



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 5, May 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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Automatic Identification and Counting of Blood Cells

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ABSTRACT: One of the important medical test to evaluate overall human health condition is the Complete Blood Cell Count (CBC). Traditionally these blood cells were counted manually by visual inspection or by using the haemocytometer along with some chemical compounds and other scientific equipment's which is a tedious and more time consuming task. This CBC test can be performed automatically along with some appropriate equipment's as well. But those equipment's are quite expensive. To avoid this problem, the proposed work here is the machine learning approach of automatic identification and counting of blood cells (RBC's, WBC's and Platelets) using 'You Only Look Once' in short YOLO object detection and classification algorithm to automatically identify and count the blood cells from the blood smear images. This YOLO framework will be trained the modified Blood Cell Count Data set (BCCD) of blood smear images to automatically identify and count the RBC's, WBC's and Platelets from the blood smear images. Thus over all the computer aided system of counting and detection enables to count the blood cells just in less than a second and this can be useful in the practical applications.

KEYWORDS: Blood Smear images, BCCD Set, YOLO, Tiny YOLO, VGG-16 Architecture, Bounding Boxes, Automatic identification and counting.

I. INTRODUCTION

Complete Blood Cell Count (CBC) is one the important medical test often requested by the medical professionals to evaluate overall human health conditions. Human blood composed of three important cells. Those are Red Blood Cells (RBC's), White Blood Cells (WBC's) and Platelets. Red Blood Cells (RBC's): These are also called as the Erythrocytes. These cells constitute 40 to 45 percentage of the blood. The main function of these cells is they carry oxygen to our body tissues. Normal range of RBC is between 4.7 to 6.1 million cells per microliter of blood. If the range is higher than the normal range then it causes several diseases like kidney tumors, congenital heart disease and lung cancer. If the range of RBC is lower than its normal range then it will cause anemia disease. White Blood Cells (WBC's): These are also called as Leukocytes. They constitute about one percent of blood. The main function of these cells is they fight against the infections. Normal range of WBC is between 4.5 to 11*10⁹ cells per litre of blood (4500 to 11000 cells per microliter of blood). If the range of WBC is higher than its normal range then it causes diseases like bone marrow cancer, Leukocytosis. If the range of WBC is lower than its normal then it causes different autoimmune disorders. Platelets: These cells are also called as Thrombocytes. The remaining part of the blood is composed by these cells. Normal range of platelets is between 150000 to 450000 cells per microliter of blood. The main function of these cells is it helps in blood clotting. If the range of platelets is higher than its normal then it causes blood clots to develop spontaneously. If the range of platelets is lower than its normal it causes the immune thrombocytopenia disease. Thus all these functions carried out by these three cells in human beings are affected by their count in the blood. As these cells are huge in number traditional method of manually counting of blood cells using haemocytometer and other equipment's is time consuming and erroneous task and is completely depends on the skill of a laboratory analyst. With the development of machine learning techniques, image processing, object detection and classification becoming more accurate and robust. Hence these machine learning methods are being applied in different fields. Generally, deep learning methods are being applied in different medical applications like detection of diabetic retinopathy in retinal fundus images, automatic segmentation of left ventricle in cardiac MRI, femoral neck fracture recovery. Thus, this model deploys a deep learning based object detection method to detect and count different blood cells from the blood smear images. Among different object detection algorithms such as Region-based fully convolutional network (R-FCN), Region-based convolutional networks (R-CNN), Single Shot Detector (SSD) and You Only Look Once (YOLO) this model will be deployed with YOLO algorithm with VGG-16 architecture, which is three times faster than other

algorithm. YOLO algorithm uses single neural network to predict class probability and bounding boxes from blood smear images in just one evaluation. The YOLO framework will be retrain to automatically identify and count RBC's, WBC's and Platelets from the blood smear images. Verification method has also deployed in order to improve the counting accuracy in order to improve the counting accuracy and to avoid the double count by the framework.

