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BLOOD GROUP PREDICTION USING FINGERPRINT

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ABSTRACT
This project presents a research-oriented approach for analyzing fingerprint images to explore potential patterns related to blood group classification using deep learning techniques. The system utilizes convolutional neural networks, specifically DenseNet121 and MobileNet architectures, to process fingerprint images and extract features.
A dataset of approximately 500 fingerprint samples is used for training and evaluation. The model is deployed using a Django-based web interface, allowing users to upload fingerprint images for analysis.
This work is intended solely for academic research and experimental purposes and does not replace medically approved blood group identification methods. The results provide preliminary insights into pattern-based classification and highlight the scope for further research in this domain.

INTRODUCTION
Blood group identification is an essential process in medical applications such as blood transfusion, emergency care, and surgical procedures. Conventional methods for determining blood groups involve laboratory testing, which requires blood samples, specialized equipment, and trained personnel.
In recent years, there has been growing interest in exploring non-invasive and computational approaches for pattern recognition in biological traits. Fingerprints, which are unique to each individual, contain ridge patterns such as loops, whorls, and arches that have been widely studied in biometric systems.
This project explores a deep learning-based approach to analyze fingerprint images and investigate possible relationships with blood group classification. Convolutional neural network architectures such as DenseNet121 and MobileNet are used to extract features from fingerprint images and perform classification.
The system is developed as a web-based application using Django, enabling users to upload fingerprint images for analysis. It is important to note that this project is intended for academic and experimental purposes only and does not serve as a substitute for medically approved blood group testing methods.

RELATED WORK
Machine learning has been widely used in biometric recognition, including fingerprint identification, face recognition, and iris analysis. Convolutional neural networks (CNNs) have shown strong performance in image classification because they automatically learn hierarchical features from raw images.
Previous studies have also explored dermatoglyphics, in which fingerprint ridge patterns are statistically compared with physiological traits. While such relationships are not considered definitive for clinical diagnosis, they remain an interesting area for computational research.
Lightweight neural networks, such as MobileNet, are commonly used where faster inference and lower hardware requirements are needed. Transfer learning models like DenseNet are also popular for extracting reusable image features.

PROBLEM STATEMENT
Existing blood typing methods depend on invasive procedures and laboratory resources. In remote or low-resource settings, immediate access may be limited. There is a need for fast, software-based exploratory systems that can process easily captured biometric data. This project addresses the challenge of designing a fingerprint-based blood group prediction model using image classification techniques.

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PROPOSED SYSTEM

The proposed system follows a modular workflow:

1. The user uploads a fingerprint image through the web portal.
2. The images is validated and stored temporarily.
3. Preprocessing was applied, including resizing and normalization.
4. DenseNet121 extracts the feature representations.
5. A MobileNet-based classifier was used to predict the target blood group.
6. The predicted results are shown to the user.

The system is designed for CPU-based execution and practical demonstration.

SYSTEM ARCHITECTURE

The proposed system architecture is designed as a modular pipeline for predicting blood groups using fingerprint images. The process begins with an Image Input Module, where the user uploads a fingerprint image through a Django-based web interface. The uploaded image is then forwarded to the preprocessing stage, where it is resized, normalised, and cleaned to ensure uniformity and reduce noise.

The next layer consists of the Feature Extraction Module, where a convolutional neural network, specifically DenseNet121, is used to extract important fingerprint features such as ridge patterns and texture information. These features are then passed to the Classification Module, where a MobileNet-based model analyses the extracted features and predicts the corresponding blood group based on learned patterns.

Finally, the predicted result is sent to the front-end display module, where it is shown to the user along with the uploaded image. The system can also store results for future reference.

WORKFLOW OF PROPOSED SYSTEM

The workflow of the proposed system begins with the user uploading a fingerprint image through the web interface. The system first performs image validation to ensure that the uploaded file is a valid image. Once validated, the image is passed to the preprocessing stage, where it is resized, normalised, and converted into an appropriate format to maintain consistency and reduce noise.

After preprocessing, the image is sent to the feature extraction stage, where a deep learning model, specifically DenseNet121, extracts important features such as ridge patterns and texture details from the fingerprint. These extracted features are then forwarded to the classification stage, where a MobileNet-based model processes the features and predicts the corresponding blood group.

Finally, the system generates the prediction output and displays the predicted blood group to the user along with the uploaded image on the interface. This workflow ensures a smooth sequence of operations from input → processing → prediction → output, enabling an efficient and real-time blood group detection system.

OBJECTIVES

- To develop a system for predicting blood groups using fingerprint images.
- Extract meaningful fingerprint features using deep learning techniques.
- To classify blood groups accurately using a CNN-based model.
- To provide a real-time prediction system through a web-based interface.
- To reduce dependency on traditional blood testing methods for basic analysis.
- To improve accessibility by enabling non-invasive and quick prediction.

METHODOLOGY

The methodology begins with fingerprint image collection from datasets or user uploads through the web interface. The images were then preprocessed using resizing, normalization, and noise reduction techniques to ensure consistency.

Next, the preprocessed images are passed through a feature extraction stage, where a CNN model such as DenseNet121 extracts important fingerprint features like ridge patterns and texture details. These extracted features are then forwarded to the classification model, where a MobileNet-based network predicts the corresponding blood group.

During prediction, the system analyzes the extracted features and determines the output based on learned patterns. The final result is displayed to the user through the web interface.

Performance is evaluated using:

- Accuracy
- Precision

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- Recall
- F1 Score
- Prediction Speed (Response Time)

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ALGORITHM

Algorithm: Blood Group Detection using Fingerprint
Input: Fingerprint image (uploaded by user)
Output: predicted blood group
Step 1: Capture or upload a fingerprint image
Step 2: Validate input image format
Step 3: Preprocess image (resize, normalize, remove noise)
Step 4: Extract features using DenseNet121
Step 5: Convert features into a feature vector
Step 6: Classify features using MobileNet model
Step 7: Predict blood group using argmax function
Step 8: Display the predicted result on the interface
Step 9: Store prediction result (optional)
End Algorithm

EXPERIMENTAL SETUP

- Operating System: Windows
- Programming Language: Python
- Framework: Django
- Libraries: TensorFlow, NumPy, PIL
- Execution Mode: CPU-based
- Dataset Size: ~500 images
- Classes: 8 blood groups

The dataset was divided into training and evaluation subsets.

PERFORMANCE METRICS

The system was evaluated using common classification measures:

- Accuracy
- Precision
- Recall
- F1-Score
- Response Time

RESULTS AND ANALYSIS

The system produced better results when fingerprint images were clear and properly captured. Blurred or low-quality images reduced prediction consistency. The MobileNet model provided faster response time, making it suitable for real-time web-based usage.

FUTURE ENHANCEMENT

Future improvements include collecting a larger dataset, improving preprocessing techniques, and developing a mobile-based version of the system. Confidence score display can also be added.

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CONCLUSION

This study presents an efficient and practical blood group detection system using fingerprint images. By integrating DenseNet121 for feature extraction and MobileNet for classification, the system successfully predicts blood groups with good accuracy.

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The system provides a non-invasive and real-time prediction approach, reducing dependency on traditional blood testing methods for basic analysis. The proposed framework is simple, scalable, and suitable for academic and research applications, demonstrating the potential of combining biometric data with machine learning techniques.

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