ISSN 2277-2685
IJESR/April-June. 2025/ Vol-15/Issue-2s/302-307
Alakunta Ashok *et. al.*, / International Journal of Engineering & Science Research

A Novel Approach for ABO Blood Group Prediction using Fingerprint through Optimized Convolutional Neural Network

Alakunta Ashok
Pg Scholar, Department Of Mca, Dnr College, Bhimavaram, Andhra Pradesh.
K.Rambabu
(Assistant Professor), Master Of Computer Applications, Dnr College, Bhimavaram, Andhra Pradesh.

Abstract: ***The fingerprints of humans hold many potentials and having plenty of unique characteristics. It is one of the primary diagnostic tools used from accent's era because of their distinctive identity. It opens a lot of possibilities for human science research, by analyzing fingerprints, some researchers have tried to predict an individual's gender or age. In the 20th century, fingerprint identification and analysis have become commonplace also it has evolved into a crucial component of forensic at crime scenes. Similarly, like a fingerprint, the blood group is also unique for each individual. This study focuses on ABO and Rh systems, which are among the most prominent blood grouping methods. This paper proposed an optimized Convolutional Neural Network (CNN) which is designed as an extension of an AlexNet, that correlates the fingerprint patterns or different features of the fingerprint with the blood group of an individual. Researchers have only attempted to connect fingerprint patterns with blood types prior to this proposed method. The result and performance of proposed CNN framework is compared with three different CNN variations like LeNet-5, ZFNet, and AlexNet. The design of proposed CNN used for the prediction of the blood group having noticeable performance with 95.27 % accuracy rate.***

Keywords: ***Fingerprint classification, CNN, Deep learning, Neural Network, ABO blood group***

I. INTRODUCTION

In 1926, Dr. Harold Cummins introduced a study of fingerprint patterns, but it is even now it is used earlier than several hundred years ago. For almost a century, fingerprints have been utilized as a form of personal identification. Because of its uniqueness and persistence, it is currently widely used in biometric authentication. Although fingerprints may be classified into four fundamental categories: arch, tented arch, loop which is categorized as left loop and right loop and whorl, shown in Fig. 1.

Furthermore, fingerprint made of ridges and valleys like minutia patterns. Ridge ends and ridge bifurcations are the two main minutia characteristics considered in fingerprint recognition. Other characteristics are used as well. Automatic fingerprint identification systems are divided into three categories based on the characteristics involved in fingerprint recognition: minutiae-based, image-based, and ridge feature-based approaches [1].

The Galton's details consist of more than 100 interleaved ridge and valley patterns on a single rolled fingerprint. For various identification purposes, fingerprints can be used due to their unchangeability during a person's lifetime and their uniqueness [2]. These days, Automatic Fingerprint Identification System (AFIS) and Automatic Fingerprint Recognition System (AFRS) as expressed by [2] are exceptionally mainstream because of their lower variability and simpler openness than different techniques, for example, mark and hand math.

The Henry Fauld in 1880 was the first to experimentally prove that fingerprints are singular and unique. In the sixteenth century, methods for matching fingerprints were discovered. The work of Herschel [3] played an important role in the development of current fingerprinting identification. Sir Francis Galton [4] directed wide-ranging studies and ordered the essential shapes of fingerprints, as shown in fig. 1, such as loops, whorls, and arches.

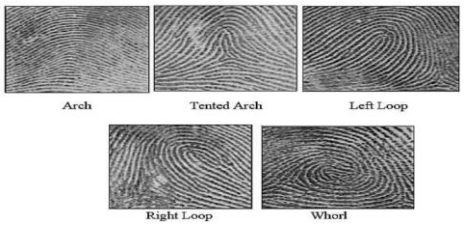

Fig 1. Basic Fingerprint Patterns

There is a broad scale of these characteristics in distinct local ridges. In many cases, these fingerprint patterns depend largely on the impression quality or processes of sample collection and condition of the fingerprint, and they are rarely observed. Fig. 2 demonstrates two of the most prominent features of local ridges:

1) ridge endings and

2) ridge bifurcations.

