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DERMATOGLYPHIC ANALYSIS FOR BLOOD GROUP PREDICTION

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Abstract: This paper presents a non-invasive blood group estimation system using fingerprint image analysis and biometric authentication. The system captures fingerprint images through a sensor and applies preprocessing techniques such as image enhancement, noise removal, and ridge extraction. Biometric and texture features are extracted and analysed using Convolutional Neural Network (CNN) and Support Vector Machine (SVM) classifiers to estimate ABO and Rh blood groups. Fingerprint authentication is also integrated to link the estimated blood group information with individual user records in a database. The proposed system aims to provide a fast and low-cost approach for preliminary blood group estimation. It is intended as an exploratory aid and does not replace laboratory-based blood grouping.

Keywords: Fingerprint Analysis, Blood Group Estimation, CNN, SVM, Biometric Authentication, Image Processing.

I. INTRODUCTION

Blood group identification plays an important role in healthcare, particularly in blood transfusions, organ transplantation, surgical procedures, and emergency medical care. Conventional blood grouping methods rely on serological testing, which requires blood samples, specific reagents, and laboratory facilities. Although reliable, these methods may be time-consuming and require trained personnel, especially in resource-limited environments. Recent developments in biomedical engineering and artificial intelligence have encouraged research into non-invasive healthcare solutions. Fingerprint analysis has gained attention because of its uniqueness and ease of acquisition. By applying image processing and machine learning techniques, fingerprint patterns can be analysed to extract biometric and texture features for exploring possible associations with blood group categories.

This project proposes a fingerprint-based blood group estimation system that combines fingerprint image analysis with biometric authentication. The system uses image preprocessing and machine learning techniques, including Convolutional Neural Networks (CNN) and Support Vector Machines (SVM), to estimate ABO and Rh blood groups. It also links the estimated information to authenticated user records through a database.

The proposed approach aims to provide a fast and low-cost method for preliminary blood group estimation, particularly in emergency situations and low-resource healthcare environments. However, fingerprint-based estimation is not a medically validated replacement for conventional blood grouping and laboratory cross-matching procedures

II. LITERATURE SURVEY

1. Dermatoglyphic Study: Association Of Fingerprint Patterns Among Abo Blood Groups (2016)
Tri Panjiasih Susmiarsih, M. Samsul Mustofa, and Mirfat studied the relationship between fingerprint patterns and ABO blood groups among 302 medical students. The researchers classified fingerprints into arches, loops, and whorls and analysed their distribution across different blood groups. Their findings showed statistically significant differences in fingerprint pattern distribution among ABO blood groups. This study provided an initial basis for investigating the possible relationship between fingerprint characteristics and blood group classification.

2. Dermatoglyphics And Their Relationship With Blood Group: An Exploration (2019)
Saranya Manikandan and other researchers conducted a study involving 150 dental students to examine the relationship between fingerprint patterns and ABO and Rh blood groups. Fingerprint impressions were collected using the ink method and classified into loops, whorls, and arches. The study reported an association between dermatoglyphic patterns and

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blood groups. It highlighted the possibility of using fingerprint characteristics for further research in blood group-related analysis.

3. Relation of Primary Fingerprint Patterns With Gender and Blood Group: A Dermatoglyphic Study (2023)
A study conducted among 800 participants at AIIMS Patna investigated the relationship between primary fingerprint patterns and ABO and Rh blood groups. The researchers observed that loops were the most common fingerprint pattern, followed by whorls and arches. A statistically significant association was reported between fingerprint patterns and ABO blood groups, while no significant association was found with Rh blood groups. The study also indicated the need for further research and validation.

4. Fingerprint Image Enhancement Using Multiple Filters (2023)
Haroon Shams and other researchers proposed a fingerprint image enhancement technique using a combination of coherence diffusion and two-dimensional log-Gabor filters. The study focused on reducing noise while preserving important fingerprint ridge and valley structures. It demonstrated the importance of image enhancement for improving fingerprint feature extraction and biometric analysis. Such preprocessing techniques are relevant to systems that use fingerprint images for machine learning-based classification.

Research Gap
The reviewed studies indicate that researchers have explored possible relationships between fingerprint patterns and blood groups. However, the findings are not sufficient to establish a reliable medical method for blood group identification. Many studies use manually classified fingerprint patterns, while image processing and machine learning provide opportunities for automated analysis. Therefore, the present project implements fingerprint image preprocessing, feature extraction, CNN and SVM classification, fingerprint authentication, and database integration to explore automated blood group estimation. Further testing with larger and independently validated datasets is necessary to establish its reliability.

III. METHODOLOGY

The proposed system uses fingerprint images to estimate an individual's blood group through image processing and machine learning techniques. Fingerprint images are collected using a fingerprint sensor and other image sources. The collected images are preprocessed using Python and OpenCV to improve image quality. Relevant fingerprint features are then extracted and provided to CNN and SVM models for training, testing, and blood group prediction. The predicted results are linked to user details through a database, while fingerprint authentication is used to verify user identity. Finally, the developed user interface displays the prediction results.

IV. RESULTS AND DISCUSSION

A. Frontend Interface
The frontend provides a user-friendly interface to access the system's features, including the dashboard and fingerprint-based prediction options.

