International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Survey Paper on Detection of Blood Groups Using Fingerprint Images

Prof. Sachin Dighe [1], Sai Dube[2], Mayur Bhandare[3], Tanmay Veer[4], Shreeyash Bistekar [5]

Sinhgad Institute of Technology and Science ,Pune 411041,Maharastra,India

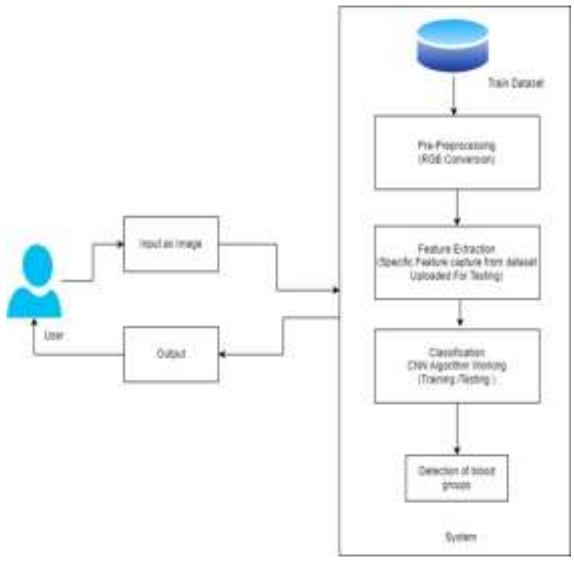
---

Abstract - The detection of blood groups traditionally requires invasive methods, such as blood sample collection and laboratory analysis. This paper presents a novel, non-invasive approach for predicting blood groups by analyzing fingerprint images. Fingerprint patterns are known to be influenced by genetic factors, which also govern blood group types. In this study, a dataset of fingerprint images from individuals with known blood groups (A, B, AB, and O) was analyzed using DL algorithms. Key features were extracted from the finger print patterns, including ridge count, ridge density, and minutiae distribution. These features were used to train a classification model for predicting the blood group. The proposed method achieved a promising accuracy of blood group detection, demonstrating the potential for integrating biometric and genetic information in non-invasive diagnostic tools. This approach could revolutionize medical diagnostics by offering a quick, cost-effective, and non-invasive alternative for determining blood group types.

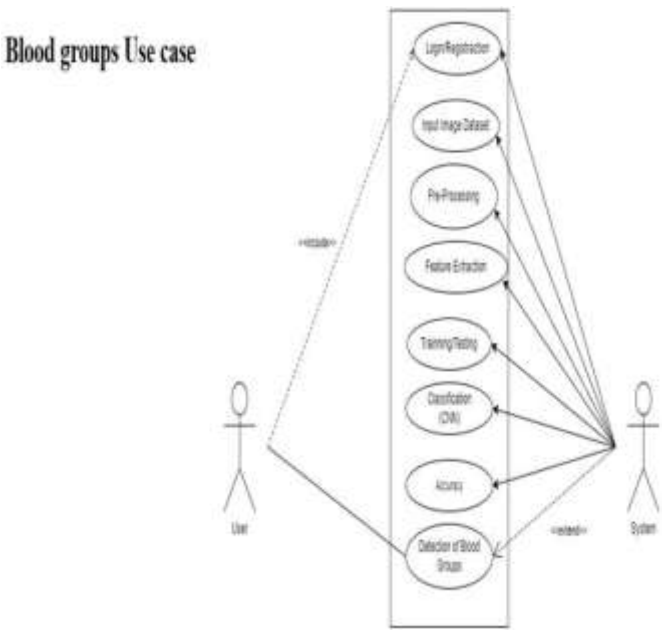
Keywords: Non-invasive blood group detection, Fingerprint analysis, Blood group prediction, Deep learning (DL)