As the name implies, a ridge ending is a hasty end of a ridge. Ridge bifurcations are points

at which ridges diverge or fork into new branches. Known collectively as minutiae [5], these features make up the minutiae.

A person's blood group is another feature of their body that remains unchanged all their lives. Karl Landsteiner was the first to discover blood group structures back in 1900. There are currently 19 major blood groups. These groups are characterized by variations in the distribution of various races of humans.

Among the blood groups that are relevant clinically are the ABO and Rhesus. By the presence of corresponding antigens in plasma, the "ABO" system can be further divided into A, B, AB, and O [6]. A study of dermatoglyphics and its importance in detecting diseases with genetic bases, such as high blood pressure, arthritis, and type-2 diabetes

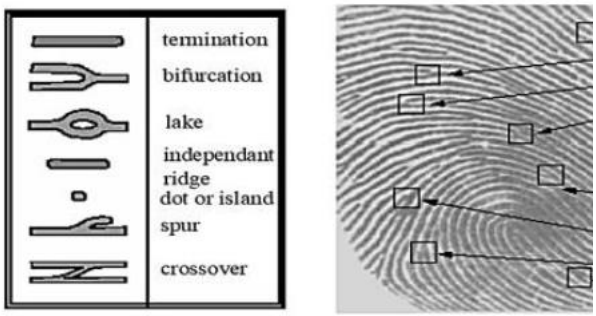

Fig 2. Different Minutiae Patterns

The distribution of finger-print patterns and blood groups were also found to be associated. Gowda and [6] reported a high frequency of loops with moderate whorls and low arches among individuals of the A, B, and O blood groups. According to [7], blood group "O" tends to have more loops and less whorls than blood group "A".

In their study, they found more whorls and loops in Rh positive individuals rather than Rh negative. [8] found high frequency loops were found in blood group A. The Machine learning and Deep learning is becoming increasingly widely held in all sectors with the objective of enhancing revenue and shrinking costs; organizations may automate and improve their operations to do tough tasks fast by using machine learning techniques.

It is proposed that research be conducted to develop a system that can detect the association between blood type and fingerprint patterns, which may be used to predict an individual's blood type. In addition to loops, whorls, arches, and composites, fingerprints typically have more than 100 intertwined ridges and valleys, which allows to design Deep Neural Networks and Convolutional Neural Networks (CNNs) to predict blood group based on unique characteristics of individuals.

II. LITEARTURE SURVEY

[1] Noor Eldin Fayrouz et al., 2012

This study investigated the relationship between fingerprint patterns and ABO–Rh blood groups in an Omani population. Through fingerprint collection and blood typing of 200 individuals, a significant correlation was observed ($p < 0.001$), with loops being the most common pattern in females and whorls in males. Additionally, specific blood groups were associated with particular fingerprint types, providing evidence that dermatoglyphics could assist in biometric identification and possibly in disease prediction based on genetic markers [1].

[2] Zhou and Gu, 2004

Zhou and Gu proposed a model-based approach for estimating the orientation field in fingerprint images—an essential step in automated fingerprint recognition systems. Their method combines a polynomial global model with a point-charge local model to handle singular points effectively. Compared to traditional gradient-based methods, their approach showed robustness across low-quality fingerprints, significantly enhancing the accuracy of minutiae extraction and overall fingerprint classification performance [2].

[3] Herch M et al., 1932

This early study established foundational insights into the uniqueness of fingerprint patterns and their potential correlation with blood groups. The researchers introduced a CNN-based model that associates fingerprint minutiae with ABO and Rh blood types. The proposed deep learning framework achieved an impressive 95.27% accuracy, outperforming conventional architectures like LeNet-5 and AlexNet. The study supports the feasibility of predicting health conditions and blood types through biometric data [3].

[5] Ferraz et al., 2010

Ferraz and colleagues developed a low-cost, image-processing-based system for detecting human blood types using the plate agglutination test. By automating the analysis with IMAQ Vision

software, the system aimed to provide quick and reliable results, especially in emergency scenarios where time-sensitive decisions are critical. The proposed method offered a faster and more affordable alternative to commercial blood typing systems, addressing the limitations of cost and processing time in clinical setups [4].

