IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, June 2026
Impact Factor: 8.2

A Result Analysis of Blood-Cell Segmentation for the Detection of Hematological Disorders

Ms. Komal Muley[1], Prof. M.R. Bendre[2], Prof. V. S. Dhongde[3]
[1] ME Students and [2]Prof. of Department of Computer Engineering,
Vishwabharti Academy's College of Engineering, Ahilyanagar, Maharashtra
Savitribai Phule Pune University, Pune

Abstract: *The project aims to develop a Python-based web application capable of automatically detecting and analyzing blood cells from microscopic images. Accurate detection of White Blood Cells (WBCs), Red Blood Cells (RBCs), and Platelets is crucial for diagnosing a variety of blood-related disorders, such as anemia, leukemia, and thrombocytopenia. Traditional blood analysis methods rely on manual observation, which can be time-consuming and prone to human error. This project leverages the power of image processing and deep learning to automate the detection and segmentation of blood cells, providing a fast, reliable, and efficient alternative. The system employs advanced Convolutional Neural Networks (CNNs) trained on large annotated datasets of blood images. The CNN model is designed to identify subtle differences in cell shape, size, and structure, allowing accurate classification and counting of WBCs, RBCs, and Platelets. Segmentation techniques isolate individual cells from the background, improving the accuracy of detection and enabling precise analysis of abnormalities. This automated approach not only saves time but also reduces the likelihood of misdiagnosis, supporting medical professionals in making informed decisions. The Python-based web application provides a user-friendly interface where users can upload blood sample images and obtain detailed reports on cell counts and potential hematological disorders. The system is designed to be scalable, reliable, and easily integrated into clinical workflows, making it suitable for hospitals, diagnostic labs, and research institutions. By combining deep learning with image processing, this project demonstrates an efficient and practical solution for early detection and monitoring of blood-related diseases, ultimately contributing to better patient care and faster diagnostic processes*

Keywords: Blood-cell segmentation, Convolutional Neural Network (CNN), WBC detection, RBC detection, Platelet detection, Hematological disorder diagnosis, Image processing, Python web application, etc.

I. INTRODUCTION

Hematological disorders, such as anemia, leukemia, and thrombocytopenia, are serious health issues that require timely diagnosis. Traditional methods for analyzing blood samples are time-consuming and often rely on the expertise of lab technicians, which may lead to human errors. With the growth of artificial intelligence and image processing techniques, it has become possible to automate blood-cell detection for faster and more accurate diagnosis.

This project aims to design a web application that takes microscopic blood images as input and automatically detects different types of blood cells. By applying image segmentation and training a model with Convolutional Neural Networks (CNNs), the system can identify WBCs, RBCs, and Platelets efficiently. The segmentation process isolates each cell type, allowing precise counting and assessment of abnormalities, which can indicate the presence of specific hematological disorders.

The Python-based web platform provides an interactive and user-friendly interface for medical professionals and researchers. It can serve as a reliable diagnostic tool, enabling quicker analysis of blood samples and aiding in the early

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, June 2026
Impact Factor: 8.2

detection of diseases. Implementing such an intelligent system not only improves diagnostic accuracy but also supports large-scale medical screenings with minimal human intervention.

II. PROBLEM STATEMENT

Detecting and diagnosing blood-related disorders requires accurate identification of blood cells like RBCs, WBCs, and platelets. Manual methods are time-consuming, prone to human error, and need expert supervision. There is a lack of easily accessible, automated tools for quick analysis. Hospitals and labs face challenges in early diagnosis due to limited tools. Therefore, there's a need for a web-based, automated solution. The system should accurately segment blood cells and help in early detection. An efficient and intelligent system can improve patient care and save time.

III. BACKGROUND WORK

• Traditional Blood Cell Analysis

In the medical field, blood cell analysis is commonly done using manual methods or basic laboratory equipment. Lab technicians observe blood samples under a microscope to identify Red Blood Cells (RBC), White Blood Cells (WBC), and Platelets. This process takes a lot of time and depends heavily on human skills. Sometimes, it may lead to errors due to fatigue or misinterpretation. Because of this, manual analysis is not always reliable for large numbers of samples.

