



Research Digest on Engineering Management and Social Innovations

Available on: <http://rdems.in>

DOI: 10.46647/rdems0204029

Volume: 02 Issue: 04, April, 2026

p-ISSN: 3117-4418

e-ISSN: 3117-4426

AI-Based Blood Group Classification and Prediction Using Image Processing

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Abstract

Accurate identification of blood groups is essential in medical diagnostics, transfusion management, and emergency healthcare. Conventional blood typing methods are typically manual, time-consuming, and require skilled laboratory personnel, which can lead to delays and potential human errors. This paper presents an automated system titled “*AI-Based Blood Group Classification and Prediction Using Image Processing*,” which leverages artificial intelligence and computer vision techniques to improve the efficiency and accuracy of blood group detection. The proposed system utilizes image processing methods to analyze microscopic images of blood samples and identify agglutination patterns associated with different blood groups. Features are extracted using techniques such as segmentation, edge detection, and pattern recognition, and are then classified using machine learning and deep learning models such as Convolutional Neural Networks (CNN). The system is capable of accurately classifying blood groups (A, B, AB, and O) and predicting Rh factors with high precision. Experimental results demonstrate that the approach significantly reduces processing time, minimizes human intervention, and improves diagnostic reliability, making it a valuable tool for automated and scalable blood typing in healthcare systems.

Keywords: AI-based blood group classification, image processing, blood typing, convolutional neural networks (CNN), agglutination detection, medical image analysis, pattern recognition, machine learning, Rh factor prediction, and healthcare automation.

I. Introduction

Accurate determination of blood groups is a critical requirement in healthcare, particularly for safe blood transfusions, organ transplantation, and emergency medical procedures. Blood groups are classified based on the presence or absence of specific antigens and antibodies, primarily under the ABO and Rh systems. Traditional blood typing methods involve manual slide or tube tests, where blood samples are mixed with specific reagents and visually examined for agglutination. Although these methods are widely used, they are time-consuming, require skilled personnel, and are prone to human error, especially in high-volume or resource-limited settings.

With the advancement of artificial intelligence and image processing, automated systems have emerged as a promising solution for improving the efficiency and accuracy of blood group detection. By analyzing microscopic or captured images of blood samples, image processing techniques can identify agglutination patterns that indicate specific blood groups. Machine learning and deep learning models, particularly Convolutional Neural Networks (CNN), can learn complex visual features and classify blood types with high precision. This paper focuses on developing an AI-based system for blood group classification and prediction, aiming to reduce manual effort, enhance diagnostic accuracy, and enable faster decision-making in medical environments.



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II. Literature survey

1. Title: A Study of Cyberbullying Detection and Classification Using Machine Learning

Authors: S. Unnava et al.

Abstract:

This study presents a comparative analysis of various machine learning techniques for detecting and classifying cyberbullying on social media platforms. It evaluates both traditional and deep learning models using different datasets and highlights the importance of feature engineering, preprocessing, and model selection. The results show that advanced models improve classification accuracy and efficiency, helping researchers choose appropriate techniques for real-world applications.

2. Title: Cyberbullying Detection System on Social Media Using Supervised Machine Learning

Authors: A. Perera

Abstract:

This research proposes an automated cyberbullying detection system using supervised machine learning techniques. The system analyzes textual content based on characteristics such as abusive language, repetition, and harmful intent. It demonstrates that machine learning models can effectively identify and prevent cyberbullying, contributing to safer social media environments.

3. Title: Cyberbullying Detection on Social Networks Using a Hybrid Deep Learning Architecture

Authors: Aigerim Altayeva, Rustam Abdrakhmanov, Aigerim Toktarova, Abdimukhan Tolep

Abstract:

This paper proposes a hybrid deep learning model combining Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks for cyberbullying detection. The model captures both spatial and temporal features from social media data, achieving high detection accuracy. The study also discusses challenges such as overfitting and ethical concerns in automated detection systems, emphasizing the need for responsible AI implementation.

