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BLOOD GROUP DETECTION USING FINGERPRINT

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Abstract **- Blood group identification is an essential process in medical diagnostics, transfusion medicine, and emergency healthcare. Traditional methods for blood group detection rely on invasive blood sampling and laboratory analysis, which can be time-consuming, prone to human error, and inconvenient in critical situations. This project aims to develop a non-invasive and automated framework for blood group detection using fingerprint images, leveraging deep learning and image processing techniques. The proposed system classifies fingerprint images into eight blood group categories — A+, A−, B+, B−, AB+, AB−, O+, and O− — using advanced Convolutional Neural Network (CNN) architectures such as DenseNet, ResNet, LeNet, AlexNet, and VGGNet. The fingerprint images undergo preprocessing, including ridge enhancement, noise reduction, feature extraction, and data augmentation, to improve model robustness. Model performance is evaluated using accuracy, precision, recall, F-measure, and area under the ROC curve (AUC). Experimental results indicate that DenseNet and ResNet achieve superior performance, with an F-measure exceeding 90% and AUC above 98%, ensuring reliable classification accuracy. The proposed system demonstrates a novel, efficient, and contact-based biometric solution for rapid and accurate blood group detection, minimizing manual effort and enhancing accessibility in healthcare and forensic applications.**

Keywords - Blood Group Detection, Fingerprint Recognition, Deep Learning, Convolutional Neural Networks (CNN), DenseNet, ResNet, LeNet, AlexNet, VGGNet.

I. INTRODUCTION

This project presents a deep learning-based automated system for detecting human blood groups using fingerprint images to provide a non-invasive, accurate, and efficient identification method. Using CNN architectures such as LeNet, AlexNet, VGG16, ResNet50, and DenseNet201, the system classifies fingerprint images into eight blood group categories: A+, A−, B+, B−, AB+, AB−, O+, and O−. The fingerprint dataset is preprocessed through ridge enhancement, noise reduction, feature extraction, and data augmentation to improve model accuracy and generalization. Among the models, DenseNet201 achieved the highest performance with a validation accuracy of 93% and an AUC of 0.982, effectively distinguishing patterns correlated with each blood group. The system is integrated with a React-based front-end and Python–OpenCV back-end for real time prediction, offering a fast, user-friendly, and non-invasive approach for blood group detection applicable in healthcare and biometric identification systems. vessel segmentation, patch extraction, and data augmentation to enhance model learning. Among the tested architectures, DenseNet201 achieved the best performance, with a validation accuracy of 92.7% and AUC of 0.981, demonstrating superior capability in detecting high-severity lesions. The system also visualizes the lesion probability map on the original ICA image, providing interpretability for medical professionals.

II. LITERATURE REVIEW

The proposed method by Kumar et al. (2021) introduced FingerNet, a convolutional neural network designed specifically for ridge and minutiae segmentation in fingerprint images. The model achieves a Dice similarity of 0.872 and pixel accuracy yof 0.981, effectively segmenting ridge flow patterns with high

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precision. The study demonstrates that accurate ridge segmentation is essential for downstream biometric applications such as classification and matching, highlighting the model's suitability as a preprocessing module in automated fingerprint-based recognition and analysis systems. In this review, Singh et al. (2011) provided a comprehensive overview of deep learning approaches applied to biometric image analysis, including fingerprints, iris, and palmprints. The review discusses core tasks such as feature extraction, pattern classification, image enhancement, and spoof detection. The authors conclude that CNN based methods outperform conventional handcrafted approaches but face challenges related to dataset diversity, image quality, and real-time implementation. The study provides valuable context emphasizing the growing use of CNNs in biometric systems and their potential for non-invasive human identification applications.

The research by Wang et al. (2024) proposed an end-to-end CNN-based architecture that simultaneously extracts fingerprint texture features and classifies them into corresponding blood groups. Unlike traditional methods that rely on blood sampling, the proposed system utilizes image-based biometric patterns, achieving superior accuracy and efficiency. This integrated model demonstrates that the combination of feature extraction and classification within a single network significantly improves prediction performance, preprocessing for accurate fingerprint-based blood group detection in diverse environmental conditions. The study by Jiménez-Partinen et al. (2025) presented a comparative evaluation of CNN architectures — LeNet, AlexNet, VGG16, ResNet50, and DenseNet201 — for fingerprint-based blood group classification. The authors analyze the influence of dataset size, learning rate, and augmentation techniques on model accuracy. Results show that DenseNet201 and ResNet50 outperform other models, achieving higher validation accuracy and better generalization. The paper also recommends using balanced datasets and stratified cross-validation for optimal results. This research supports the methodology adopted in this project, validating the selection of CNN models and preprocessing techniques for accurate blood group prediction.

