**Fingerprint-Based Blood Group Prediction Using Deep Learning Architectures for Non-Invasive Healthcare Applications**

Accurate and rapid blood group identification is vital in emergency medicine, transfusion safety, and healthcare. Traditional serological techniques, while dependable, are invasive, slow, and depend on laboratory infrastructure. This study explores fingerprint images as a non-invasive biometric method for blood group prediction using advanced deep learning models. The main goal is to evaluate and compare cutting-edge architectures to find the most effective and reliable model suitable for real-world use. A comprehensive fingerprint image dataset was preprocessed with augmentation, normalization, and noise reduction techniques. Several models, including CNN variants (Xception, InceptionV3, SEResNet50), lightweight architectures (MobileNetV3, EfficientNetV2-S), transformer-based models (ViT, SwinV2), and ConvNeXt variants, were trained and assessed using accuracy, precision, recall, F1-score, log-loss, and Brier score as metrics. MobileNetV3-Large achieved the highest accuracy of 98.51% with the lowest Brier score (0.0039), showing superior prediction confidence and efficiency. EfficientNetV2-S and RegNetY-032 also performed well with accuracy above 96%. The results show that fingerprint-based deep learning provides a feasible non-invasive alternative for blood group detection, with lightweight models enabling practical use in mobile or point-of-care systems. This research advances healthcare by offering a scalable, fast, and accurate method for patient identification and blood group determination, with potential use in emergency medicine, rural healthcare, and biometric health records.

**Keywords**: Fingerprint recognition, Blood group prediction, Deep Learning, MobileNetV3, Non-invasive healthcare