BLOOD GROUP DETECTION BY FINGERPRINTS USING MACHINE LEARNING

Mr. A. Sai Prasad[1], M. Vijaya Lakshmi[2]

[1]Assistant Professor & HOD, M Tech (Master of Technology) Final Semester,
[2]Sanketika Vidya Parishad Engineering College, Visakhapatnam, Andhra Pradesh, India

---***---

Abstract-*Blood group identification is critical for medical applications, especially in emergencies requiring quick and precise blood transfusion. Traditional blood typing methods involve chemical-based serological tests, which, although accurate, are time-consuming and sometimes resource-intensive. Recent advancements in deep learning and computer vision have introduced alternative approaches that leverage biometric features, such as fingerprints, for rapid and non-invasive blood group detection. This study proposes a novel deep learning model for blood group detection using fingerprint images, aiming to enhance accessibility, efficiency, and ease of blood type identification. In this work, a convolutional neural network (CNN)-based model is trained on an extensive dataset of fingerprint images labelled with their corresponding blood groups (A, B, AB, and O, with positive and negative Rh factors). The proposed architecture consists of multiple convolutional layers that extract biometric features from fingerprint ridge patterns, followed by dense layers that map these features to blood group classifications. Additionally, data augmentation techniques are employed to enhance model robustness, ensuring it generalizes well across different fingerprint patterns. The model was evaluated on a test dataset with high accuracy, demonstrating that fingerprint ridge characteristics carry specific patterns indicative of different blood groups. Experimental results indicate that the proposed deep learning model achieves substantial accuracy, precision, and recall in blood group detection. Comparisons with traditional methods suggest that the proposed approach offers a viable and rapid alternative for preliminary blood group identification, especially useful in resource-limited and point-of-care settings. Future work may expand on this by incorporating larger datasets and exploring hybrid models for further accuracy enhancement. The study highlights the potential of biometrics combined with AI to innovate in the field of personalized healthcare diagnostics.*

Keywords: Blood Group Detection, Fingerprint Biometrics, Deep Learning, Convolutional Neural Network (CNN), Computer Vision, Non-Invasive Diagnostics, Medical Imaging, Data Augmentation, Pattern Recognition, Personalized Healthcare, Artificial Intelligence in Medicine

I. INTRODUCTION:

Blood group identification is a fundamental component of modern healthcare and plays a vital role in blood transfusions, organ transplantation, emergency medicine, prenatal care, and forensic investigations. Accurate determination of blood groups helps prevent transfusion-related complications and improves patient safety. Conventional blood group detection methods rely on serological testing, which requires blood sample collection, laboratory equipment, chemical reagents, and trained personnel. Although these methods provide high accuracy, they are invasive, time-consuming, and may not be readily available in remote or resource-limited areas [1], [2].

Advancements in biometric technologies and artificial intelligence have opened new possibilities for non-invasive medical diagnosis. Fingerprints are unique, permanent, and easily obtainable biometric characteristics that contain distinctive ridge patterns and minutiae. Several forensic and biomedical studies have reported a correlation between fingerprint patterns and ABO blood groups, encouraging researchers to investigate fingerprint-based blood group prediction using machine learning techniques [1], [6], [20], [21].

Recent developments in image processing and deep learning have significantly improved the ability to extract meaningful features from fingerprint images. In particular, Convolutional Neural Networks (CNNs) have demonstrated remarkable performance in image classification tasks by automatically learning discriminative features without the need for manual feature extraction. CNN-based approaches have achieved promising results in biometric recognition and medical image analysis, making them suitable for fingerprint-based blood group prediction [2], [9], [10], [16].