II. RELATED WORK

A. Existing System

Various existing systems employ machine learning for the automatic identification and counting of blood cells, contributing significantly to medical diagnostics. These systems typically utilize convolutional neural networks (CNNs) or deep learning architectures to analyze microscopic images of blood samples. Preprocessing techniques, such as image enhancement and segmentation, are commonly employed to isolate individual cells for accurate identification. One approach involves training models on large datasets of labeled blood cell images, enabling them to learn distinctive features of different cell types. Transfer learning, leveraging pre-trained models, has proven effective in tasks related to blood cell classification. Moreover, ensemble learning methods, combining predictions from multiple models, enhance overall accuracy. Some systems integrate additional technologies, such as image stitching and robotic microscopy, to automate the imaging process and increase throughput. Automated counting algorithms play a crucial role in providing quantitative data for medical professionals, aiding in disease diagnosis and monitoring treatment effectiveness. Despite advancements, challenges persist, including the need for robustness to handle diverse sample variations and ensuring real-time processing capabilities for clinical applications. Continuous research and development in this field aim to refine existing systems, making them more accessible and reliable for healthcare practitioners.

B. Proposed System

This proposed model includes the modified training model where the final convolutional layers will be changed for three outputs (RBC, WBC and Platelet), with an appropriate threshold identifying the blood cells and counting them from their labels. There is no misunderstanding in this framework among the different cells like recognizing WBCs as RBCs, or RBCs as platelets, so on. There are cases where the model may predict and counts same platelet twice. It is because of the presence of same platelet at two corresponding grids so it will double counts the same platelet. This problem can be resolved by applying k-nearest neighbor (KNN) and IoU algorithms in each platelet. First the KNN is applied to every platelet for the determination of the nearest platelet. After that by applying Intersection over Union (IoU) among two of the platelets and calculates the range of the overlap between those two platelets. In this proposed model 10% of overlap between those two platelets is allowed and taken that as a threshold. If the overlap is greater than that threshold then that platelet will be ignored as double count and thus it will get rid of spurious counting as shown in figure below. In this way this proposed model will detects the blood cells automatically from the blood images and gives their count.

III. IMPLEMENTATION

A. Training datasets:

- 1.Data Collection: Gather a dataset of blood cell images. This dataset should include labeled images indicating the type of each blood cell (e.g., red blood cell, white blood cell, platelet).
- 2.Data Preprocessing: Clean and preprocess the images. This may involve resizing, normalization, and augmentation to improve the quality and diversity of the dataset.
- 3.Feature Extraction: Extract features from the images that are relevant for classification. For blood cells, features like shape, texture, and color may be important.
- 4.Model Selection: Choose a machine learning model suitable for image classification. Convolutional Neural Networks (CNNs) are commonly used for this task due to their ability to learn hierarchical features from images.
5. Model Training: Train the selected model using the preprocessed dataset. This involves feeding the images through the network, adjusting the model parameters (weights and biases) based on the prediction error, and repeating this process until the model performs well on the training data.
- 6.Model Evaluation: Evaluate the trained model on a separate validation dataset to assess its performance and make any necessary adjustments.
- 7.Deployment: Deploy the trained model to automatically identify and count blood cells in new images

B. Training blood cell and detection algorithm Cell segmentation: This module separates individual cells from the background and other cells in the image. Techniques like thresholding, edge detection, and morphological operations are commonly used for this task.

C. Identification and counting Classification: This module uses machine learning algorithms to classify each cell based on the extracted features. Common classification techniques include support vector machines (SVM), random forests, or convolutional neural networks (CNNs). Counting: Finally, the count of each type of blood cell is calculated based on the results of the classification module.

D. KNN and IOU based verification: 1.K-Nearest Neighbors (KNN) Classification: Train a KNN classifier on the extracted features and their corresponding labels. KNN is a simple and effective algorithm for classification tasks. 2.Intersection over Union (IoU) based Verification: After classifying individual cells, use IoU to verify the detected cells and count them accurately. IoU measures the overlap between the predicted bounding boxes of cells and the ground truth bounding boxes. Finally, count the verified blood cells based on the IoU threshold.