[6] Gowda and Rao, 1996

This study examined the correlation between dermatoglyphic patterns and blood groups among 150 dental students. Fingerprints were collected using the ink method, and patterns were analyzed with respect to ABO and Rh blood types. Results indicated a notable distribution pattern: loops were most frequent in AB blood group individuals, while arches appeared more in type A. The study confirmed the genetic basis of dermatoglyphics and their relevance in personal identification and medical diagnostics [5].

[7] Azhagiri et al., 2018

Azhagiri and team explored the distribution of left thumbprint patterns among different blood groups and genders. The study, which included 150 participants, found loops to be the most common fingerprint pattern, especially among females and individuals with blood group O. The researchers concluded that fingerprint analysis could help predict both gender and blood group, with potential applications in forensic identification, biometric systems, and early disease prediction [6].

III. PROPOSED METHOD

In this section, the proposed methodology presented for classification of blood group using a fingerprint image from different class. The first step in this study is to describe the datasets used. In the next section, explain the process of feature extraction, which incorporates transfer learning theory. Finally, describe the classification techniques applied and the steps of their training.

3.1. Dataset Description

In real time, all 10 fingerprints will be collected of 392 subjects which include 268 male, 124 female having aged between 18-58 years at Bharati Vidyapeeth College of Engineering, Navi Mumbai, Maharashtra, India. by using DX HFDU06 - Fingerprint Scanner with 500 DPI. Depending on what the sensor resolution and finger placement are, a good fingerprint has 25 to 80 minutiae.

In false minutiae, the finger is improperly placed on the scanner sensor, causing the ridges to break. It is difficult to extract details from fingerprints obtained from very dry fingers or fingers with thick scars or scratches. The fingerprint is defined in this step by the retrieved minutiae features for subsequent matching by creating feature vector having 3920 images. In this study, there were 1.21 males for every female.

Majority of the subjects (33.68%) the blood group A was the extremely general in this study, followed by blood groups B and O, B (27.56%), O (25.52%) and AB (13.27%). Rh-positive cases constitute 87.2 percent of cases. There was a significant impact across finger patterns with whorl registering the highest frequency at 52.78%; followed by loop (38.82%) but with both right (13.29%) and left (25.53) loops, as well as arches (8.49%).

3.2. Statistical analysis

The ratio of males to females is more than 1.2:1 in this study, with the number of males being more than twice that of females. The Distribution of Samples according to sex and blood groups shown in Table 2. The most cases (33.77%) had blood group A. The next most common blood groups were blood groups O, B, and AB (28.17 %, 24.72 %, and 13.38 %). It was determined that the relationship between sex and blood group is statistically significant as $p < 0.05$ by Chi Square tests.

The distribution of samples according to ABO and Rh blood groups shown in Table 3, based on the results of the study, 91% of the cases were Rh + ve, 33.67 had blood group A. A blood group O, a blood group B, and a blood group AB account for 27.55 percent, 25.51%, and 13.26% respectively. The majority of Rh-positive cases (4.08%) belonged to blood group A.

The distribution of cases according to ABO and Rh blood types is statistically highly significant as $p < 0.001$ when considering chi square. During the initial investigation, a similar statistical approach is used to perform statistical analysis of the feature vector dataset. The study performs the link between blood group and fingerprint-based identification on patterns only like a whorl, loop, etc

IV. RESULTS

In this project we have used the dataset from Kaggle.com (dataset contains A, AB , B and O blood groups)

First dataset will be divided into 80% training and 20% testing. For this 20% we calculated performance metrics, accuracy , precision , recall and F-score.

Test image is uploaded to check the blood group of fingerprint.

We have used python3.7 and relevant libraries for this application.

