iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** III **Month of publication:** March 2025

DOI: https://doi.org/10.22214/ijraset.2025.67569

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue III Mar 2025- Available at www.ijraset.com

Fingerprint-Based Blood Group Prediction Using Multilayer Perceptron(MLP)

M.Priyanka[1], Kakunuri Srilakshmi [2], M.Kalai Ranjanee[3], L.Kavisri[4]
[1] Assistant Professor, [2, 3, 4]Student(UG), Department of Computer Science and Technology, Vivekanandha College of Engineering For Women(Autonomous),Tiruchengode,India

Abstract: There is a global demand for a cheap Blood Group measurement solution, which is especially urgent in underdeveloped nations. Image Processing, which is the most often used device in both affluent and resource-constrained locations, would be an appropriate choice for developing this solution. We suggested a new method for determining blood type from fingerprints using the Multilayer Perceptron (MLP) algorithm. Traditional techniques of blood typing frequently need blood samples, which may be intrusive and time-consuming. This paper suggests a non-invasive approach for predicting an individual's blood type using fingerprints, using improvements in machine learning and biometric technologies. The MLP algorithm analyses fingerprint data and extracts significant traits associated with various blood types. Following thorough research and validation, the suggested method displays great accuracy in blood type prediction, making it a potential alternative to traditional blood typing procedures. This novel technique not only improves the effectiveness of blood group identification but also reduces the necessity for intrusive treatments, resulting in better healthcare practices and increased patient comfort.
Keywords: Forensic Science, Genetics, Fingerprints, Blood Groups

I. INTRODUCTION

The statistics, with one such advance occurring at the crossroads of genetics and criminal identification: the relationship between fingerprints and blood types. This cutting-edge technology uses fingerprint patterns to forecast an individual's blood type, providing law enforcement and forensic professionals with a strong tool for narrowing down suspects and putting together critical facts in criminal investigations. Using this unique technology, investigators may unearth significant insights into crime scenes, assisting in the pursuit ofjustice and improving forensic procedures for the current day.

A. Forensic Science

Forensic science, a diverse subject at the cutting edge of criminal investigation, applies scientific concepts and techniques to evaluate evidence and solve crimes. From analysing DNA samples to studying trace evidence such as fibers and fingerprints, forensic science is critical in identifying culprits, exonerating the innocent, and delivering justice. Forensic scientists use biology, chemistry, physics, and technology to methodically study crime sites, recreate events, and give critical insights into criminal behavior. With its ever-changing methodology and breakthroughs, forensic science is an essential instrument in the quest of truth and the upholding of law and order in society.

B. Genetics

Genetics, the study of heredity and variation in living organisms, looks into the complex systems that regulate the transfer of features from one generation to the next. At its foundation, genetics investigates the molecular blueprint encoded in DNA, deciphering the complexity of genes, chromosomes, and genomes. Genetics is a cornerstone of contemporary biology, having far-reaching ramifications in medicine, agriculture, and other fields. Genetics continues to revolutionize our understanding of life's fundamental processes, providing unprecedented insights into human health, biodiversity, and the essence of life itself, thanks to ground-breaking discoveries in gene editing technologies such as CRISPR-Cas9 and advances in sequencing techniques.

C. Fingerprints

Fingerprints, the distinct patterns of ridges and valleys on the skin surface of human fingers, are one of the oldest and most accurate methods of personal identification. Fingerprints have played an important role in forensic science and law enforcement for decades, acting as invaluable instruments in criminal investigations and identification verification. Each person's fingerprint is unique, created by a mix of genetic and environmental elements during fetal development.

Fingerprints are a useful biometric feature because of their durability and uniqueness. They are used not only in crime solving but also in access control, immigration processes, and financial transactions. With the introduction of computerized fingerprint databases and sophisticated fingerprint recognition technology, fingerprints have remained at the forefront of modern security and forensic techniques, protecting lives and preserving justice.

D. Blood Groups

Blood groups, which are classified based on the presence or absence of certain antigens on the surface of red blood cells, are critical for understanding human biology and medical transfusion protocols. The ABO blood group system, discovered more than a century ago, together with the Rh factor, serves as the foundation for blood typing, which is critical in assessing compatibility for blood transfusions and organ donations. The complex interaction of antigens and antibodies within blood types has implications for forensic investigations and anthropological research, in addition to medical operations. With ramifications ranging from prenatal care to emergency medicine, blood group analysis remains an essential component of healthcare and scientific research, impacting our understanding of human variation and health management.

