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DEPARTMENT OF INFORMATION TECHNOLOGY

IT3811 - Project work

Second Review

Fingerprint-Based Blood Group Detection Using Deep Learning and Image Processing

Submitted by

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Abstract

1 Blood group prediction is crucial for medical diagnostics and emergency care.

2 Traditional methods are invasive, time-consuming, and rely on laboratory resources.

3 This project proposes a non-invasive approach using fingerprint images and Convolutional Neural Networks (CNNs).

4 The method is faster, cost-effective, and accessible in resource-limited or emergency settings.

5 Through experimentation, the proposed system has shown promising results for real-world healthcare application.

Introduction

- Traditional blood group testing depends on serological methods involving blood samples and lab equipment.
- These are not suitable for emergency or rural healthcare scenarios.
- With advancements in **deep learning** and **image processing**, we explore an alternative: predicting blood groups from **fingerprint patterns**.
- The project introduces a **CNN-based approach** that improves speed, accessibility, and affordability in diagnostics.

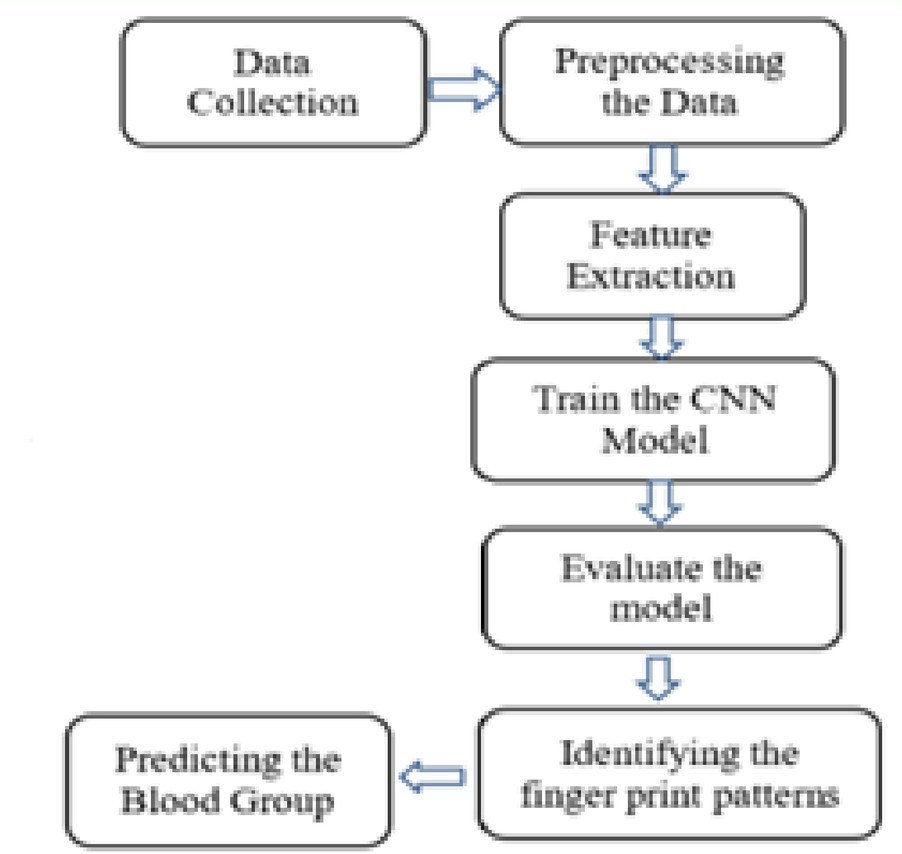
Methodology

Existing Methods

- **Serological Testing:** Requires blood sample mixing with antibodies.
- **Automated Blood Typing Systems:** Optical sensors analyze blood reactions.
- **Genotyping:** Uses molecular techniques for antigen detection (costly & complex).

Proposed Method

- Uses fingerprint images for blood group prediction.
- Applies **Convolutional Neural Networks (CNNs)** to detect blood group patterns.
- Uses datasets of **6000 fingerprint images**, labeled with blood groups.