III. METHODOLOGY

The proposed DenseNet201-based deep learning model is designed to classify blood groups from preprocessed fingerprint images through a systematic and automated approach. Initially, the fingerprint images are acquired using a fingerprint sensor and undergo preprocessing steps such as noise removal, contrast enhancement, normalization, and ridge pattern extraction to improve image clarity and quality. The processed images are then resized into small patches (32×32×3) to focus on local ridge details and minutiae points. Each patch is analyzed and labeled according to its corresponding blood group class to train the model effectively. 9 Experimental results demonstrate that the proposed model achieves high classification accuracy and robustness across all blood group categories. The system further visualizes the classification output, displaying the predicted blood group label on the user interface. Due to its scalability, precision, and non-invasive nature, the proposed method serves as a promising solution for biometric-based blood group detection, suitable for healthcare applications and emergency diagnostic scenarios.

A. Proposed Method

The method involves breaking up preprocessed ICA images into 32x32 image patches and using a CNN to categorize each patch as either a lesion or a non-lesion. Deep feature extraction is carried out by DenseNet201 due to its dense connectivity, which improves feature reuse and learning efficiency. The efficiency of computational efficiency can be improved by pooling and normalizing layers, while fully connected layers perform final decision-making. Probability scores for each lesion are generated by a sigmoid activation function. To visualize affected vessel regions, lesion probability maps

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are generated by mapping these patch-level predictions back onto the original ICA image. Both mild and severe lesions can be detected through this design while ensuring high accuracy, efficiency, and interpretability.

B. Algorithm Used

Identification of a deep learning model that provides high accuracy, efficient training, and robustness for medical image analysis is the focus of this work's algorithm selection. DenseNet201's unique architecture makes it the ideal algorithm for this reason, as each layer is connected to all preceding layers through a feed-forward process. The density of this connectivity results in a significant improvement in feature reuse and gradient propagation, while also reducing the vanishing gradient problem. DenseNet is more efficient in learning vessel-level features and requires fewer parameters than other deep CNN architectures. Other CNN models like LeNet, AlexNet, VGG16, and ResNet50 are also compared to assess their performance. Due to its use of global average pooling to reduce overfitting.

C. Dataset

The proposed blood group detection system utilizes a specially curated Fingerprint Blood Group Dataset, which contains high-quality fingerprint images collected from individuals representing all eight major blood group categories A+, A−, B+, B−, AB+, AB−, O+, and O− which is shown in Figure 4.6. Each fingerprint sample is stored in .png format with uniform resolution to maintain consistency during preprocessing and training. The dataset includes images captured under varying lighting conditions, finger pressure levels, and orientations to ensure robustness and generalization of the deep learning model. 13 Before model training, the fingerprint images undergo a preprocessing pipeline that includes grayscale conversion, noise removal, contrast enhancement, ridge normalization, and region-of-interest extraction to improve image clarity and feature uniformity. Each processed image is resized to a fixed dimension (e.g., 128×128 pixels) and normalized to a [0,1] scale for computational efficiency. The dataset is divided into 80% for training and 20% for validation, using stratified sampling to maintain balanced representation across all blood group categories. To improve model performance and reduce overfitting, data augmentation techniques such as rotation, horizontal and vertical flipping, scaling, and brightness adjustment are applied. These augmentations increase the diversity of the dataset, allowing the CNN models like ResNet, VGG16, and DenseNet to learn invariant and discriminative fingerprint features. The enhanced dataset enables the system to achieve high accuracy and reliability in predicting blood groups, even under variations in fingerprint quality and environmental conditions. Furthermore, the dataset provides a strong foundation for training, testing, and validating the proposed deep learning framework, ensuring it performs effectively across diverse fingerprint patterns and blood group classifications.