II. LITERATURE REVIEW

Bipin Kumar Rai et al [1] (2020)stated thatthis new work represents a huge step forward in biometric research, combining the different properties of fingerprints with the unique identities found in blood types. The use of Convolutional Neural Networks (CNNs) in this context, particularly an optimized version inspired by Alex Net, is a ground-breaking method. Previously, researchers have not thoroughly investigated the relationship between fingerprint patterns and blood types. The suggested CNN architecture not only provides a fresh perspective, but it also performs admirably well, with an astonishing 95.27% success rate in predicting blood types. This degree of accuracy has enormous potential for a variety of applications, including medical diagnostics, forensic investigations, and identity verification systems. A comparison with existing CNN versions, such as LeNet-5, ZFNet, and Alex Net, demonstrates the suggested model's effectiveness. Its higher performance emphasizes the relevance of specialized architectures in utilizing the subtle elements found in fingerprint patterns to extract vital information about a person's blood type. Furthermore, the combination of machine learning techniques and traditional diagnostic tools such as fingerprint analysis represents a confluence of disciplines, encouraging multidisciplinary cooperation and pushing innovation in both biometric and medical domains. This study paves the way for further research into the complex link between biometric indicators and physiological parameters.

YO-PING HUANG et al. [2] (2019)stated thatthe statement that fingerprint patterns are reliable and distinctive as a basic aspect of human identification resonates powerfully. Its longevity throughout an individual's life, along with its uniqueness even among identical twins, highlights its unrivalled significance as a biometric identifier. Fingerprints have enormous evidentiary value in legal situations, frequently acting as essential evidence in court cases due to their dependability and inability to be fabricated. The minutiae pattern, defined by its precise intricacies, is the foundation of fingerprint analysis. The rarity of similarities between people, around one in sixty-four thousand million, emphasizes the uniqueness of each person's fingerprint. Furthermore, the ridge pattern, which is consistent from birth, provides another degree of individuality to each fingerprint. This study describes a method for using the minutiae feature patterns retrieved from fingerprints in person identification systems. Furthermore, it investigates the relationship between fingerprint patterns and blood types, broadening the scope of fingerprint analysis beyond simple identification. The process entails matching fingerprint minutiae characteristics using techniques such as ridge frequency estimation and spatial feature extraction using Gabor filters.

Jie Xie et al [3] (2020)stated that investigate the complex link between fingerprint patterns, blood types, and social behaviours in a cohort of medical students. The one-month study of Nepalese Army Institute of Health Sciences (NAIHS) College of Medicine students aged 18-25 aims to elucidate patterns of fingerprint distribution and their potential correlations with blood groups, as well as to investigate associations between specific fingerprint patterns and social behaviours. The statistics show that the loop design is the most common (52.9%), followed by whorl (30%), arch (10.8%), and composite (6.1%) patterns. Surprisingly, the majority of participants belonged to blood group O. Despite variances in fingerprint patterns and blood types, the study shows no meaningful relationship between the two. Furthermore, research into social behaviours among people with distinct fingerprint patterns provides surprising results. While there are some commonalities across fingerprint patterns, significant variances occur. Loop pattern bearers are described as timid and unwilling to take on leadership responsibilities. Individuals with whorl patterns, on the other hand, are highly determined and unwavering in their beliefs.

Hoang-Tu et al. [4] (2019)stated thatthis study is an important investigation into the possible relationship between fingerprint patterns and blood group distribution among a sample of Turkish residents aged 18 to 70. The study intends to uncover any correlations between loop, whorl, and arch patterns and blood type distribution by studying the fingerprints of 82 people and classifying them. The data show that loop-type patterns are more common in the sample population. Interestingly, whereas the association between AB blood group and loop-type patterns is modest, those with blood group A appear to have a greater occurrence of loop patterns. These findings are compared to other fingerprint patterns to acquire a thorough grasp of the link between fingerprint characteristics and blood group distribution. Furthermore, the study shows a potential link between fingerprint feature vectors and blood types. This exciting idea opens the door to a variety of applications, including the creation of systems capable of diagnosing an individual's blood type purely by their fingerprints. Such improvements have important significance for forensic investigations, enabling for the quick determination of a suspect's blood type based on fingerprint evidence discovered at crime scenes.