- Preprocessing includes **image normalization, noise reduction, contrast adjustment**.
- **Feature extraction:** Identifies ridges, bifurcations, and minutiae points.
- Models are trained and validated using **LeNet5, AlexNet, VGG16, and ResNet34**.

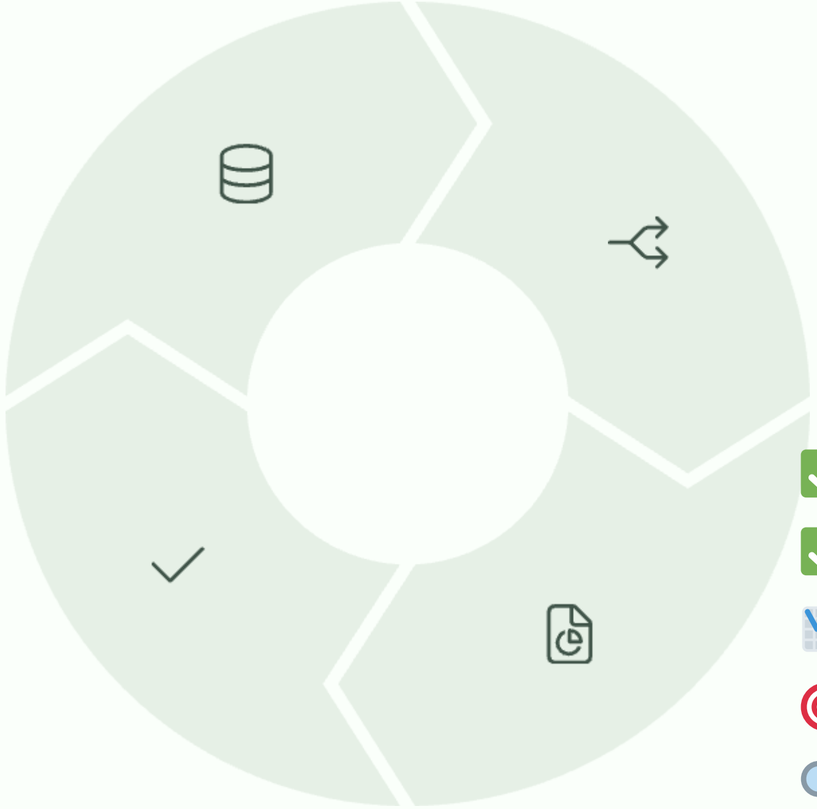
Testing and Validation

Dataset Preparation

Custom dataset of fingerprint images