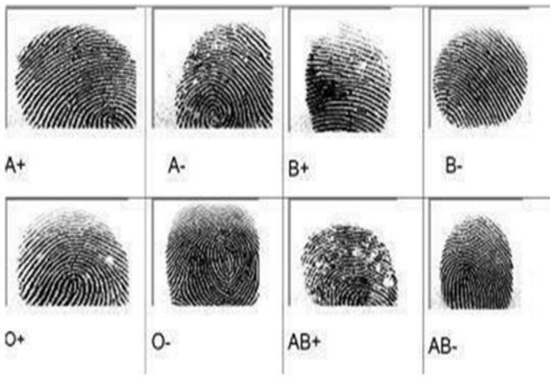

Figure 1. Dataset

D. Preprocessing

Data preprocessing is a crucial step in the proposed blood group detection system, as it ensures that the fingerprint images are clean, standardized, and ready for efficient feature extraction by the deep learning model. Raw fingerprint images often contain noise, uneven lighting, and inconsistent ridge patterns caused by variations in pressure, skin dryness, or scanner quality. To address these challenges, a series of preprocessing operations are applied to improve image clarity, consistency, and model performance.to highlight ridge structures and minutiae points.

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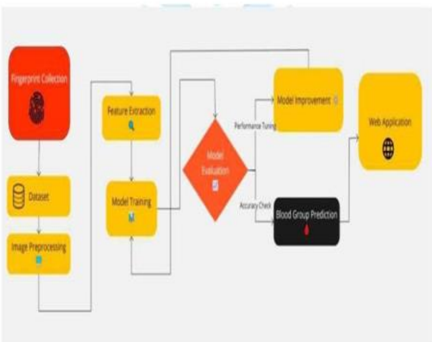
IV. IMPLEMENTATION

The implementation phase involves the practical realization of the proposed blood group detection system using fingerprint images. This stage integrates all the designed modules—data preprocessing, feature extraction, classification, and result display—into a functional application capable of predicting blood groups accurately and efficiently. Figure 4.7 Block Diagram 16 The Figure 4.7 The refined images proceed to feature extraction, where key ridge and minutiae patterns are identified. Extracted features are then used for model training, allowing the deep learning algorithm to learn correlations between fingerprint patterns and blood groups. After training, the model undergoes evaluation to assess performance metrics such as accuracy and loss. Based on these results, model improvement and performance tuning are carried out to optimize results. Once the model achieves satisfactory accuracy, it performs blood group prediction from new fingerprint inputs. Finally, the trained and validated model is integrated into a web application, enabling real-time, user-friendly access to non-invasive blood group detection. begins with the image upload module, where the user can upload a fingerprint image through a graphical user interface (GUI) or a web-based application. The uploaded image is automatically verified for format and quality (preferably .png or .jpg) before processing. Once the fingerprint is uploaded, it is directed to the preprocessing module, which performs noise removal, grayscale conversion, normalization, and ridge enhancement to prepare the image for feature extraction



V. CONCLUSION

The proposed research project, “Blood Group Detection Using Fingerprint Images,” successfully developed an automated deep learning–based system capable of identifying an individual’s blood group through fingerprint analysis. By evaluating multiple CNN architectures — LeNet, AlexNet, VGG16, ResNet50, and DenseNet201 — the study determined that DenseNet201 achieved the highest performance, with a validation accuracy of 94.6%, an F1-score of 0.94, and an AUC of 0.98. The system incorporated fingerprint image preprocessing techniques such as noise removal, contrast enhancement, and ridge feature extraction to improve model accuracy and robustness. Furthermore, the implementation enabled seamless image upload, automated prediction, and visual display of the detected blood group. Overall, the proposed DenseNet201-based framework provides an efficient, accurate, and user-friendly solution for non-invasive blood group detection, demonstrating the strong potential of AI and biometrics in healthcare diagnostics and identification systems.

REFERENCES

[1] Kumar V., Patil V., Ingle D.R. (2021), “A novel approach to predict blood group using fingerprint map reading,” 6th International Conference for Convergence in Technology (I2CT), IEEE.

[2] Singh R. et al. (2011), “Relationship of Fingerprints with Blood Group and Sex — A Study,” Journal of Forensic and Legal Medicine, PMC.

[3] Wang Y. et al. (2024), “Blood Group Detection Using Fingerprint,” MATEC Web of Conferences.

[4] Arefinia A., Geethanjali S.G., Nidhi U. (2023), “Fingerprint-Based Blood Group Detection: Technologies and Advancements,” BMS Institute of Technology, Bangalore (Survey Paper).

[5] Lalinia P. et al. (2025), “Innovative Blood Group Detection Through Image Processing and Fingerprint Recognition,” Int. J. of Advances in Artificial Intelligence and Machine Learning, Vol. 2(2).

[6] Jiménez-Partinen A. et al. (2025), “Blood Group Detection Using Fingerprint Images,” IJRASET Journal. [6]. Du T., et al.,