1. INTRODUCTION :

Blood group detection is a fundamental aspect of medical diagnostics, often required in emergency medical procedures, transfusions, and for general health information. Traditionally, blood group determination is carried out using serological methods, which require blood samples and reagents. While effective, these methods can be time-consuming, require trained personnel, and involve the handling of biological fluids, which carries certain risks. With advancements in deep learnings (DL) and image processing techniques, there has been growing interest in non-invasive method of determining blood groups. One such approach is using fingerprint images combined with Convolutional Neural Networks (CNNs). This method leverages the unique patterns found in fingerprints, which are thought to have a correlation with certain biological traits, including blood groups. Recent advancements in deep learning (DL) and image processing techniques have opened up new possibilities for non-invasive blood group detection methods. One innovative approach is the use of fingerprint images analyzed through Convolutional Neural Networks (CNNs). Fingerprints are known for their unique patterns, which may be linked to various biological characteris1 DETECTION OF BLOOD GROUPS USING FINGERPRINT IMAGES tics, including blood groups. By leveraging CNNs, which are highly effective in recognizing patterns in images, researchers are exploring the potential to determine blood groups based on the distinct features in fingerprint images.



System Architecture



Blood Group Use Case

2. WORKING

The proposed system for non-invasive blood group detection using fingerprint images and Convolutional Neural Networks (CNNs) involves several key stages, combining image processing, deep learning, and classification. The overall workflow is as follows:

1. Data Collection

Fingerprint images are collected from individuals with known blood groups. These images must be high-resolution and consistent in terms of lighting, orientation, and clarity to ensure reliable analysis. Alongside the fingerprint images, the corresponding blood group labels (A, B, AB, O – with Rh factor if needed) are recorded to be used for supervised learning.

2. Preprocessing of Fingerprint Images

To ensure high-quality input for the CNN model, the raw fingerprint images undergo several preprocessing steps:

- Noise Reduction: Using filters to remove background noise.
- Contrast Enhancement: Improving ridge-valley pattern visibility.
- Normalization: Resizing all images to a fixed dimension (e.g., 224×224 pixels).
- Segmentation and Orientation Correction: Ensuring consistent alignment across all fingerprint samples.

3. Feature Extraction using CNN

A Convolutional Neural Network (CNN) is trained on the pre-processed fingerprint images. CNN automatically extracts complex hierarchical features from the image data, capturing intricate patterns such as:

- Ridge frequency
- Minutiae points
- Local texture variations

These features are hypothesized to have underlying correlations with specific blood groups.

4. Model Training

The CNN model is trained using a labeled dataset where each fingerprint is associated with a known blood group. During training:

- The network learns the mapping between fingerprint features and blood group labels.
- Techniques such as data augmentation, dropout, and batch normalization are applied to prevent overfitting and improve generalization.

Popular CNN architectures like VGGNet, ResNet, or custom lightweight models may be used depending on computational constraints and dataset size.

5. Classification

The final layer of the CNN is typically a softmax classifier that outputs the probability distribution across all possible blood groups. The class with the highest probability is taken as the predicted blood group for the input fingerprint image.

6. Evaluation and Validation

The trained model is tested on unseen data to evaluate its accuracy, precision, recall, and F1-score. Cross-validation techniques and confusion matrices help in understanding the performance and limitations of the model.

7. Deployment

Once validated, the model can be embedded into a user-friendly application or healthcare system interface, allowing users to scan fingerprints using a biometric scanner or camera to determine blood groups non-invasively.