The proposed project, "Blood Group Prediction from Fingerprint Images Using Machine Learning," aims to develop a non-invasive, fast, and cost-effective system for predicting an individual's blood group from fingerprint images. The methodology involves fingerprint image acquisition, pre-processing, feature extraction, CNN model training, and blood group classification. By utilizing deep learning techniques, the proposed system seeks to reduce dependence on conventional laboratory-based testing while providing rapid preliminary blood group prediction. This research has potential applications in emergency healthcare, blood donation camps, forensic science, and rural medical services where quick and accessible blood group estimation is desirable. Although fingerprint-based prediction is not intended to replace standard serological blood typing, it can serve as an efficient screening and decision-support tool. The integration of machine learning with biometric analysis represents a promising direction for developing intelligent, non-invasive healthcare solutions [3], [12], [15], [18].

1.1 Research Objectives:

The primary objective of this research is to develop a machine learning-based system for predicting an individual's blood group using fingerprint images. The study aims to investigate the relationship between fingerprint ridge patterns and blood group classification by utilizing image processing and Convolutional Neural Networks (CNNs).

The specific objectives are:

1. To collect and prepare a dataset of fingerprint images with corresponding blood group labels.
2. To pre-process fingerprint images by applying image enhancement and noise removal techniques to improve image quality.
3. To develop a Convolutional Neural Network (CNN) model for automatic feature extraction and blood group classification.
4. To train and test the proposed model using fingerprint images and evaluate its performance using accuracy, precision, recall, and F1-score.
5. To compare the predicted blood groups with actual blood group labels to determine the effectiveness of the proposed system.
6. To provide a non-invasive, rapid, and cost-effective alternative for preliminary blood group prediction using biometric information.
7. To explore the potential application of fingerprint-based blood group prediction in healthcare, emergency medical services, forensic science, and blood donation management.

1.2 Project Scope and Future Direction

Project Scope

The scope of this project is to develop a machine learning-based system capable of predicting an individual's blood group from fingerprint images using image processing and Convolutional Neural Networks (CNNs). The system focuses on acquiring fingerprint images, preprocessing them to enhance quality, extracting relevant features automatically through deep learning, and classifying them into the corresponding ABO blood group categories. The

Proposed approach aims to provide a non-invasive, fast, and cost-effective alternative for preliminary blood group prediction. The system can be applied in healthcare centers, blood donation camps, forensic investigations, and emergency situations where rapid blood group estimation is beneficial. Although the proposed model offers a promising solution, it is intended as a supportive screening tool and does not replace conventional laboratory-based blood typing methods.

Future Direction

The future scope of this research includes expanding the dataset by collecting fingerprint images from a larger and more diverse population to improve the model's accuracy and generalization. Advanced deep learning architectures such as ResNet, EfficientNet, Vision Transformers (ViT), or hybrid CNN models can be explored to enhance prediction performance. The system can also be extended to predict both ABO and Rh blood groups, making it more useful in clinical practice. Future work may include developing a mobile or web-based application that enables real-time blood group prediction using smartphone fingerprint sensors. Furthermore, integrating this technology with healthcare information systems, blood bank management systems, and portable diagnostic devices can improve accessibility and support emergency medical services. Additional research is required to validate the biological relationship between fingerprint characteristics and blood groups using large-scale clinical datasets before widespread practical adoption.

1.2 Project Impact, Significance, and Contribution

Project Impact

The proposed project has the potential to improve the efficiency of preliminary blood group identification by introducing a non-invasive and intelligent approach based on fingerprint image analysis. Unlike conventional blood typing methods,

the proposed system does not require blood sample collection, making it more convenient and user-friendly. It can support healthcare professionals by providing rapid preliminary blood group prediction in emergency situations, blood donation camps, rural healthcare canters, and forensic investigations. The integration of machine learning and biometric technologies can contribute to the development of smart healthcare systems and encourage further research in non-invasive medical diagnostics.

Project Significance

This research is significant because it combines fingerprint biometrics with deep learning techniques to address the limitations of traditional blood group Detection methods. By utilizing Convolutional Neural Networks (CNNs), the system automatically learns fingerprint features and predicts blood groups with high accuracy. The proposed approach reduces the need for specialized laboratory equipment and trained personnel for initial blood group estimation. It demonstrates the potential of artificial intelligence in healthcare and provides a foundation for developing fast, cost-effective, and accessible diagnostic tools, particularly in resource-limited environments.