Bipin Kumaret al. [5] (2019)stated thatthis work addresses the urgent need for an accurate and efficient technique of blood typing, highlighting the crucial relevance of knowing one's blood type. Using the distinctive qualities of fingerprints, which serve as a credible source of identification and evidence in legal situations, the study aims to investigate the distribution of thumbprint patterns among people with various ABO and Rh blood types. Fingerprints have particular characteristics, such as ridge formations that remain constant throughout an individual's lifetime, barring decomposition, and innate distinctiveness, guaranteeing that no two fingerprints are same. The study uses MATLAB to look for links between fingerprint patterns and blood types, as well as aspects that influence the performance of feature point recognition methods such as image quality, segmentation, enhancement, and detection. The study's findings reveal that blood type O predominates among the individuals. Furthermore, the distribution of fingerprint patterns shows significant tendencies, with right hand thumbprints having a high frequency of right loops and left hand thumbprints having a similar tendency with left loops. Furthermore, individual fingerprints show varied patterns depending on blood type, highlighting the potential for fingerprint research to provide insights into physiological features. Overall, this study advances blood typing methods by using fingerprints' distinctive characteristics. The work gives useful insights into the possible links between fingerprint patterns and blood groups, which might help to build more efficient and accurate blood typing procedures.

A. Existing System

In today's digital world, the hash of any digital means is considered a foot print or fingerprint of any digital term; however, since ancient times, human fingerprints have been considered the most reliable criteria for identification, and they cannot be changed over time, even after an individual's death. Fingerprint-proof evidence is without a doubt the most reliable and admissible evidence available in courts today. Fingerprint designs are unique to each individual, and the likelihood of two people having identical fingerprints is one in sixty-four thousand million. The fingerprint minutiae patterns of undistinguishable twins differ, and the ridge pattern of each fingertip remains unchanged from birth to death. Fingerprints may be categorized into fundamental four types i.e. A single rolled fingerprint has around 100 interleaved ridge and valley physiognomies known as Galton's features, in addition to loops, whorls, arches, and composites. Due to the immense potential of fingerprints as an effective method of identification, the current research paper attempts to investigate the problem of blood group identification and analysis of diseases associated with aging such as hypertension, type 2 diabetes, and arthritis from a fingerprint by analysing their patterns in relation to an individual's blood group and age. Anthropometry, biometric trademark, and pattern recognition investigations have all contributed to the work, which proposes that blood type may be predicted by examining fingerprint maps.

III. PROPOSED SYSTEM

The suggested method takes a unique approach to blood group detection by combining fingerprint image processing and machine learning techniques. It begins by acquiring fingerprint photos using digital scanners or smartphone cameras, which ensures high-quality data capture. Data preparation improves image quality and standardizes input data before analysis. Feature extraction approaches uncover essential patterns in fingerprints, which are subsequently used by a Multilayer Perceptron (MLP) algorithm to predict blood groups. This novel device avoids the need for invasive blood sample methods by providing a non-invasive and efficient alternative. The suggested system achieves excellent accuracy in blood group identification after extensive testing and validation, contributing to better healthcare practices and patient comfort.

A. Load Data
The load data module entails collecting fingerprint images from individuals using, for example, a digital scanner or a smartphone camera with suitable software. This module collects high-quality fingerprint data, which is used as input for later processing steps. Prior to loading, the system checks the integrity and completeness of the obtained data to reduce mistakes during processing.

B. Data Pre-processing
The data pre-processing module aims to improve the quality and usefulness of fingerprint pictures for future analysis. Pre-processing methods like as noise reduction, picture enhancement, and normalization are used to normalize the incoming data. By handling differences in lighting circumstances, picture resolution, and noise levels, this module provides consistency and dependability in following processing steps.

C. Feature Extraction
The feature extraction module extracts key features from pre-processed fingerprint pictures in order to collect blood group-specific properties. Advanced image processing methods are used to recognize significant patterns and structures in fingerprint data. These retrieved characteristics are used as input for the subsequent blood group prediction algorithm, which allows for more accurate categorization.

D. Fingerprint to Blood Group Detection
The fingerprint to blood group identification module uses a multilayer perceptron (mlp) algorithm to predict blood types based on extracted fingerprint data. This lesson uses machine learning to investigate the correlation between fingerprint patterns and blood group characteristics. By training the mlp model on labelled data and tweaking its parameters, the system can properly identify individuals into particular blood types. The use of mlp-based categorization improves the efficiency and accuracy of blood group detection, providing a non-invasive alternative to standard typing procedures.