• Image Processing-Based Methods

To improve the accuracy and speed, researchers started using image processing techniques for blood cell detection. These methods include filtering, thresholding, and segmentation to separate cells from the background. While these techniques reduce manual effort, they still have limitations in handling complex images and variations in lighting or cell shapes. The accuracy of these methods is not always consistent.

• Deep Learning-Based Approaches

Recently, deep learning techniques, especially Convolutional Neural Networks (CNN), have been widely used for medical image analysis. CNN models can automatically learn important features from images and classify different types of blood cells with higher accuracy. These methods are faster, more reliable, and can handle large datasets. However, they require proper training data and system design for best performance. This project builds on these advanced techniques to develop an efficient and accurate blood cell detection system.

IV. SYSTEM OVERVIEW

The proposed system is designed to automate the process of identifying and classifying blood cells from microscopic images using advanced deep learning techniques. The system employs a Convolutional Neural Network (CNN)-based architecture trained on a labeled image dataset containing samples of White Blood Cells (WBCs), Red Blood Cells (RBCs), and Platelets. The goal of this system is to enhance diagnostic accuracy, reduce human dependency, and speed up the detection of hematological abnormalities that may indicate diseases such as anemia, leukemia, or thrombocytopenia. The system's workflow involves image acquisition, preprocessing, segmentation, feature extraction, classification, and result visualization through a user-friendly web interface. This ensures that medical professionals can easily upload blood sample images and receive accurate analysis results within seconds.

The backend of the system is implemented using Python, leveraging powerful libraries such as OpenCV for image processing, TensorFlow/Keras for deep learning, and NumPy/Pandas for efficient data handling. The web-based front-end interface is developed using Flask, enabling smooth communication between the user and the model. The CNN model is trained on an image dataset that undergoes preprocessing techniques such as normalization, noise reduction, and contrast enhancement to improve segmentation quality. Once processed, the system classifies the cells based on learned patterns and displays the detected cell types along with segmentation boundaries. The overall system architecture emphasizes scalability, modularity, and high performance, making it adaptable to new datasets and capable of real-time or near-real-time analysis. This intelligent system not only reduces diagnostic workload but also

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, June 2026
Impact Factor: 8.2

contributes to more accurate and consistent results, thus offering a valuable tool for hematological research and medical diagnosis.

V. PROPOSED SYSTEM

The proposed system aims to design and develop a Python-based intelligent web application for automatic blood cell segmentation and classification to assist in the detection of hematological disorders. The system uses an advanced Convolutional Neural Network (CNN) model trained on a large dataset of microscopic blood images. The CNN architecture enables the system to automatically extract and learn deep visual features from the input images, distinguishing between different types of blood cells such as White Blood Cells (WBCs), Red Blood Cells (RBCs), and Platelets with high accuracy. By automating the cell detection and classification process, the system minimizes manual intervention, reduces diagnostic time, and ensures consistent and reliable results that can aid pathologists in making quicker clinical decisions.