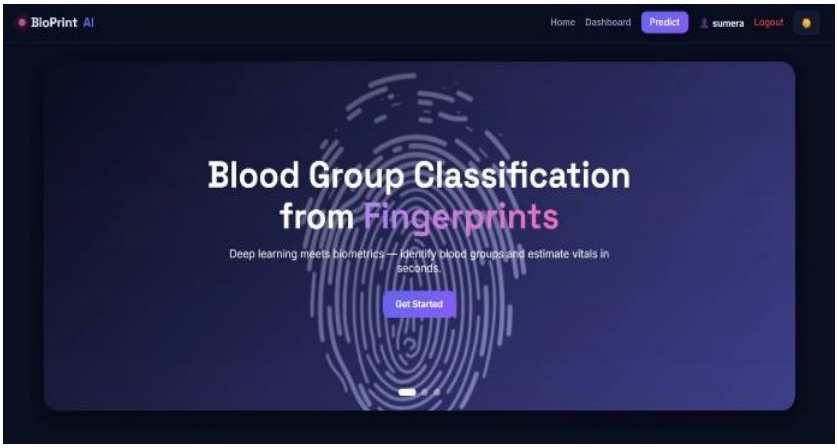


Fig. 1 Frontend interface of the proposed system.

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B. Dashboard

The dashboard displays previously generated blood group prediction records. It allows users to view and access the results saved in the system.

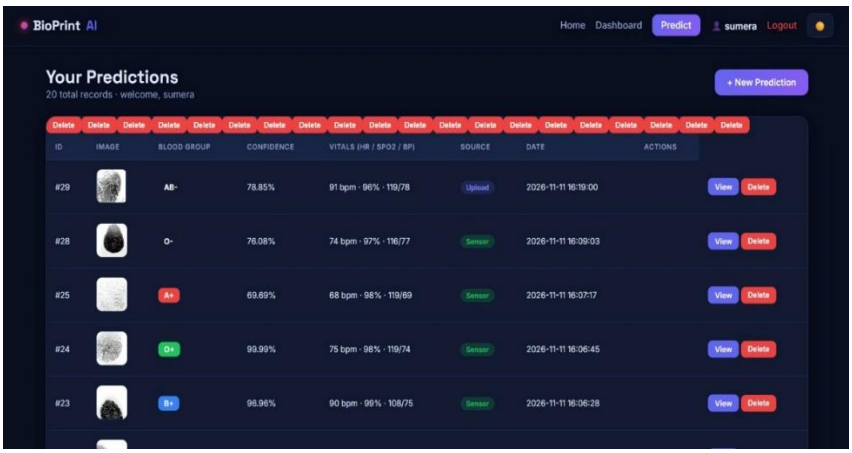


Fig. 2 Dashboard displaying saved prediction records.

C. Blood Group Prediction Using Fingerprint Sensor

This screen shows the prediction process using a fingerprint sensor. The system captures the fingerprint, processes the image, and displays the estimated blood group.

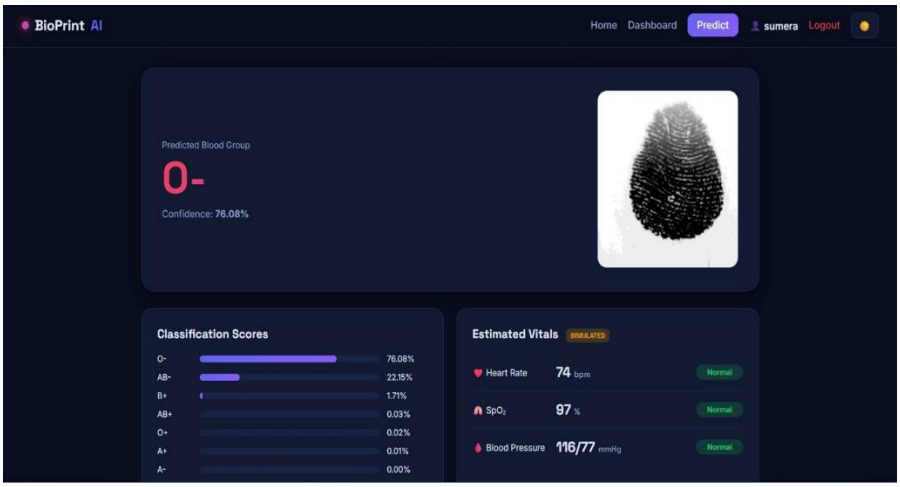


Fig. 3 Blood group prediction using fingerprint sensor.

D. Blood Group Prediction Using Dataset Image

This screen allows users to select a fingerprint image from the dataset. The selected image is processed by the model to generate and display the estimated blood group.

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Fig. 3 Blood group prediction using a dataset image.

VII. CONCLUSION

The Non-Invasive Blood Group Detection System was developed to estimate ABO and Rh blood groups using fingerprint image analysis and machine learning techniques. The system integrates fingerprint acquisition, image preprocessing, feature extraction, CNN and SVM classification, fingerprint authentication, and database management. A user interface was also developed to display and store prediction results. The CNN model achieved 87% prediction accuracy, with an average processing time of 6.5 seconds, as reported in the project evaluation. The system demonstrates the potential of fingerprint-based blood group estimation as an exploratory approach. However, it requires further testing with larger datasets and must not replace conventional laboratory blood grouping.

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