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Hemodetection Using Fingerprint

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Abstract
Fingerprints are unique identification mechanism useful for deter mining human identity. Hardly one in more than 64,000 million people share a similar fingerprint pattern. The minute pattern of fingerprint of each individual is unmatched with possibility of similarity being very less. The science behind detection of blood group from fingerprint is derived from the presence of proteins and antigens present in sweat on ridges and grooves of the fingerprint. This paper focuses to correlate between finger print patterns and various blood groups using advanced image processing algorithm and machine learning techniques. This research aims in contributing to biometric applications and thereby enhancing healthcare through innovative approaches using latest technology such as artificial intelligence. We use deep learning methodologies like Convolutional Neural Network (CNN) to extract hidden patterns inside the image and make appropriate predictions. Traditional blood group detection methods are time consuming and may incur human errors. In order to make blood group determination error free and less time-consuming various machine learning and image processing techniques can be implemented. Blood group determination is important for cases such as medical diagnosis, blood transfusions etc.
Keywords: *Detecting fingerprint, Blood Group detection.*

1. Introduction
Hemodetect leverages fingerprint analysis with machine learning and deep learning (CNNs) to non-invasively detect blood groups. Fingerprints, unique for every individual, contain sweat proteins and antigens that can be linked to specific blood types. By using image processing, feature extraction, and pattern recognition, this method offers a faster, safer, and more accurate alternative to traditional serological tests, which are invasive, time-consuming, and prone to human error. Current systems achieve around 62% accuracy, highlighting the need for larger datasets, refined feature extraction, and advanced architectures to boost reliability. The technology holds promise in healthcare diagnostics, forensic investigations, blood donation drives, and emergency medical situations. Its non-invasive nature enables quick testing in remote areas and infection-sensitive environments. Future advancements could integrate Hemodetect into smartphones or wearable devices, making blood typing instant, portable, and painless, thereby revolutionizing blood group identification in both medical and non-medical contexts. [1-5]

2. Method
The Hemodetection system is designed to determine blood groups from fingerprint images using advanced image processing and deep learning techniques, specifically the LeNet-5 Convolutional Neural Network (CNN). The process begins with the collection of a diverse dataset of fingerprint images, each labeled with its corresponding blood group. To ensure accuracy and model generalization, the dataset includes variations in ridge patterns such as arches, loops, and whorls. In the preprocessing stage, captured fingerprint images undergo a series of enhancement steps, including noise removal, contrast adjustment, normalization, and region of interest (ROI) extraction to isolate the fingertip area. Images are resized to 224×224×3 pixels, converted to grayscale to reduce computational load, and processed with edge detection algorithms to emphasize ridge contours and minutiae points. These preprocessing steps ensure that the CNN receives high-quality, standardized inputs. Feature extraction

focuses on detecting and quantifying key biometric markers such as ridge endings, bifurcations, ridge density, and spatial relationships. The LeNet-5 CNN architecture processes these features through multiple convolutional and pooling layers to detect hierarchical patterns, followed by fully connected layers for high-level representation. The final softmax output layer classifies the fingerprint into one of eight categories: A+, A-, B+, B-, AB+, AB-, O+, O-. The backend—implemented using Python Flask or FastAPI with TensorFlow—manages image preprocessing, model inference, result generation, and secure storage. The frontend, developed using Gradio or web technologies (HTML, CSS, JavaScript), provides an intuitive user interface for uploading fingerprints, previewing images, and viewing predictions. The system outputs the detected blood group along with a confidence score and offers options to download results as PDF reports. Security is ensured through AES-256 encryption for data storage and SSL/TLS protocols for secure transmission. Cloud integration with AWS, Google Drive, or Azure enables scalable deployment. Designed to be compatible with Windows, Linux, and Android platforms, the system works with high-resolution fingerprint scanners (≥500 DPI) and delivers predictions within five seconds, achieving high operational efficiency. This approach provides a non-invasive, rapid, and scalable solution for blood group determination, making it valuable in healthcare diagnostics, forensic science, emergency medicine, and remote healthcare settings where traditional blood testing may be slow, invasive, or impractical