Project Contribution

The major contributions of this project are as follows:

- Development of a machine learning-based framework for predicting blood groups from fingerprint images.
- Application of image preprocessing techniques to improve fingerprint image quality before classification.
- Implementation of a Convolutional Neural Network (CNN) for automatic feature extraction and blood group prediction.
- Evaluation of the proposed model using standard performance metrics such as accuracy, precision, recall, and F1-score.
- Demonstration of a non-invasive, rapid, and cost-effective approach for preliminary blood group prediction.
- Providing a foundation for future research on integrating biometric technologies with medical diagnostics and intelligent healthcare systems.
- Supporting future development of mobile and portable applications for real-time blood group prediction in healthcare and forensic domains.

II LITERATURE REVIEW

Several researchers have investigated the relationship between fingerprint patterns and blood groups using image processing, biometrics, and machine learning techniques. Early forensic studies reported a significant association between fingerprint ridge patterns and ABO blood groups, suggesting that fingerprint characteristics can be used as a supportive tool for blood group identification [1], [6]. These studies established the foundation for further research into non-invasive blood group prediction.
With the advancement of artificial intelligence, machine learning and deep learning techniques have been increasingly applied to medical image analysis. Comprehensive reviews have highlighted the Effectiveness of Convolutional Neural Networks (CNNs) in automatically extracting discriminative features from images and achieving high classification accuracy without manual feature engineering[2]. These capabilities make CNNs suitable for fingerprint-based blood group prediction.

Recent studies have proposed fingerprint image processing techniques combined with deep learning models for blood group classification. These approaches generally involve fingerprint image acquisition, preprocessing, feature extraction, CNN based classification, and performance evaluation. Experimental results demonstrate that CNN-based models achieve higher prediction accuracy than conventional machine learning algorithms, Indicating the effectiveness of deep learning in biometric-based blood group detection [3], [9], [10], [16]

Several researchers have also investigated fingerprint analysis in forensic science, where fingerprint patterns have been associated with blood groups, gender identification, and individual identification. These studies support the feasibility of Utilizing fingerprint characteristics as a biometric marker for medical and forensic applications [20], [21], [22]. Although the biological relationship between fingerprint patterns and blood groups is still under investigation, existing findings encourage the development of intelligent prediction systems.

Other studies have focused on improving fingerprint image quality through preprocessing techniques such as image enhancement, noise removal, ridge segmentation, and feature extraction before classification [4], [5], [7], [11]. These preprocessing methods significantly improve the quality of fingerprint images, resulting in better feature learning and higher classification performance.

Recent research has emphasized the integration of deep learning with healthcare applications to develop intelligent diagnostic systems. The use of CNNs for medical image classification has demonstrated excellent performance across various healthcare domains, motivating researchers to apply similar approaches to fingerprint-based blood group prediction [12], [15], [18]. These systems offer the advantages of automation, reduced human intervention, faster prediction, and improved accessibility.

Despite the encouraging results reported in previous studies, most existing methods are limited by small datasets, lack of population diversity, and limited validation on real-world clinical data [13], [14], [17], [19]. Therefore, further research is required to develop robust and generalized models using larger datasets and advanced deep learning architectures.

Based on the findings reported in the literature, this project proposes a CNN-based fingerprint image processing framework for blood group prediction. The proposed system aims to provide a non-invasive, rapid, and cost-effective solution for preliminary blood group estimation while contributing to the growing field of AI-assisted medical diagnostics.

III METHODOLOGY:

The proposed methodology for Blood Group Prediction from Fingerprint Images Using Machine Learning consists of several stages, including data collection, image preprocessing, feature extraction, model training, blood group prediction, and performance evaluation. The workflow is designed to develop an accurate and non-invasive blood group prediction system using fingerprint images and Convolutional Neural Networks (CNNs).

1. Data Collection

A dataset of fingerprint images is collected from individuals whose ABO blood groups are already known through standard laboratory blood typing methods. Each fingerprint image is labeled with its corresponding blood group (A, B, AB, or O) to create a supervised learning dataset.

