

Exploring the Biometric Potential of Fingerprints for Blood Group Identification: A Survey

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Abstract

Successful identification of a blood type quickly and correctly is essential for patient-centered care and emergency settings. Traditional methods could include technically invasive blood collection (e.g., fingerstick), and typically involves laboratory determination which may not be feasible in urgent or limited-resource settings. This study explores non-invasive biometric possibilities, especially through the lens of fingerprint ridge type analysis, and highlights ideas including combining various types of biometric identifiers and developing a baseline dataset to enhance replicability and study-to-study comparisons. A systematic literature search was conducted using IEEE Xplore, PubMed, and Scopus for works published between 2010 and 2025. The search terms searched were fingerprint biometrics, blood group classification, ABO typing, Rh factor, and machine learning. The inclusion criteria were for peer-reviewed literature that used computational methods to achieve biometric-based blood group detection, and the exclusion criteria excluded literature without good methodological detail or evaluation metrics. The review highlights relationships between ABO/Rh blood groups and fingerprint ridge patterns (ARCHES, LOOPS, and WHORLS) and highlights developments in computational methods, especially convolutional neural networks (CNNs). The review also examines aspects of datasets, feature extraction methods, and classification accuracy. Typical biases in the literature include small and geographically constrained sample sets, blood groups that are minoritized, and that a contained dataset is a training set and therefore leaves open opportunities for overfitting. This survey summarizes the key findings and highlights the need for larger and more diverse datasets and has developed a plan to identify and integrate multimodal biometric features and developments that will help provide a rapid, low-cost, and scalable alternative to blood typing while further enhancing diagnostic capacity in hospitals, rural clinics, and emergencies.

Keywords: Fingerprint Biometrics, Blood Group Classification, Convolutional Neural Networks, ABO and Rh Typing, Machine Learning