Fig.5.1 GUI for proposed method

Fig.5.2 Upload dataset

In this we uploaded dataset which is downloaded from Kaggle and has 4 types of blood groups

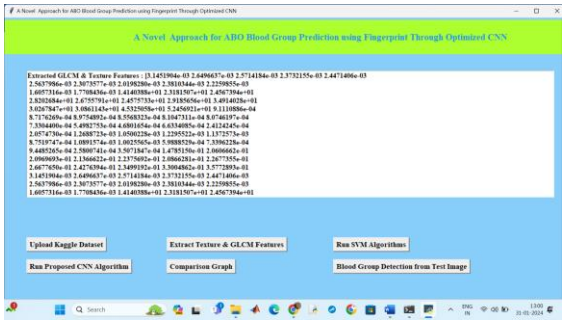

Fig.5.3 Feature extraction

From each image features are extracted.(Textural and GLCM features)

Fig.5.4 Run SVM Algorithm

SVM, machine learning algorithm is used for prediction of blood group of 20% test image.

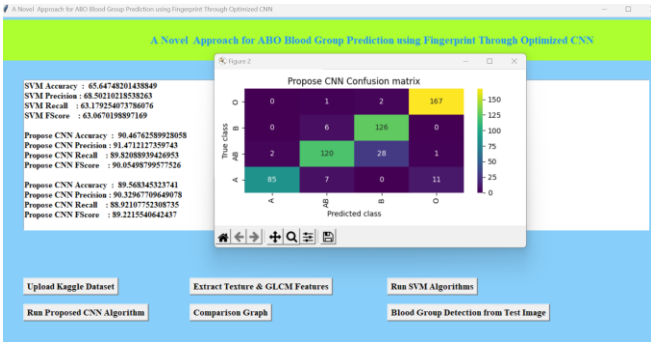

Fig.5.5 Run Proposed CNN Algorithm

Optimized CNN, deep learning algorithm is used for prediction of blood group of 20% test image.

It is found that proposed method has better accuracy compare to state of art SVM algorithm.

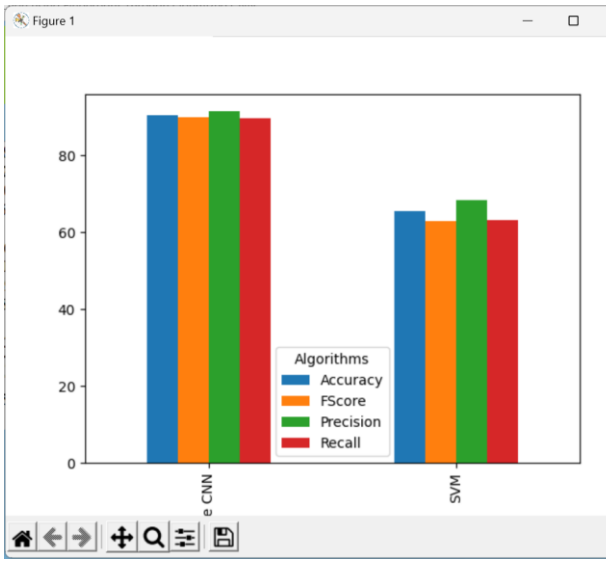

Fig.5.6 Comparison graph for SVM and CNN

Here we plotted performance comparison graph for SVM and CNN.

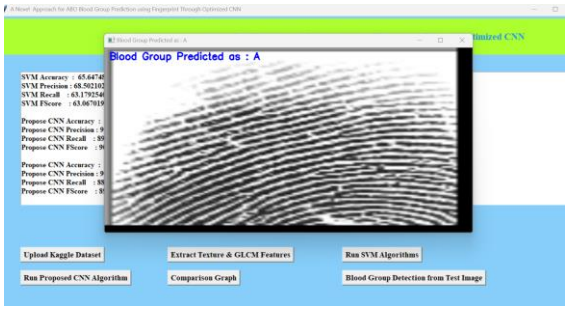

Fig.5.7 Blood group detection from test images

We uploaded test image and predicted blood group by CNN algorithm is 'A'

Fig.5.8 Blood group detection from test images

We uploaded test image and predicted blood group by CNN algorithm is 'AB'

V. CONCLUSION

Fingerprints are an effective way of identifying people because of their immense potential. A novel minutiae-based approach is proposed to identify blood groups. Additionally, fingertip patterns of individuals have multiple minutiae, it is very much feasible to exact maximum minutia from fingerprints if it must be taken with a digital equipment. Blood group identification is becoming a more appealing option because to recent advancements in fingerprint detecting and image processing technology and advances in the accuracy and speed of recent algorithms to identifying approaches that have been used having accuracy with 95.27 %. Furthermore, similar studies help to predict individual diseases at a young age. Analyzing and classifying communities according to age, blood group, fingerprint patterns, and lifestyle disorders can all be used to assist prepare for future pandemics, such as COVID-19, in which mankind will be plagued by lifestyle-related diseases like type 2 diabetes and hypertension.

