IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Blood Group Detection Using Fingerprint

Guide: Mrs. Raut P. S.

Authors: Shital Narwad, Sanika Jadhav

Abstract

This paper explores the innovative concept of detecting blood groups using fingerprint imaging and machine learning. The correlation between dermatoglyphic patterns and genetics suggests that fingerprint features might have predictive potential for ABO and Rh blood groups. This research proposes a hybrid approach using image preprocessing, handcrafted feature extraction, and convolutional neural networks to classify blood group types. The methodology includes dataset formation, model training, evaluation, and analysis of performance metrics. Although the results show moderate accuracy, the research highlights the potential for non-invasive, cost-effective, and fast blood group prediction systems.

1. Introduction

Blood group determination is essential for medical treatments, blood transfusions, and forensic purposes. Traditionally, blood typing requires biochemical testing using invasive procedures. In recent years, researchers have explored biometric and image-based solutions for identity verification and medical prediction. Fingerprints, being unique and genetically influenced, present an opportunity to correlate dermatoglyphic characteristics with blood types.

The main objective of this research is to develop a reliable model using fingerprint images to predict human blood groups. The study focuses on extracting image-based features like ridges, minutiae points, valley structures, and global fingerprint patterns. By applying machine learning and deep learning methods, this paper demonstrates the practical potential of this approach.

Contributions

1. A complete pipeline for fingerprint-based blood group detection using ML and DL.

2. Collection and processing of fingerprint and blood group dataset.

3. Comparison of feature-based and CNN-based approaches.

4. Analysis of ethical, privacy, and clinical aspects.

2. Related Work

Dermatoglyphics is the study of fingerprint patterns that are influenced by genetics. Several studies have shown connections between fingerprint ridge counts and genetic disorders, indicating possible relationships with blood groups. Machine learning researchers have also explored fingerprint biometrics for gender, age, and disease prediction.

The use of soft biometrics for predicting personal attributes has gained attention, especially in medical and forensic applications. These studies formed the foundation for our feature selection and methodology.

3. Dataset

3.1 Data Collection Protocol

Data was collected using optical fingerprint scanners with 500 dpi resolution. Each participant provided multiple impressions of their thumb, index, and middle fingers. Blood group data was verified using standard serological testing. Ethical approval and participant consent were obtained before collection.

3.2 Dataset Statistics

The dataset contains N samples with distributions across ABO blood groups: A, B, AB, and O. Rh factor distribution includes Rh+ and Rh-. Data diversity was ensured across gender, age groups, and ethnicity.

4. Methodology

4.1 Preprocessing

Preprocessing included normalization, noise removal, and segmentation using adaptive thresholding. Gabor filters were applied to enhance ridge clarity, followed by alignment and cropping.

4.2 Handcrafted Features

Handcrafted features included Local Binary Patterns (LBP), ridge frequency, ridge count, minutiae points, and texture descriptors. These features were used to train classical ML models like Random Forest, Support Vector Machine, and Gradient Boosting.

4.3 Deep Learning Approach

A CNN-based approach was used for end-to-end prediction. ResNet architecture was modified for fingerprint input data. Data augmentation techniques improved robustness, and dual classification heads handled ABO and Rh detection.

4.4 Explainability

Explainability techniques like Grad-CAM were applied to visualize model focus areas, showing which fingerprint regions contributed to predictions.

5. Experiments

Experiments followed a 70-15-15 split for training, validation, and testing. Performance metrics included accuracy, precision, recall, F1-score, and confusion matrix comparison across models.

6. Results

Handcrafted features yielded moderate performance, while CNN models outperformed them in accuracy. However, results suggest that fingerprints have limited but exploitable correlation with blood group data.

7. Discussion

Although deep learning showed better performance, the overall accuracy levels are not yet suitable for clinical use. The study reveals potential but requires more robust datasets, advanced preprocessing, and explainable AI techniques.

8. Limitations

Limited dataset size, non-uniform scanning conditions, and demographic bias.

9. Conclusion and Future Work

This research has demonstrated the basic feasibility of predicting blood groups from fingerprint images. Future work will focus on larger datasets, multimodal biometrics like palmprints and veins, and improved DL architectures for higher accuracy.