Of Subtype Blood Cell Using Deep Learning AUTHORS : C.

Deepak Gupta, A.Benyou wang

Deep Learning has already shown power in many application fields, and is accepted by more and more people as a better approach than the traditional machine learning models. In particular, the implementation of deep learning algorithms, especially Convolutional Neural Networks (CNN), brings huge benefits to the medical field, where a huge number of images are to be processed and analyzed. This paper aims to develop a deep learning model to address the blood cell classification problem, which is one of the most challenging problems in blood diagnosis. A CNN-based framework is built to automatically classify the blood cell images into subtypes of the cells. Experiments are conducted on a dataset of 13k images of blood cells with their subtypes, and the results show that our proposed model provide better results in terms of evaluation parameters.

Detection of White Blood Cell Cancer using Image Processing AUTHORS : Rohit Agrawal; Sachinandan Satapathy

Detection of White Blood Cell (WBC) cancer diseases like Acute Myeloid Leukemia (AML), Acute Lymphoblastic Leukemia (ALL), and Myeloma is a complex task in medical field because they are sudden in onset. Our proposed method consists of designing and developing an automated system which will assist the medical professionals in correctly diagnosing all the types and sub-types of this disease. In this paper, we have proposed a novel method in which we have taken microscopic blood images as an input image. A dataset of 100 images in which 62 training and 38 testing images is taken. After that we have converted the image to proper format (YCbCr) for segmentation. For segmenting, we have used the combination of Gaussian Distribution, Otsu Adaptive Thresholding and for clustering we have used K-Means method. Using Gray Level Co-occurrence Matrix (GLCM), the features are extracted and were used for classification using Convolutional Neural Network (CNN). The overall accuracy of the system obtained after processing is 97.3%.

4. PROPOSED SYSTEM:

This classification will assist the hematologist distinguish the type of White Blood Cells present in human body and find the root cause of diseases. Currently there are a large amount of research going on in this field. Considering a huge potential in the significance of classification of WBCs, we will be using a deep learning technique Convolution Neural Networks (CNN) which can classify the images of WBCs into its subtypes namely, Neutrophil, Eosinophil, Lymphocyte and Monocyte. In this paper, we will be reporting the results of various experiments executed on the Blood Cell Classification and Detection (BCCD) dataset using CNN.

ADVANTAGES OF PROPOSED SYSTEM:

Predication of blood cell is perfectly well this models.
Provides an information on malaria epidemiological surveillance.
Distinguishes between different plasmodium species.
Provides both qualitative plasmodium species and quantitative parasite desnsity,data.

ADVANTAGES OF PROPOSED SYSTEM:

- Predication of blood cell is perfectly well this models.
- Provides an information on malaria epidemiological surveillance.
- Distinguishes between different plasmodium species.
- Provides qualitative plasmodium species and quantitative parasite density, data.

5. CONVOLUTIONAL NEURAL NETWORK

Artificial Intelligence has been witnessing a monumental growth in bridging the gap between the capabilities of humans and machines. Researchers and enthusiasts alike, work on numerous aspects of the field to make amazing things happen. One of many such areas is the domain of Computer Vision.

The agenda for his field is to enable machines to view the world as humans do, perceive it in a similar manner and even use the knowledge for a multitude of tasks such as Image & Video recognition, Image Analysis & Classification, Media Recreation, Recommendation Systems, Natural Language Processing, etc. The advancements in Computer Vision with Deep Learning has been constructed and perfected with time, primarily over one particular algorithm — a **Convolutional Neural Network**.