Cross-Validation

Ensured robustness and minimized overfitting



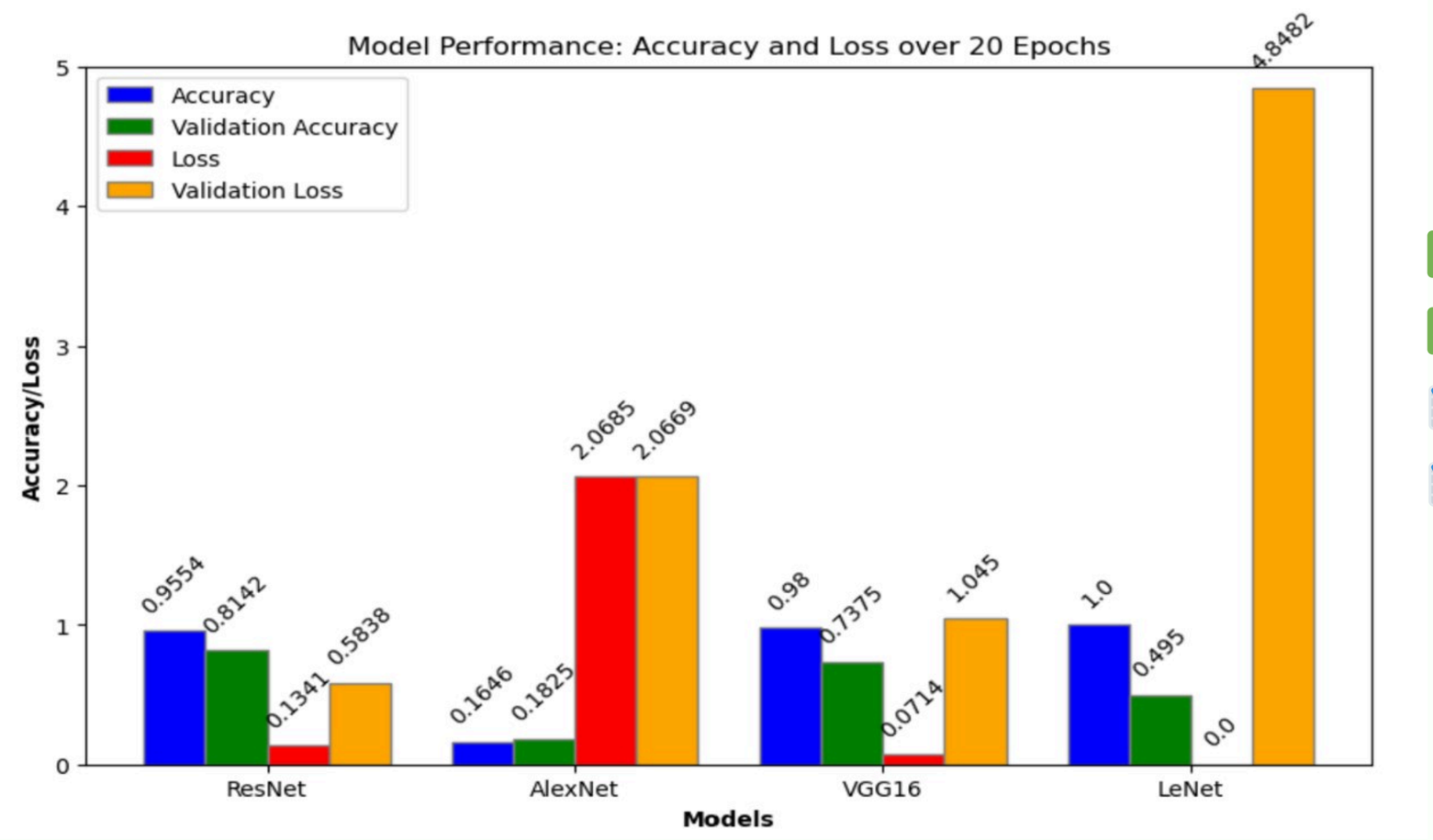
Data Split

Training (80%) and **Testing (20%)**

Evaluation Metrics

✅ **Training Accuracy:**	95.54%
✅ **Validation Accuracy:**	81.42%
📉 **Validation Loss:**	0.5838
🎯 **Precision:**	91.80%
🔍 **Recall:**	90.10%
📊 **F1-Score:**	90.94%