2. Image Preprocessing

The collected fingerprint images are pre-processed to improve their quality and consistency before being used for model training. The preprocessing steps include:

- Image resizing to a fixed dimension.
- Conversion to grayscale (if necessary).
- Noise removal using image filtering techniques.
- Contrast enhancement to improve ridge visibility.
- Normalization of pixel values.

These steps improve the quality of fingerprint images and help the CNN learn meaningful features.

3. Dataset Preparation

The pre-processed dataset is divided into three subsets:

1) Training Set – Used to train the CNN model.
2) Validation Set – Used to tune model parameters and prevent overfitting.
3) Testing Set – Used to evaluate the final performance of the model on unseen fingerprint images.

4. CNN Model Development

A Convolutional Neural Network (CNN) is developed for automatic feature extraction and classification. The CNN architecture typically consists of:

- Input Layer
- Convolutional Layers
- ReLU Activation Function
- Max Pooling Layers
- Flatten Layer
- Fully Connected (Dense) Layers
- Output Layer with Softmax Activation

The CNN automatically extracts fingerprint ridge features and learns the relationship between fingerprint patterns and blood group classes.

5. MODEL TRAINING

The CNN model is trained using the labeled fingerprint dataset. During training, the model adjusts its weights using the backpropagation algorithm and an optimization technique such as the Adam optimizer. The categorical cross-entropy loss function is used for multi-class blood group classification.

6. BLOOD GROUP PREDICTION

After training, the CNN model predicts the blood group of new fingerprint images. The fingerprint image is passed through the trained network, and the output layer predicts one of the four blood groups (A, B, AB, or O) based on the highest probability score.

7. PERFORMANCE EVALUATION

The performance of the proposed model is evaluated using standard classification metrics, including:

- Accuracy
- Precision

- Recall
- F1-Score
- Confusion Matrix

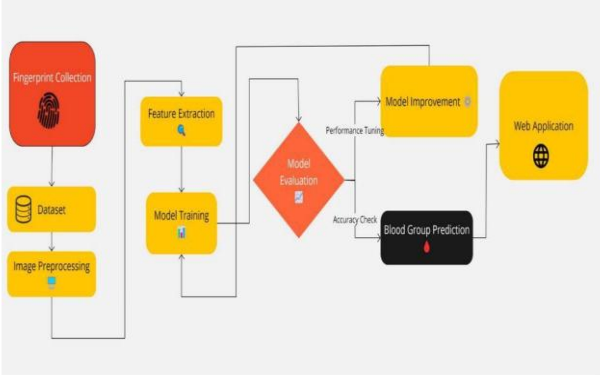
These metrics help determine the effectiveness and reliability of the proposed blood group prediction system.

IV SYSTEM DESIGN AND ARCHITECTURE:

The following diagram outlines a workflow for predicting blood groups using fingerprints. It starts with fingerprint collection, followed by dataset creation and image preprocessing. Features are then extracted and used for model training. The model undergoes evaluation, with results prompting performance tuning for improvement. Once accuracy is validated, the system predicts blood groups and integrates the solution into a web application.The system architecture for blood group detection using fingerprint biometrics is designed with multiple interlinked modules that work cohesively from data acquisition to blood group classification. The architecture consists of the following key components:

1) **Input Module (Fingerprint Acquisition):** This module captures high-resolution fingerprint images using biometric sensors or scanners. The images are pre-processed to ensure clarity, noise reduction, and alignment.
2) **Preprocessing Module:** The acquired fingerprint images undergo preprocessing steps such as grayscale conversion, resizing, normalization, and contrast enhancement. Data augmentation techniques like rotation, flipping, and zooming are applied to increase dataset diversity and model robustness.