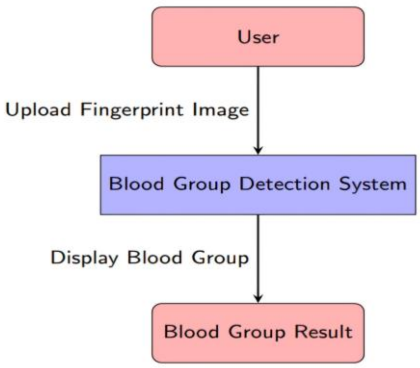

Figure 1 Level 0: Blood Group Detection System

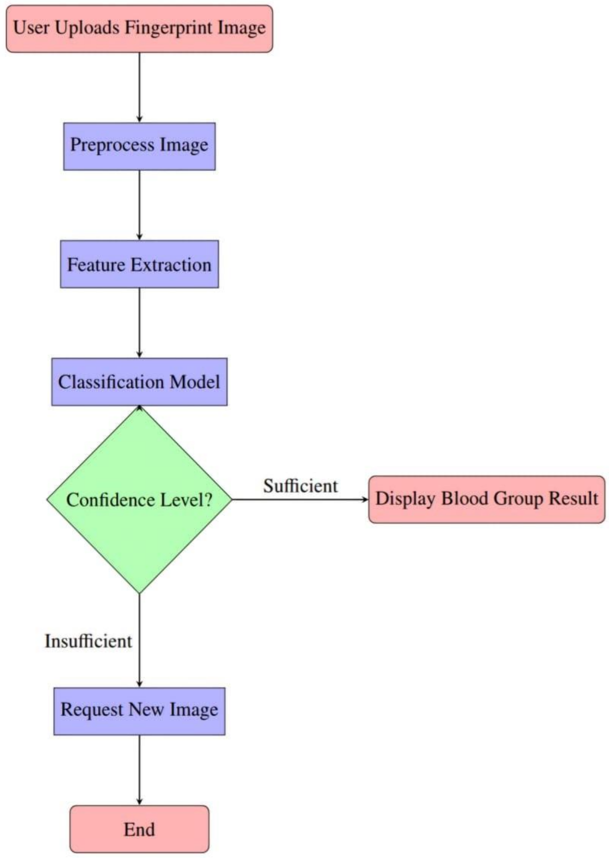

Figure 2 Level 1: High Level Process Flow

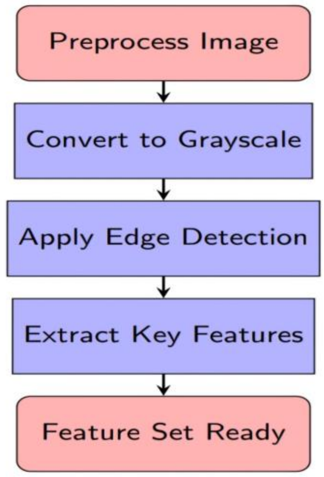

Figure 3 Level 2: Detailed Feature Extraction Process

3. Results

The Blood Group Detection system provides an intuitive and user-friendly interface designed for

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efficient fingerprint-based analysis. On the initial screen, users are prompted to upload a fingerprint image either by dragging and dropping it into the designated area or by selecting it from their device. The interface includes clear functional buttons such as "Clear" to reset the input and "Submit" to initiate processing. Once a fingerprint image is uploaded, it appears in the preview section, confirming that the system has successfully received the input and is ready for analysis. When the user clicks "Submit," the system processes the fingerprint image through its trained deep learning model to extract biometric patterns and predict the corresponding blood group. In the illustrated example, the system accurately predicts the blood group as "O-," which is displayed in the output section alongside a "Flag" button for marking or reviewing results. Throughout the process, the interface retains its operational controls, allowing users to clear the image, re-upload a new one, or submit additional samples, ensuring a seamless, repeatable, and reliable workflow for quick and non-invasive blood group determination. Figure 1,2,3,4, Figure 5 & Figure 6 [6-10] [16-19]

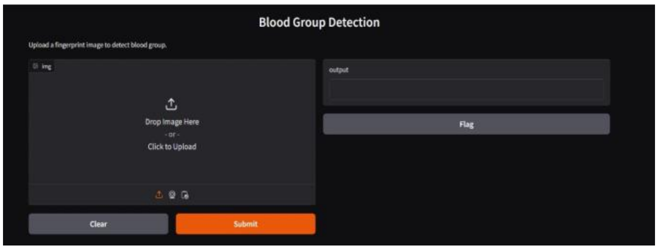

Figure 4 Initial Interface of The Blood Group Detection System, Prompting the User to Upload a Fingerprint Image for Analysis

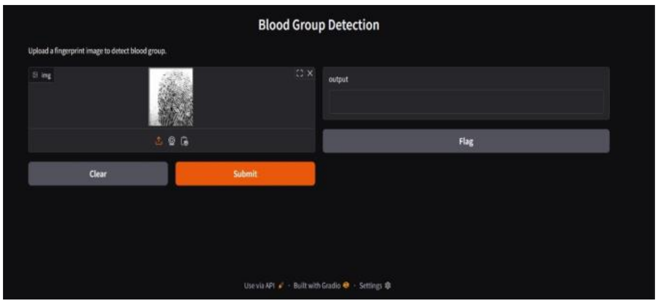

Figure 5 A Fingerprint Image Is Successfully Uploaded, Ready for Processing to Determine the Blood Group

Figure 6 The System Processes the Fingerprint Image and Predicts the Blood Group as O-

Conclusion

This research highlights the chances of making use of fingerprint analysis for blood group determination from advanced machine learning and deep learning methodology, especially Convolutional Neural Network (CNN). The research shows the strong relation between fingerprint patterns and blood groups, demonstrating that image processing, deep learning and ma chine learning techniques. The adoption of CNN architectures like LeNet-5 resulted in very effective extraction and analysis of fingerprint features, which eventually led to accurate map ping of fingerprints to blood groups. [11-15] This approach offers a noninvasive, convenient, and scalable solution compared to traditional blood testing methods, making it highly applicable in healthcare diagnostics, forensic science, and emergency scenarios.

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