4. Title: Cyberbullying Detection in Social Networks Using Machine Learning Approaches

Authors: Various Authors

Abstract:

This research focuses on detecting abusive and bullying messages by combining natural language processing techniques with machine learning algorithms. It utilizes features such as Bag-of-Words (BoW) and TF-IDF for text representation and evaluates multiple classifiers. The findings indicate that integrating NLP with machine learning improves detection accuracy and helps identify harmful content effectively.

5. Title: Cyberbullying Detection Using Deep Learning Techniques

Authors: S. S. Nath et al.

Abstract:

This study introduces a deep learning-based approach for cyberbullying detection using a Bidirectional Long Short-Term Memory (Bi-LSTM) model. The model is trained on large-scale social media datasets and captures contextual and sequential information in text data. Experimental results show improved performance in detecting cyberbullying across different languages, highlighting the effectiveness of deep learning for handling complex linguistic patterns.

III. Existing sytem

In current medical practice, blood group identification is primarily performed using **manual serological methods** such as slide tests, tube tests, and gel card techniques. These methods involve mixing a blood sample with specific antisera (Anti-A, Anti-B, Anti-D) and visually observing agglutination reactions to determine the blood group. While these techniques are widely used and reliable under controlled conditions, they are **time-consuming**, require skilled laboratory personnel,

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and are prone to **human error** during interpretation, especially in large-scale or emergency scenarios.

Some existing automated systems incorporate basic **image processing or rule-based approaches** to assist in blood group detection. However, these systems often rely on simple thresholding and limited feature extraction techniques, which may not effectively handle variations in image quality, lighting conditions, or complex agglutination patterns. Additionally, they lack advanced learning capabilities, making them less adaptable and less accurate compared to modern AI-based approaches. As a result, existing systems face challenges in scalability, speed, and precision, highlighting the need for more intelligent and automated solutions.

IV. Proposed System

The proposed system introduces an intelligent **AI-based framework for blood group classification and prediction using image processing techniques**. In this approach, images of blood samples are captured using a digital microscope or camera after the application of antisera. The system processes these images through several stages, including preprocessing (noise removal, contrast enhancement), segmentation, and feature extraction to identify agglutination patterns. These patterns are crucial indicators used to determine the blood group and Rh factor.

The extracted features are then fed into advanced **machine learning and deep learning models**, particularly Convolutional Neural Networks (CNN), which automatically learn and classify blood groups such as A, B, AB, and O. The system is capable of distinguishing subtle differences in agglutination with high accuracy and consistency. Additionally, it supports **real-time analysis**, reduces human intervention, and minimizes errors associated with manual methods. The proposed system enhances speed, scalability, and reliability, making it suitable for deployment in hospitals, laboratories, and emergency healthcare environments.

V. system Architecture

The system architecture for *“AI-Based Blood Group Classification and Prediction Using Image Processing”* illustrates a structured workflow for automatically identifying blood groups using artificial intelligence techniques. The process begins with the **blood sample image acquisition stage**, where images of blood samples are captured using a digital microscope or camera after applying specific antisera. These images serve as the primary input for the system and contain visible agglutination patterns that indicate different blood groups.

The captured images are then processed in the **image preprocessing stage**, where operations such as noise reduction, contrast enhancement, and segmentation are performed to improve image quality and isolate the region of interest. After preprocessing, the system performs **feature extraction**, where important characteristics such as agglutination patterns, shape, and texture features are identified. These features are then fed into the **AI model training and classification module**, which uses machine learning and deep learning techniques, particularly Convolutional Neural Networks (CNN), to classify blood groups (A, B, AB, and O) and determine the Rh factor (positive or negative).

Finally, the system provides **real-time analysis and automated reporting**, generating quick and accurate results along with diagnostic reports. The output can be stored in a database for future reference and analysis. This architecture enhances speed, accuracy, and reliability while reducing human intervention, making it suitable for modern healthcare applications.