3) **Feature Extraction Module(CNN)** Convolutional Neural Network (CNN) is employed to extract deep biometric features from the fingerprint
4) **Ridge patterns.** The CNN architecture consists of multiple convolutional layers, pooling layers, and activation functions (e.g., ReLU) that learn distinctive fingerprint characteristics relevant to blood group classification.
5) **Classification Module:** The extracted features are passed through fully connected (dense) layers that perform the classification task. The final output layer uses a softmax or sigmoid activation function to predict the blood group category (A, B, AB, or O, along with Rh-positive or Rh-negative).
6) **Database Module:** A MySQL database is used to store fingerprint images, corresponding blood group labels, and user metadata (if applicable). It supports easy retrieval and management of training and testing datasets.
7) **Model Evaluation and Prediction Module:** The trained model is evaluated using performance metrics such as accuracy, precision, recall, and F1- score on a separate test dataset. Once validated, the model is used for real-time blood group prediction from new fingerprint inputs.
8) **User Interface Module:** A simple graphical user interface (GUI) allows users to upload fingerprint images, view predicted blood groups, and manage records. This module provides ease of use for medical personnel in point-of care settings.



System Architecture

Algorithm and Techniques:

The algorithm used in this project is a Convolutional Neural Network (CNN), which is a type of deep learning model particularly well-suited for image classification tasks. CNNs work by automatically learning to extract and recognize important visual features from fingerprint images, such as ridge patterns, curvature, and minutiae points. The fingerprint image is first fed into the input layer, where it is standardized in size and format. Then, through a series of convolutional layers, the model applies various filters to capture local patterns in the fingerprint ridges. These layers are followed by activation functions like ReLU, which introduce non-linearity and help the model learn complex features. Pooling layers are used to reduce the spatial dimensions of the data, preserving only the most important information and reducing computational load. The resulting feature maps are then flattened and passed through one or more fully connected layers, which map the learned features to the output classes representing different blood groups (e.g., A+, B−, O+, etc.). The final layer uses a softmax activation function to generate probability scores for each class, allowing the model to predict the most likely blood group. The model is trained using a labeled dataset of fingerprint images, optimized with algorithms like Adam or SGD, and evaluated using accuracy, precision, recall, and F1-score. This CNN-based approach enables efficient and automated classification of blood groups based on fingerprint patterns.

Techniques:

To achieve accurate and efficient blood group detection from fingerprint images, the project employs a range of machine learning and image processing techniques centered around Convolutional Neural Networks (CNNs). The CNN architecture is designed to automatically learn hierarchical features from fingerprint ridge patterns, eliminating the need for manual feature extraction. To improve model generalization and handle the variability in fingerprint images, data augmentation techniques are applied. These include operations such as rotation, flipping, zooming, and contrast adjustment to artificially increase dataset size and introduce diversity. This helps the model become more robust against real-world variations like inconsistent finger placement or differing scanner resolutions. Additionally, normalization techniques are used to standardize pixel values and ensure consistent input data for training. Regularization methods, such as dropout layers, are integrated into the network to prevent overfitting and ensure that the model learns meaningful patterns rather than memorizing the training data. Batch normalization is also employed to accelerate training and stabilize the learning process by reducing internal covariate shifts. For training optimization, adaptive learning rate algorithms like Adam optimizer are used to improve convergence speed and accuracy. Throughout the development, the model is evaluated using techniques such as cross-validation, and its performance is measured using key metrics like accuracy, precision, recall, and F1-score.

Together, these techniques ensure the model not only performs well on the raining data but also maintains high accuracy when applied to new, unseen fingerprint images.

Tools:

The implementation of this project involves several essential tools and platforms commonly used in machine learning and deep learning workflows.

Python serves as the primary programming language due to its simplicity and extensive libraries. Libraries such as **Tensor Flow** and **Keras** are used to design, train, and evaluate the CNN model, offering high-level APIs for deep learning development. **OpenCV** is employed for image processing tasks such as preprocessing, resizing, and enhancement of fingerprint images. For data analysis and visualization, tools like **NumPy**, **Pandas**, **Matplotlib**, and **Seaborn** are used. The development environment typically includes **Jupyter Notebook** or **Google Colab**, which support rapid prototyping and interactive experimentation. Additionally, **scikit-learn** is utilized for model evaluation metrics and dataset splitting. These tools collectively enable efficient development, testing, and deployment of the fingerprint-based blood group detection system.