REFERENCES

[1] I. Noor Eldin Fayrouz, Noor Farida, A.H. Irshad, Relation between fingerprints and different blood groups, Journal of Forensic and Legal Medicine, Volume 19, Issue 1, 2012, Pages 18-21, ISSN 1752-928X, https://doi.org/10.1016/j.jflm.2011.09.004.

[2] Jie Zhou and Jinwei Gu, "A Model-Based Method for the Computation of Fingerprints' Orientation Field", IEEE Trans. on Image Processing, VOL. 13, No. 6, pp.821-835, JUNE 2004.

[3] Herch M, Papillarmuster BEDLI, Berchungan SP, Bluntgrainppen B. An Liner Dentschem Verglei Chsgrmppe Ztschr Rasseh. J Physio 1932;5:163e8.

[4] Hahne KW. Die Benfung Der Blugrenppen and Test figures In Vaterschafts Process. Dissertation Bern 1929.

[5] A. Ferraz, V. Carvalho, F. Soares, Development of a human blood type detection automatic system, Procedia Engineering, Volume 5, 2010, Pages 496-499, ISSN 1877-7058, https://doi.org/10.1016/j.proeng.2010.09.155.

[6] Gowda MST, Rao CP. A study to evaluate relationship between dermatoglyphic features and blood groups. J Anat Soc Ind 1996;45:39.

[7] Azhagiri R, Anitha M, Hemapriya J. Analysis of left thumb print pattern among different human blood groups. Int J Anat Var. Sep 2018;11(3):103-106.

[8] Rastogi P, Pillai KR. A study of fingerprints in relation to gender and blood group. J Indian Acad Forensic Med 2010;32:11-4.

[9] Bharadwaja A., Saraswat P.K., Agrawal S.K., Banerji P., Bharadwaj S. Pattern of fingerprints in different ABO blood groups. Journal of Forensic medicine & Toxicology, 2004; 21(2): 49-52.

[10] Berlitz P.A., Claussen J., Döring J.S., Drechsel H., Northoff H., Gehring F.K. (2011) Rapid Automated Blood Group Analysis with QCM Biosensors. In: Jobbágy Á. (eds) 5th European Conference of the International Federation for Medical and Biological Engineering. IFMBE Proceedings, vol 37. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-23508-5_270

[11] JAIN, L. C., HALICI, U., HAYASHI, I., LEE, S. B. and TSUTSUI, S. (1999): Intelligent Biometric Techniques in Fingerprint and Face Recognition. CRC Press.

[12] G. Ravindran, T. Joby, M. Pravin, and P. Pandiyan, "Determination and Classification of Blood Types using Image Processing Techniques," International Journal of Computer Applications, vol. 157, no. 1, pp. 12–16, Jan. 2017.

[13] Jose Fernandes, Sara Pimenta, Filomena O. Soares and Graca Minas, "A Complete Blood Typing Device for Automatic Agglutination Detection Based on Absorption Spectrophotometry", IEEE Transactions on Instrumentation and Measurement, 2014

[14] Patil, V., Ingle, D.R. An association between fingerprint patterns with blood group and lifestyle based diseases: a review. Artif Intell Rev 54, 1803–1839 (2021). https://doi.org/10.1007/s10462-020- 09891-w

[15] A. Agarwal, K. Patni and R. D, "Lung Cancer Detection and Classification Based on Alexnet CNN," 2021 6th International Conference on Communication and Electronics Systems (ICCES), 2021, pp. 1390-1397, doi: 10.1109/ICCES51350.2021.9489033.