Model Performance: Accuracy and Loss over 20 Epochs



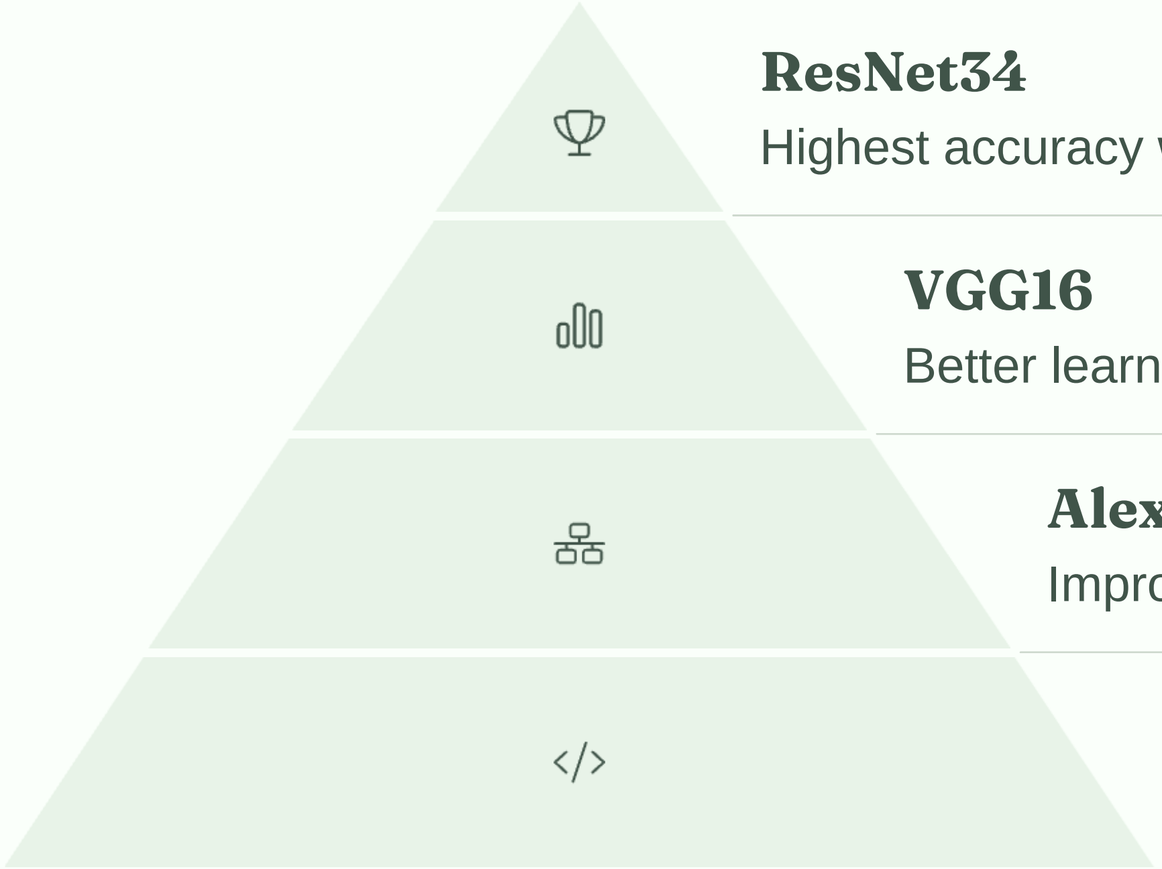
✅ **Accuracy:** 0.9554

✅ **Validation Accuracy:** 0.8142

📉 **Validation Loss:** 0.5838

📉 **Loss:** 0.1341

Results and Analysis



ResNet34
Highest accuracy with residual connections

VGG16
Better learning, but overfits small datasets

AlexNet
Improved layers but low fingerprint recognition accuracy

LeNet5
Simple, fast but struggles with complex patterns

- **ResNet34** outperformed other models with the **highest accuracy** due to residual connections that reduce vanishing gradients.
- Results confirm the effectiveness of deep learning in biometric-based classification.

Challenges and Solutions

Challenges	Solutions
Limited dataset	Data augmentation to expand training samples
Overfitting in deeper models	Applied dropout and regularization techniques
Noise in fingerprint images	Preprocessing using filters and edge detection
Model convergence issues	Used adaptive optimizers
Lack of existing labeled biometric datasets	Created a custom dataset and manually labeled blood groups

Conclusion

Viability Demonstrated

This work demonstrates the **viability of using fingerprint biometrics** to predict blood groups through deep learning.

Best Performance

ResNet34 showed the best performance, validating the choice of architecture.

Practical Benefits

The approach is **non-invasive**, **cost-effective**, and **suitable for real-time medical applications**.

Potential Impact

It has potential to revolutionize emergency diagnostics, especially in **rural and under-resourced areas**.

Contribution

The study contributes to the growing intersection of **AI and healthcare diagnostics**.

THANK YOU!