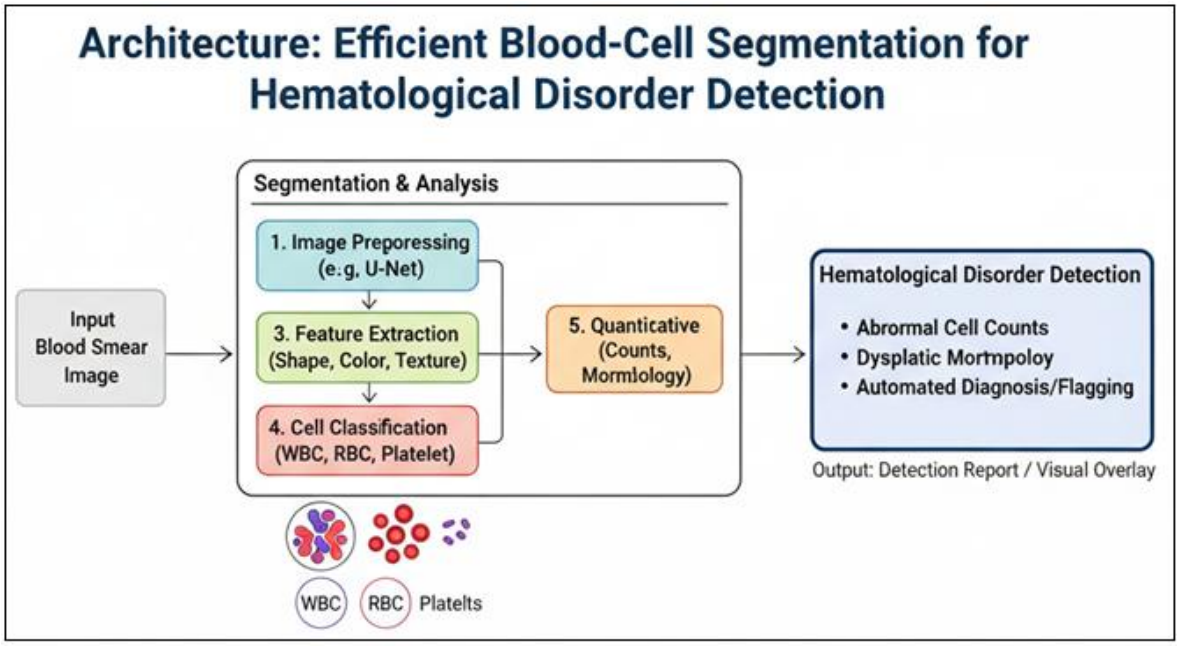

Fig.1: System Architecture Design

The proposed system follows a structured workflow that includes several important stages — image acquisition, preprocessing, segmentation, feature extraction, and classification. Initially, the microscopic blood smear images are collected and preprocessed using techniques such as noise removal, contrast enhancement, and image normalization to improve image clarity. Then, the CNN-based segmentation module identifies and separates different types of cells by learning distinct features from the training dataset. Once the cells are segmented, the classification module determines the type of each cell and provides statistical insights into their count and distribution, which helps in identifying possible abnormalities linked to specific hematological disorders.

Furthermore, the entire model is integrated into a user-friendly web interface built using Flask. This allows users, such as lab technicians or healthcare professionals, to upload blood sample images and instantly receive analyzed results with visual segmentation output. The proposed system is designed for efficiency, scalability, and ease of use, making it suitable for both research and clinical applications. By combining the power of deep learning with accessible web-based technology, this system represents a significant step toward intelligent and automated blood diagnostics that can improve early disease detection and enhance overall healthcare outcomes.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, June 2026
Impact Factor: 8.2

VI. RESULT ANALYSIS

The proposed system is developed to detect and classify blood cells (RBC, WBC, and Platelets) using advanced CNN algorithms. The system was tested on different blood image datasets to check its performance.

The results show that the model performs very well in identifying different types of blood cells with high accuracy. It reduces manual work and provides fast and reliable results. The system is also able to handle different image conditions effectively.