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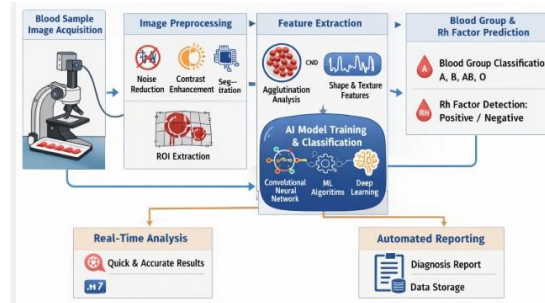


Fig 5.1: System Architecture

VI. Implementation

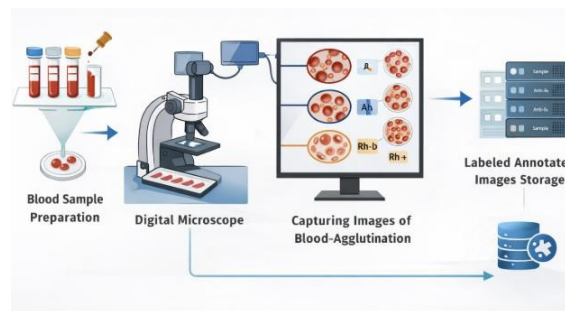


Fig 6.1 Data collection image

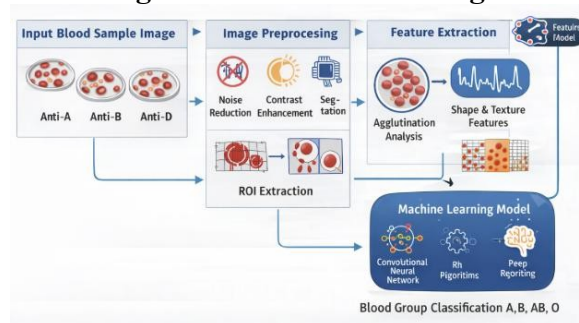
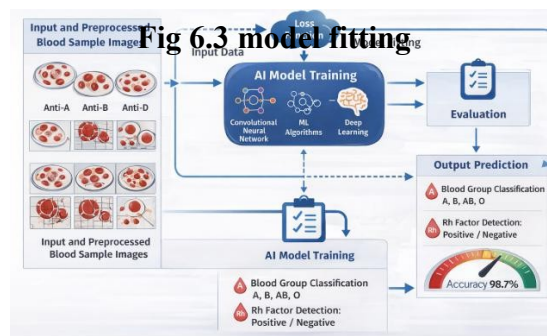


Fig 6.2 Feature Extraction



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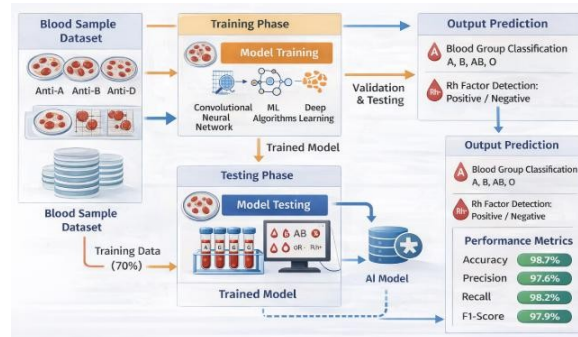


Fig 6.4 traing and testing image



Fig 6.5 prediction page

VII. Conclusion

The proposed system for “*AI-Based Blood Group Classification and Prediction Using Image Processing*” provides an efficient, accurate, and automated solution for blood group identification. By integrating image processing techniques with artificial intelligence models such as Convolutional Neural Networks (CNN), the system is capable of analyzing agglutination patterns in blood sample images and classifying blood groups and Rh factors with high precision. This approach significantly reduces human intervention, minimizes errors, and accelerates the overall diagnostic process.

Furthermore, the system enhances reliability and scalability, making it suitable for deployment in hospitals, diagnostic laboratories, and emergency healthcare environments. The ability to perform real-time analysis and generate automated reports improves decision-making and patient safety. Overall, the proposed framework represents a significant advancement over traditional manual methods, contributing to the development of intelligent and automated healthcare systems.

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