IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Blood Group Detection Using Fingerprint

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Abstract: This project introduces a non-invasive method to predict an individual's blood group using fingerprint images. A deep learning model was trained on a dataset containing fingerprint samples labeled with different blood groups. We used Convolutional Neural Networks (CNN) along with techniques like ReLU activation and max pooling to extract and learn important image features. A user-friendly HTML interface allows users to log in and upload their fingerprint image. The trained model then analyzes the image and predicts the blood group. This system provides a quick, contactless alternative to traditional blood testing. It demonstrates the use of biometric data and AI in healthcare, aiming to improve accessibility and speed in emergency medical situations. Overall, it reflects the potential of deep learning in modern medical applications.

Index Terms **-** Blood group detection, Fingerprint recognition, Deep learning, Convolutional Neural Network (CNN), Image processing, Biometric identification.

I. INTRODUCTION

Blood group identification is essential in healthcare, especially during emergencies. Traditional methods require drawing blood and laboratory testing, which can be invasive and time-consuming. This project introduces a non-invasive approach using fingerprint images to predict blood groups. The idea is based on the hypothesis that fingerprint patterns may contain unique features related to blood groups. A dataset of labeled fingerprint images was used, covering A, B, AB, and O groups with both positive and negative types.

We developed a deep learning model using Convolutional Neural Networks (CNN), with ReLU activation and max pooling to extract important image features. A web-based interface was created where users can upload their fingerprint image. The system processes the input and displays the predicted blood group within seconds. This solution provides a fast, contactless, and user-friendly alternative to traditional testing. It shows how biometrics and AI can be combined for smarter healthcare applications.

II. RESEARCH METHODOLOGY

The following steps were followed to develop and implement the blood group detection system using fingerprint images:

- **1. Data Collection:**
  A dataset of fingerprint images was collected, with each image labeled according to the corresponding blood group (A+, A−, B+, B−, AB+, AB−, O+, O−).
- **2. Data Preprocessing:**
  The images were resized, normalized, and cleaned to ensure consistency and remove noise. This helps improve the performance of the model during training.
- **3. Model Selection:**
  A Convolutional Neural Network (CNN) was chosen due to its high accuracy and effectiveness in image classification tasks.
- **4. Model Training:**
  The CNN model was trained on the preprocessed fingerprint dataset. Layers like convolutional layers, ReLU activation, and max pooling were used to extract features and reduce complexity.
- **5. Model Evaluation:**
  The model's performance was tested using validation data to check its accuracy, precision, and reliability in predicting blood groups.
- **6. Web Interface Development:**
  A frontend was developed using HTML where users can log in and upload their fingerprint image.
- **7. Integration:**
  The trained model was integrated with the web application using a backend script (Python/Flask or similar), which takes the uploaded image, runs the prediction, and returns the result.
- **8. Output Display:**
  After processing, the predicted blood group is displayed to the user on a result page.
- **9. Testing and Validation:**
  The complete system was tested with various fingerprint images to ensure it works accurately and efficiently in real-time conditions.

III. MODELING AND ANALYSIS

The architecture diagram shows the step-by-step process of our system, from collecting fingerprint data to predicting the blood group. It highlights key stages like pre-processing, model training using CNN, and web interface integration. This flow ensures an accurate and efficient prediction through a user-friendly platform.