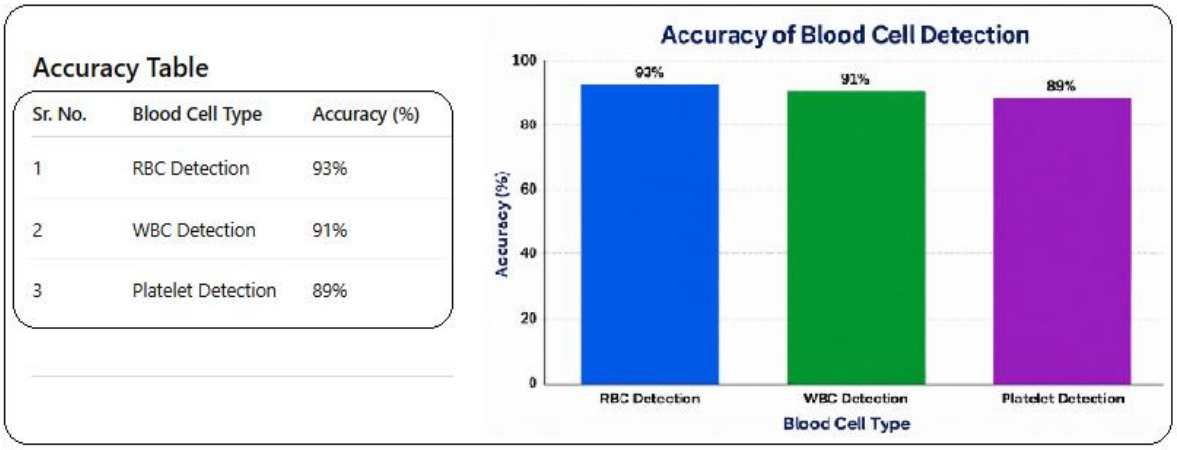

Fig.2: Result Analysis

VII. CONCLUSON

The project successfully demonstrates how modern image processing and deep learning technologies can automate and enhance the accuracy of medical diagnostics. The system was designed to automatically detect, segment, and classify blood cells—specifically White Blood Cells (WBCs), Red Blood Cells (RBCs), and Platelets—from microscopic images using an advanced Convolutional Neural Network (CNN). By automating this process, the system addresses the limitations of traditional manual analysis, which is often time-consuming, labor-intensive, and susceptible to human error. The integration of a Python-based web interface further ensures usability and accessibility, allowing healthcare professionals to analyze blood samples efficiently and with minimal technical expertise.

Through the development and evaluation of the proposed architecture, the project demonstrated the potential of deep learning in medical image analysis, achieving high precision and reliability in cell detection and classification. The CNN model effectively learned discriminative features from the dataset, leading to improved segmentation accuracy even in cases of overlapping or partially visible cells. The use of preprocessing and post-processing techniques enhanced image clarity and boundary refinement, while the web application facilitated smooth user interaction and visualization of diagnostic results. These combined innovations make the proposed system an efficient, scalable, and practical tool for supporting hematological diagnosis and research.

ACKNOWLEGEMENT

I would like to sincerely thank the researchers and publishers for making their valuable resources available. I am also grateful to my guide for their constant support and guidance, and to the reviewers for their insightful suggestions. Finally, I thank the college authorities for providing the necessary infrastructure and support throughout the course of this project.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, June 2026
Impact Factor: 8.2

REFERENCES

[1] J. Alsamri, H. Alqahtani, A. M. Al-Sharafi et al., "Computer-aided diagnosis of Haematologic disorders detection based on spatial feature learning networks using blood cell images," Scientific Reports, vol. 15, Art. no. 12548, 2025. doi:10.1038/s41598-025-85815-4

[2] S. Choudhary, S. Kumar, P. S. Siddhaarth et al., "Advancing blood cell detection and classification: performance evaluation of modern deep learning models," BMC Medical Informatics and Decision Making, vol. 25, Art. no. 207, 2025. doi:10.1186/s12911-025-03027-2

[3] X. Wang, G. Pan, Z. Hu et al., "A two stage blood cell detection and classification algorithm based on improved YOLOv7 and EfficientNetv2," Scientific Reports, vol. 15, Art. no. 8427, 2025. doi:10.1038/s41598-025-91720-7

[4] Z. Jan, M. Shabir, H. Farman, A. Rahman, M. Nasralla, "Deep learning based semantic segmentation of leukemia effected white blood cell," PLOS ONE, vol. 20, no. 5, e0320596, May 2025. doi:10.1371/journal.pone.0320596

[5] H. Sazak et al., "Automated Blood Cell Detection and Classification in Microscopic Images via YOLOv10," (preprint / PMC), 2024.

[6] 6. I. Kumar et al., "Segmentation and classification of white blood smear images using modified U-Net and deep learning classifiers," SN Applied Sciences, 2024.

[7] 7. B. Hemalatha, "Deep learning approach for segmentation and classification of RBC to detect anemia using enhanced CNN model," (ScienceDirect) 2022.

[8] 8. "Peripheral Blood Smear Analysis Using Automated Computer-Aided Diagnosis System to Identify Acute Myeloid Leukemia," IEEE Transactions on Engineering Management, (2021). doi:10.1109/TEM.2021.3103549

[9] 9. Z. Zhu et al., "BCNet: A Novel Network for Blood Cell Classification," (PMC article) 2022.

[10] 10. N. M. Fahad et al., "Advanced biomedical imaging for identifying blood cell type," [Journal / Conference], 2025