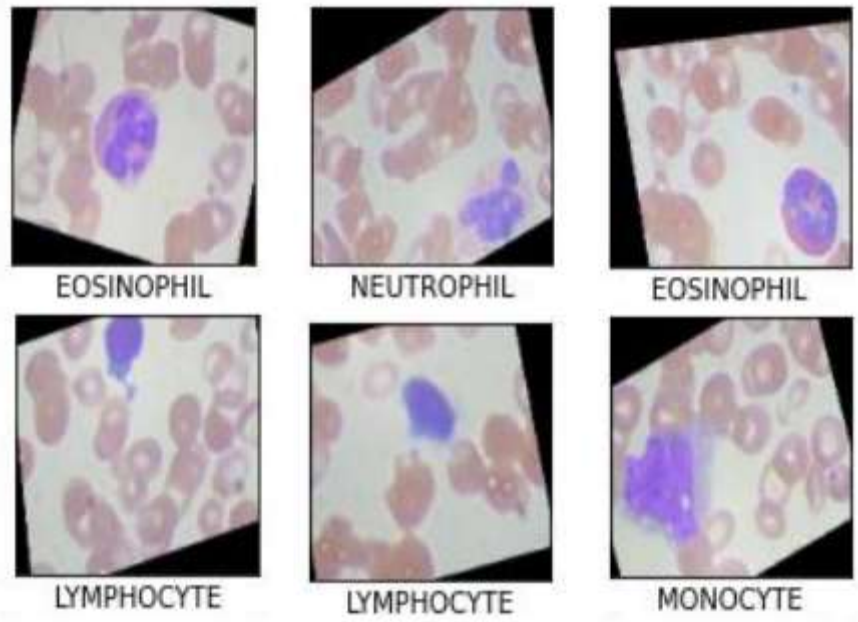
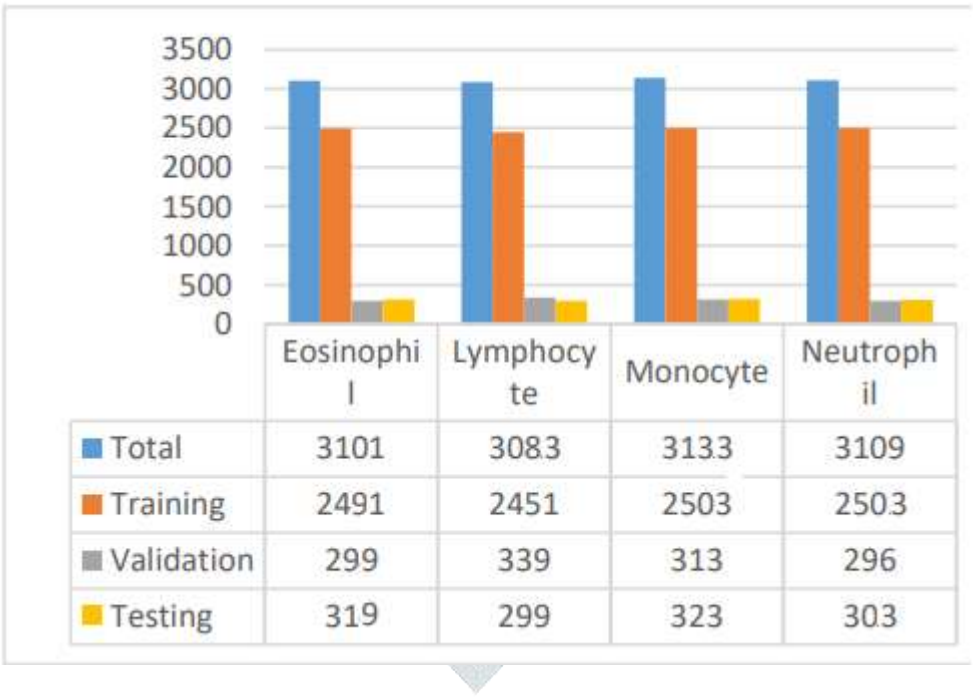


Fig: WBC Images



	Eosinophil	Lymphocyte	Monocyte	Neutrophil
Total	3101	3083	3133	3109
Training	2491	2451	2503	2503
Validation	299	339	313	296
Testing	319	299	323	303

Fig: The distribution of the blood cells in the given dataset.

6. A **Convolutional Neural Network (ConvNet/CNN)** is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area.

7. RESULT ANALYSIS

In this section, there is a discussion on Machine Learning performance of a Novel Approach is used for Blood Cell Classification Using CNN, to Optimize Prediction Method.

The performance metrics like Accuracy, Recall and F1 score are measured, based on these values. By the terms, these factors of classification measurement are calculated.

True Positive: If a sample is predicted correctly as positive and in actual it is positive.
True Negative: If a sample is predicted correctly as negative and in actual it is negative.
False positive: If a sample is incorrectly predicted as negative but in actual it is positive.
False Negative: If a sample is predicted incorrectly as positive but in actual it is positive.