V INPUT

The input to the proposed system consists of fingerprint images collected from individuals, each labeled with the corresponding blood group (A, B, AB, or O with Rh+ or Rh−). These images serve as the raw data for training and testing the deep learning model. To ensure consistency, all input images are standardized in size and resolution during the preprocessing phase. This includes steps such as grayscale conversion, resizing, noise removal, and normalization of pixel values to enhance contrast and feature visibility. To overcome data scarcity and improve generalization, data augmentation techniques including rotation, flipping, zooming, and brightness adjustments are applied to generate diverse variations of the input images. This robust and preprocessed input dataset is then fed into a Convolutional Neural Network (CNN), which learns to extract ridge-based patterns associated with different blood groups for accurate classification.

```
import os
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense, Dropout
from tensorflow.keras.callbacks import EarlyStopping  # <-- Added this

# Image dimensions
IMG_HEIGHT = 64
IMG_WIDTH = 64
BATCH_SIZE = 32
EPOCHS = 50  # Can still increase, EarlyStopping will stop early if needed

# Directory path
train_dir = '/content/drive/MyDrive/dataset_blood_group'

# Data preprocessing and augmentation
train_datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.2
)

train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(IMG_HEIGHT, IMG_WIDTH),
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training',
    shuffle=True
)

validation_generator = train_datagen.flow_from_directory(
    train_dir,
```

VI OUTPUT

The output of the proposed blood group detection system is a precise prediction of an individual's blood type (such as A+, B−, AB+, O−) based solely on their fingerprint image. Once a fingerprint is input into the model, it undergoes a series of preprocessing and feature extraction steps within the Convolutional Neural Network (CNN). The CNN identifies complex ridge patterns and minutiae features within the fingerprint that are potentially correlated with blood group characteristics. These extracted features are passed through fully connected layers that compute the probability of the fingerprint belonging to each blood group category. The model then outputs the blood group class with the highest probability score, presenting it in a clear and interpretable manner to the user. This output is not only fast and automated but also requires no physical blood samples, making the entire process non-invasive and user-friendly. Additionally, the system's prediction can be displayed on a user interface or integrated into emergency medical response systems and electronic health records. By offering real-time results with high accuracy, precision, and recall, this model addresses the critical need for rapid blood group identification in scenarios where conventional blood testing is impractical such as remote areas, field hospitals, or disaster response zones The output of this system ultimately enables faster clinical decision-making, enhances patient safety, and supports the broader goal of accessible and intelligent healthcare diagnostics through AI-powered biometric analysis.