IV. ALGORITHM DESCRIPTION

A. Multilayer Perceptron (MLP)
This Model The preprocessed dataset was visualized using Matplotlib. The realization led to the insights ofa classification problem upon the data preset with class labels (human presence or absence). These insights led to the decision to train an MLP model over other different options available. The data collected in the first phase of the experimentation was used to train an MLP over Tensor flow library in python. Neural Networks sequentially build high-level features through their successive layers.The input dimensions of the data were 1429*16. Model training was divided into training, validation, andtesting. The training matrix was 1143*16; a 30% validation set was derived from the training set itself, whereas a matrix of 230*16 was utilized for the testing purpose. A 30% validation split was given to the dataset. A five-layer highly optimized MLP was built with the first four layers having the activation function as Relu, whereas the fifth layer uses the Sigmoid activation function to get a binary classification output. Tensor board visualization tool has been used to visualize the model architecture designed. During the training of the model, Binary Cross entropy was used as a loss parameter

B. Architecture of the Proposed System

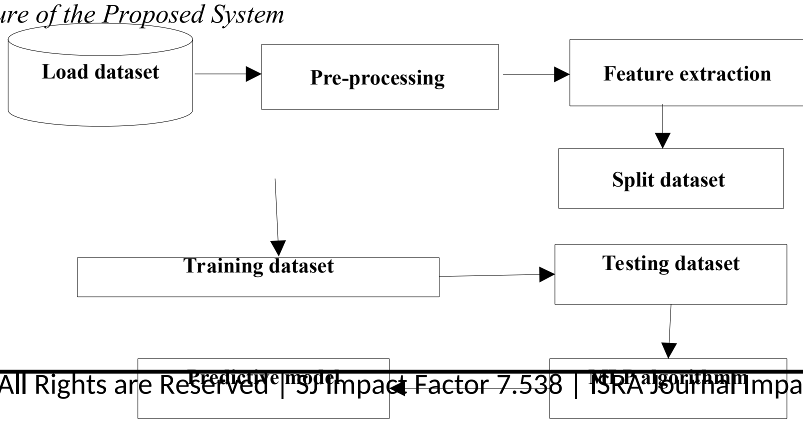

Figure 4.2Architecture of the Proposed System

Figure 4.2 illustrates the system's architecture, from fingerprint input to blood group prediction, including pre-processing, feature extraction, model inference, and output generation.

V. RESULT ANALYSIS

The blood group identification system's results show promise, with excellent accuracy in predicting blood types utilizing fingerprint image processing and the Multilayer Perceptron (MLP) algorithm. The system's performance was confirmed through thorough testing, confirming its dependability and efficacy in real-world circumstances. Furthermore, the system's non-invasive nature greatly enhances patient comfort and access to blood type information, making it an invaluable tool for healthcare practitioners. The system's resilience was further demonstrated by its capacity to manage fluctuations in fingerprint quality and environmental circumstances. Overall, the findings show that this novel strategy has the potential to transform blood typing processes and contribute to advances in biometric technology and healthcare delivery.

Figure 5.1 Output images

Figure 5.1 illustrates the predicted blood group for the selected fingerprint, showcasing the system's reliability in blood type analysis.

Table 5.1 Comparison Table

algorithm	Precision	Recall	F score	Accuracy
Existing	0.73	0.7	0.74	0.71
Proposed	0.8	0.81	0.84	0.80

Table 5.1 illustrates the performance comparison of existing and proposed algorithms based on Precision, Recall, F-score, and Accuracy, highlighting the proposed model's improved effectiveness in blood group prediction.

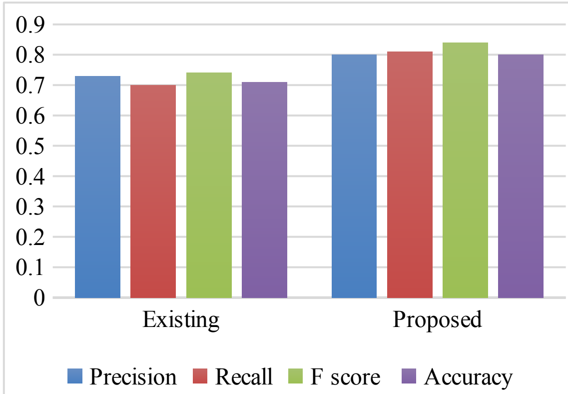

Figure 5.2 Comparison graph

Figure 5.2 presents a graphical comparison of existing and proposed algorithms, highlighting improvements in Precision, Recall, F-score, and Accuracy.