IV. EXPERIMENTAL RESULTS

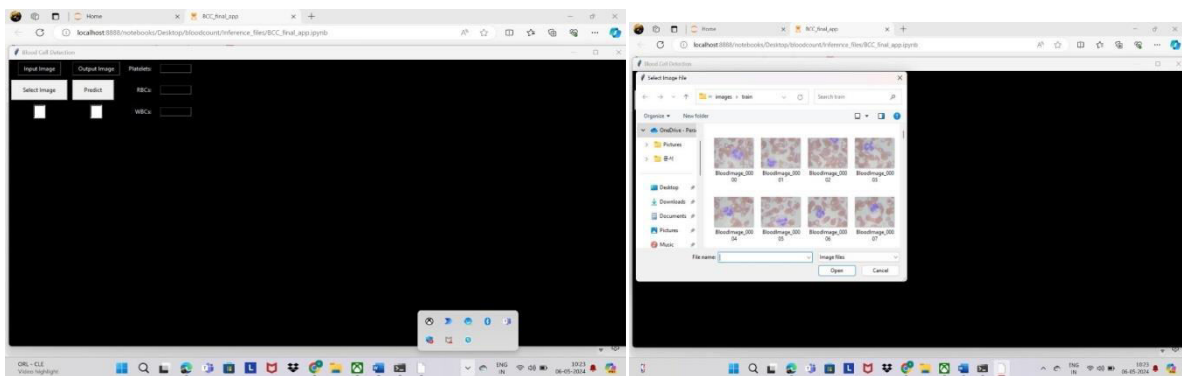


FIG 1. CHOOSE FILE TO UPLOAD

FIG 2. VIEW FILES PAGE

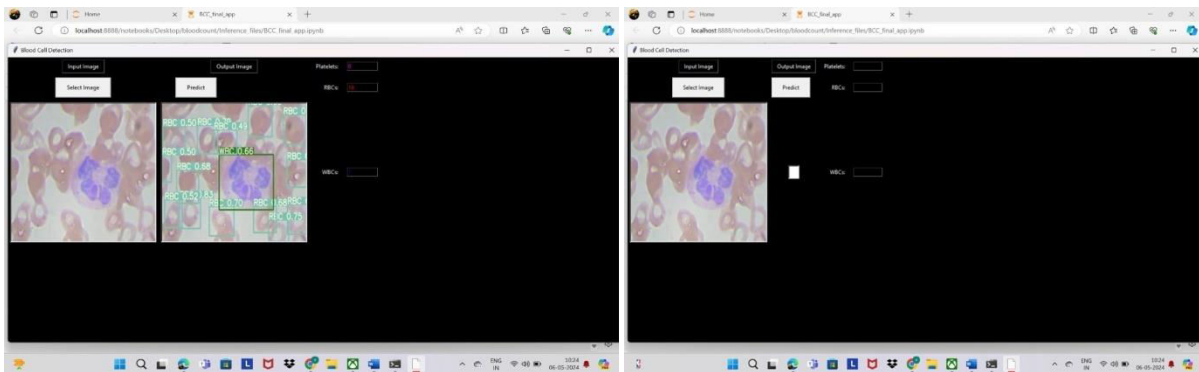


FIG 3. GRID PASSWORD

FIG 4. EDIT PROFILE

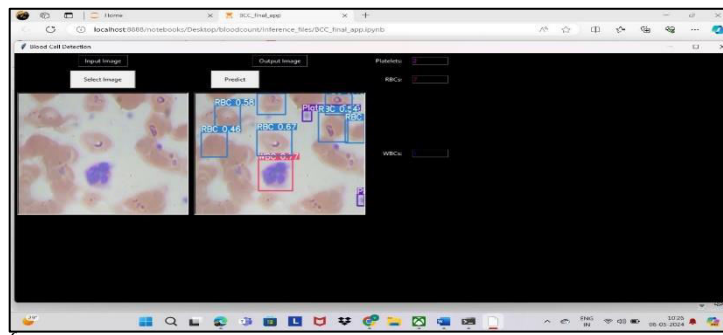


Fig 5. View attacker details

V. CONCLUSION

Machine learning approach for the identification and counting of blood cells automatically using YOLO framework has been presented, which is a deep neural network object detection and classification algorithm. This framework will use the blood smear image datasets as its input and gives the blood cell identification and its count as the output. It automatically detects the three different types of blood cells and gives the count of the respective blood cells. This model does not misinterpret between the types of blood cells and produces the accurate results. But sometimes it may double count the platelet cells which can be further removed by this algorithm by using the verification model. Thus the accuracy of the model is improved by employing the KNN – K nearest neighbor algorithm along with the IoU - Intersection Over Union operation to avoid the repeated counting of single object by the algorithm and gives the correct prediction with the single count of the cells. This model has been tested on various validation datasets of images of blood and it had outputted satisfactorily. Thus by its detection and the accuracy performances this model has gains potential to ease blood cell detection and counting manually which can be used in the practical applications.

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