Fig 1 - Login Page

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

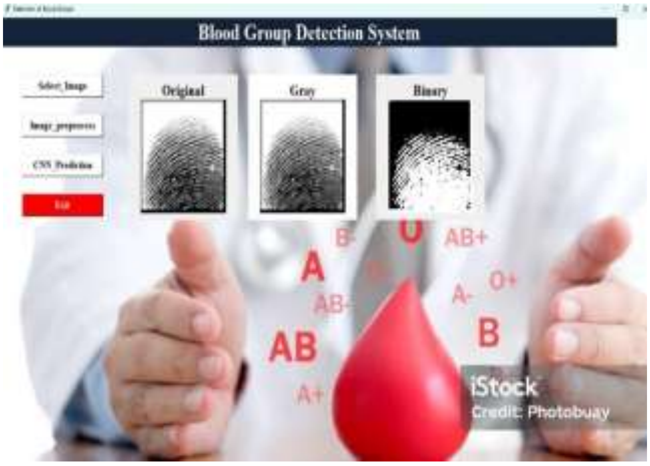


Fig 3- Detection System

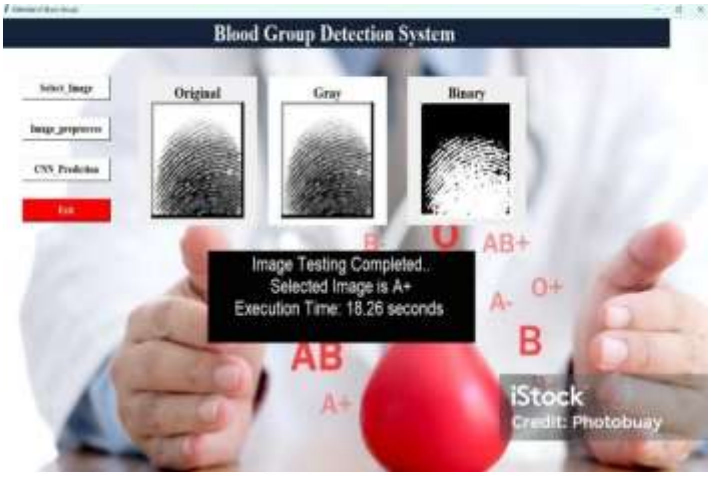


Fig 3 - Output

3. CONCLUSION :

The detection of blood groups using fingerprint images with Deep Learning represents an innovative and potentially transformative approach to blood group determination. While the concept holds promise for offering a non-invasive, efficient, and accessible alternative to traditional blood testing methods, several technical and practical challenges must be addressed to ensure its successful implementation. Technically, developing Deep Learning models that can accurately correlate fingerprint features with blood group information is feasible but requires careful design and training. The quality and availability of datasets are critical, as high-quality, annotated data are essential for effective model performance. Ensuring that the models can generalize across diverse populations and fingerprint conditions is crucial for achieving reliable results.

4. FUTURE SCOPE :

1. Once a robust model is trained, fingerprint-based blood group detection can provide rapid results. This can be particularly useful in emergency situations where knowing a patient's blood group quickly is crucial for treatment.
2. Since this approach does not require blood withdrawal, it reduces risks associated with infections or contamination from needles. It also minimizes discomfort and allows for quicker and potentially more frequent checks when necessary.
3. This method could be a valuable tool in rural or underdeveloped areas where access to medical resources, trained personnel, or laboratory facilities is limited. By using a camera or scanner to capture fingerprints and a mobile app or device running the CNN model, blood groups could potentially be detected on-site without advanced equipment.
4. Fingerprint recognition is already widely used in biometric authentication systems. By integrating blood group detection into these systems, we can enhance personal health records and potentially streamline emergency medical identification processes.

5. REFERENCES :

[1] Jose Fernandes, Sara Pimenta, Filomena O. Soares and Graca Minas, "A Complete Blood Typing Device for Automatic Agglutination Detection Based on Absorption Spectrophotometry", IEEE Transactions on Instrumentation and Measurement, 2022 In 2019.

[2] Melur K. Ramasubramanian Stewart P. Alexander, "An integrated fiber optic–microfluidic device for agglutination detection and blood typing" Biomed Microdevices, Sept. 2023, pp. 217–229 In IEEE Conference, 2016.

[3] Dr. D. Siva Sundhara Raja and J. Abinaya, A Cost-Effective Method for Blood Group Detection Using Fingerprints", International Journal of Advance Study and Research Work, Volume 2, March 2022.

[4] G. Ravindran, T. Joby, M. Pravin, and P. Pandiyan, "Determination and Classification of Blood Types using Image Processing Techniques", International Journal of Computer Applications, vol. 157, no. 1, pp. 12–16, Jan. 2023.

[5] L. Scarfe, A. Rak-Raszewska, S. Geraci, D. Darssan, J. Sharkey, J. Huang, N. C. Burton, D. Mason, P. Ranjzad, S. Kenny, N. Gretz, R. L´evy, B. Kevin Park, M. Garcıa-Finana, A. S. Woolf, P. Murray, and B. Wilm, "Spectrophotometric approach for automatic human blood typing", in Proc. IEEE 2nd Portuguese Meeting, 2022, pp. 101–104.