Accuracy: It measures the ability of the system to make correct predictions, it is a performance parameter, and is expressed as,

$$Accuracy = \frac{TP}{TP + TN + FP + FN} \quad (1)$$

Recall: To the total number of observations in actual class, it is the ratio of correctly predicted positive observations. and is expressed as,

$$Recall = \frac{TP}{TP + FN} .. (2)$$

F1-Score:
A weighted average of the precision and recall, is consider as F1-Score.

$$F1\ score = \frac{2 * TP}{2 * TP + FP + FN} .. (3)$$

Class Name	Accuracy	Precision	Recall	F1 score
Eosinophils	99%	99%	98%	98%
Lymphocytes	100%	99%	100%	100%
Monocytes	100%	100%	100%	100%
Neutrophils	99%	98 %	98%	98 %
Overall	99.5%	99%	99%	99%

Fig: Proposed Classification Model

8. CONCLUSION:

We can see that the CNN –RNN hybrid architecture offers better results than the CNN-only network for the classification problem, approximately 8% of the cases misclassified by the CNN-only solution are classified correctly by the CNN-RNN combination, assuming that the hybrid network does not misclassify the items that are correctly classified by the CNN-only network. For the two- way classification problem approximately

6% of the misclassified cases are correctly classified by the hybrid network. With the usage of the optimized cuDNN version of the LSTM layers, the same as with the pure CNN network approximately 13 seconds per epoch for CNN only, approximately 17 seconds per epoch on CNN+RNN. Thus we can conclude that the usage of an RNN along side a CNN leads to improved performance.

We presented an approach to real-time blood cells image classification using deep learnig. Our proposed deep learning model based on CNN was able to perform with 90% accuracy on our test dataset. We are developing a system that classifies the blood cells. We have achieved main advantages we propose a depth neural network architecture that combines the features of convolutional neural networks (Xception). We then implement the CNN framework for blood cell image classification. Our model preserves the temporal and spatial information of image features and can learn structured information of image features. Unlike previous manual feature extraction methods, which rely on cytoplasmic/nuclear segmentation, our method can automatically extract and classify the deep features embedded in cell image patches. Compared with the previous existing methods, our proposed technique achieved the highest performance in terms of classification based on the blood cell dataset.

9. FUTURE SCOPE

Future study may extend our work to accept training using deep learning with Tensorflow GPU (Graphics: Nvidia-Geforce-GTX) is high configuration to well prediction in classify the blood cell. We hope that this segmentation-free, highly accurate blood cell classification method can be used to develop medical-aided diagnostic systems for blood-related diseases in the future.

10. REFERENCES:

[1] N. Sinha and A. G. Ramakrishnan, "Automation of differential blood count," Conference on Convergent Technologies for Asia-Pacific Region (TENCON), pp. 547-551, 2003.

[2] M. Ghosh et al., "Statistical pattern analysis of white blood cell nuclei morphometry", IEEE Students Technology Symposium (TechSym), pp. 59-66, 2010.

[3] S. H. Rezatofighi and H. Soltanian-Zadeh, "Automatic recognition of five types of white blood cells in peripheral blood", in Compute. Med. Imag. Graph., vol. 35, no. 4, pp. 333-343, 2011.

[4] S. F. Bikhet, A. M. Darwish, H. A. Tolba, and S. I. Shaheen, "Segmentation and classification of white blood cells," IEEE International Conference on Acoustics, Speech, and Signal Processing, pp. 2259-2261, June 2000.

[5] Gajjala, Buchibabu and Mutyala, Venubabu and Vellela, Sai Srinivas and Pratap, V. Krishna, Efficient Key Generation for Multicast Groups Based on Secret Sharing (June 22, 2011). International Journal of Engineering Research and Applications,Vol. 1, Issue 4, pp.1702-1707, ISSN: 2248-9622, Available at SSRN: https://ssrn.com/abstract=4488504

[6] Karthik, J. V., & Reddy, B. V. (2014). Authentication of secret information in image stenography. International Journal of Computer Science and Network Security (IJCSNS), 14(6), 58.

[7] Sai Srinivas Vellela, Venkateswara Reddy B, Khader Basha Sk, "Detection of Spammers and Fake User Identification in Social Networks", International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882, Volume.4, Issue 4, pp.235-239, November 2016, Available at :http://www.ijcrt.org/papers/IJCRT1135186.pdf

[8] Veerendra, B., & Reddy, B. V. (2013). Implementation of Skyline Sweeping Algorithm. International Journal of Computer Science & Engineering Technology (IJCSET) ISSN, 2229-3345.

[9] Sai Srinivas Vellela, Khader Basha Sk, Venkateswara Reddy B, "Skin Diseases Detection and Classification using Deep Learning Algorithm Convolutional Neural Network", International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882, Volume.5, Issue 3, pp.177-181, September 2017, Available at :http://www.ijcrt.org/papers/IJCRT1135177.pdf