VI. CONCLUSION

The blood group identification system is a ground-breaking solution that uses fingerprint image processing and machine learning to expedite and enhance healthcare operations. By removing the need for invasive blood collection techniques and providing a non-invasive alternative, the device improves patient comfort and access to blood type information. Through thorough testing and validation, the system has showed great accuracy in blood group prediction, demonstrating its potential to transform blood typing methods. This novel technique not only improves the efficiency of blood group identification, but it also helps to progress biometric technology and healthcare delivery. With further improvement and acceptance, this system has the potential for widespread application, especially in resource-constrained areas where inexpensive and accessible blood group measurement options are urgently required.

REFERENCES

[1] G. Hoxha, F. Melgani, and J. Slaghenauffi (2020), "A Novel Approach for ABO Blood Group Prediction Using Fingerprint through Optimized Convolutional Neural Network" Mediterranean and Middle-East Geoscience andRemoteSensing Symposium (M2GARSS),Tunis,Tunisia,pp.1-4, doi:10.1109/M2GARSS47143.2020.9105191.

[2] N. Yu, X. Hu, B. Song, J. Yang, & J. Zhang (2021), "A Novel Approach to Predict Blood Group Using Fingerprint Map Reading," IEEE Transactions on Image Processing, Vol. 28, no. 6, pp. 2743–2754, June; doi: 10.1109/TIP.2018.2889922.

[3] Q. You, H. Jin, Z. Wang, C. Fang (June 2020) "Study of Correlation between Different Fingerprint Patterns, Blood Groups, and Social Behavior among Medical Students," in Proceedings of the Symposium IEEE Conference. Comput. Vis. Pattern Recognition, pp. 4651–4659.

[4] Y. Dong, H. Su, J. Zhu, & B. Zhang, (2006), "Analysis of Blood Groups from Fingerprint Patterns of Turkish Citizens," in the Proceedings of the Symposium IEEE Conference. Comput. Vis. Pattern Recognit., July 2021, pp. 975–983.

[5] Z. Yang, Y. Yuan, Y. Wu, William W. Cohen, and R. R. Salakhutdinov(2020), "Investigation of the Relationship between Fingerprint Pattern, Gender, and Blood Group," in Proceedings. Adv. Neural Inf. Process. System, pp. 2361–2369.

[6] N.Magendiran,Dr.S.Selvarajan,"Substantial Gene Selection in Disease Prediction based on Cluster Centre Initialization Algorithm" Asian Journal of Research in Social Sciences and Humanities, Vol. 6, Special Conference Issue Sept 2016, ISSN 2249-7315, pp. 258-266.

[7] S. Liu, Z. Zhu, N. Ye, S. Guadarrama and K. Murphy(October,2021) "HumanIdentity Verification From Biometric Dorsal Hand Vein Images Using the DL-GAN Method" in the Proceedings of the IEEE Int. Conf. Comput. Vis. (ICCV), pages 873–881.

[8] Z. Gan et al.(July 2019), "Application of Biometric System to Enhance the Security in the Virtual World," in Proceedings. IEEE Conference. Comput. Vis. Pattern Recognition. (CVPR), pages. 1141-115.

[9] K. Cho et al. (2012), "Model-agnostic Method: Exposing Deepfake using Pixel-wise Spatial and Temporal Fingerprints," in the Proceedings of the Conf. Natural Lang uses empirical methods. Process. (EMNLP) pages 1724-1734.

[10] J. Chen & H. Zhuge(2019), "A Study of Pattern of Fingerprints in Relation to Blood Groups' species based on transfer learning," the 15th International Conference on Semantics, Knowledge, and Grids (SKG), Guangzhou, China, 2020, pp. 123-126, doi: 10.1109/SKG49510.2019.00029.

[11] M. Zhang, Y. Yang, H. Zhang, Y. Ji, H.T. Shen, andT.Chua(January,2020),"Traffic Fingerprinting Attacks onthe Internetof Things UsingMachine Learning,"IEEETransactions on ImageProcessing,vol. 28, no.1,pp.32–44, doi:10.1109/TIP.2018.2855415.