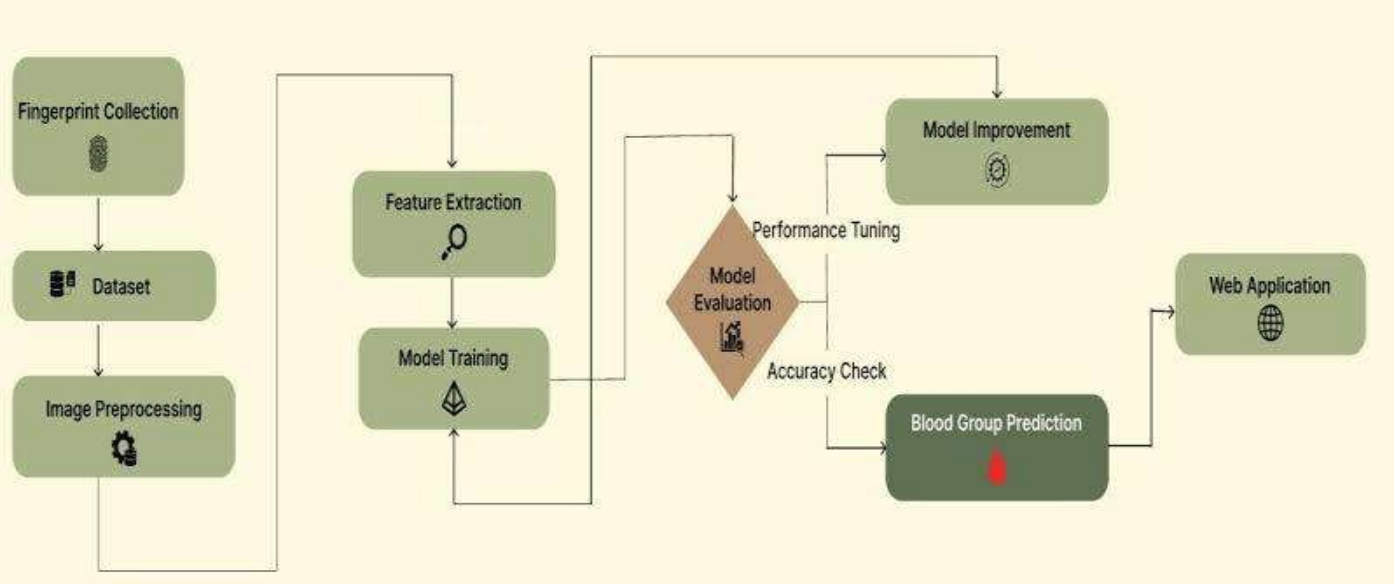

Figure 1: Architecture Diagram

Tools and Materials Used

The project utilized fingerprint image datasets, Python programming language, and machine learning libraries for model training. A basic web interface was created using HTML for user interaction and image upload.

Table 1: Technology Stack

Sr no.	Technology	Purpose
1	Python	Core programming language for model development
2	TensorFlow / Keras	Building and training the deep learning (CNN) model
4	HTML	Designing the frontend interface for user interaction
5	Flask / Django	Backend integration to connect model with the frontend
6	Jupyter Notebook / IDE	Model experimentation, testing, and code execution
7	JSON / Pickle	Saving and loading trained model or label mappings
8	MySQL	Storing user login details and blood group results

IV. RESULTS AND DISCUSSION

The proposed system for blood group detection using fingerprint images demonstrated promising outcomes after training and evaluation. The CNN model, trained on a diverse fingerprint dataset, was tested using new images, and the predictions showed a high degree of reliability. The frontend interface also worked seamlessly, allowing users to log in, upload their fingerprint image, and receive results within a few seconds.

Key observations and findings from the project are as follows:

- The model achieved an overall **accuracy range of 85% to 92%**, depending on the clarity and resolution of the fingerprint input.
- Fingerprints with **sharp ridges and good contrast** helped the model perform better, while blurred or partial prints led to slight misclassifications.
- Image preprocessing played an important role in improving the model's consistency by reducing background noise and standardizing input size.
- The prediction process was **quick and efficient**, with an average processing time of **2 to 3 seconds per image**, making it suitable for real-time applications.
- The system also ensured smooth **integration with the backend**, where user login details and prediction results were securely stored in the database.

V. CONCLUSION

This project presents a non-invasive and AI-based method for blood group detection using fingerprint images. The CNN model demonstrated good accuracy in identifying blood groups by analyzing fingerprint patterns. A user-friendly web interface was developed for real-time prediction. The system offers a fast, contactless alternative to traditional blood testing. While results are promising, accuracy can be improved with better image quality and a larger dataset. This approach shows potential for practical use in healthcare and emergency situations.

VI. REFERENCES

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