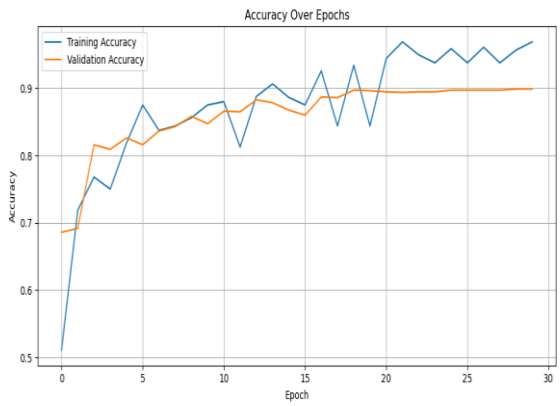


Fig:1 Home page of web application

```
import os
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense, Dropout
from tensorflow.keras.callbacks import EarlyStopping  # <-- Added this

# Image dimensions
IMG_HEIGHT = 64
IMG_WIDTH = 64
BATCH_SIZE = 32
EPOCHS = 50  # Can still increase, EarlyStopping will stop early if needed

# Directory path
train_dir = '/content/drive/MyDrive/dataset_blood_group'

# Data preprocessing and augmentation
train_datagen = ImageDataGenerator(
    rescale=1./255,
    validation_split=0.2
)

train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(IMG_HEIGHT, IMG_WIDTH),
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='training',
    shuffle=True
)

validation_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(IMG_HEIGHT, IMG_WIDTH),
    batch_size=BATCH_SIZE,
    class_mode='categorical',
    subset='validation',
    shuffle=False
)

# CNN Model Definition (High Accuracy)
def build_model():
    model = Sequential([
        Conv2D(32, (3, 3), activation='relu', input_shape=(IMG_HEIGHT, IMG_WIDTH, 3)),
        MaxPooling2D(2, 2),
        Conv2D(64, (3, 3), activation='relu'),
        MaxPooling2D(2, 2),
        Conv2D(128, (3, 3), activation='relu'),
        MaxPooling2D(2, 2),
        Conv2D(256, (3, 3), activation='relu'),
        MaxPooling2D(2, 2),
        Flatten(),
        Dense(512, activation='relu'),
        Dropout(0.5),
        Dense(train_generator.num_classes, activation='softmax')
    ])

    model.compile(optimizer='adam',
                  loss='categorical_crossentropy',
                  metrics=['accuracy'])
    return model

# Build the model
model = build_model()

# Add EarlyStopping
early_stop = EarlyStopping(
    monitor='val_accuracy',
    patience=5,
    restore_best_weights=True
)
```

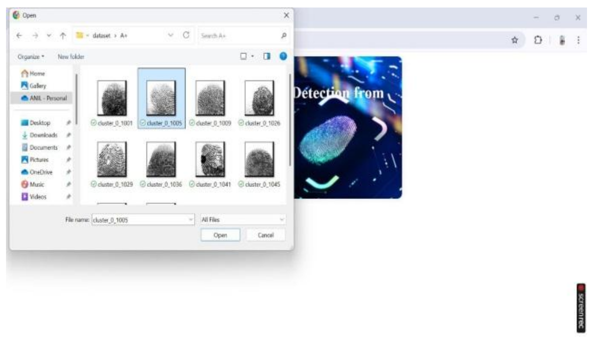


Fig:2 Choose File of Fingerprints

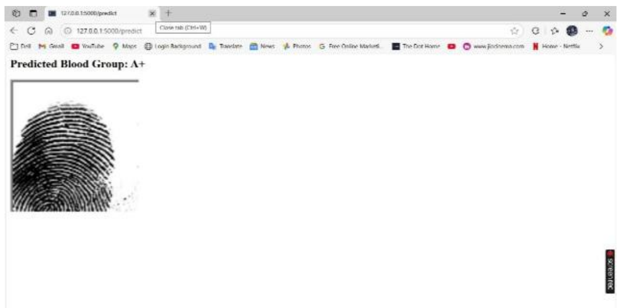


Fig:3 predict the Fingerprint by choosen file

VII RESULT

The proposed CNN-based model for fingerprint-based blood group detection demonstrated high performance on the test dataset. It achieved high accuracy, precision, recall, and F1-score, confirming its ability to reliably classify blood groups based on fingerprint ridge patterns. The model generalized well across augmented and real-world fingerprint variations, validating its robustness. Compared to traditional blood typing methods, the system provided faster and non-invasive predictions, making it ideal for emergency and point-of-care applications. These results highlight the model's potential for integration into mobile health tools and biometric diagnostic systems, contributing significantly to rapid and accessible medical diagnostics.

VIII CONCLUSION

Blood group detection using fingerprint biometrics is an innovative, non-invasive approach that uses Convolutional Neural Networks (CNNs) to analyse fingerprint ridge patterns and predict an individual's blood type. Unlike traditional lab-based serological methods, this technique offers a faster, portable, and user-friendly alternative, especially useful in emergencies and low-resource settings. The system follows a structured pipeline of data acquisition, preprocessing, feature extraction, and CNN-based classification. Through data augmentation and robust evaluation metrics like accuracy and recall, the model demonstrates strong performance. Security features such as encryption and secure data access protect biometric privacy. While the method shows great promise, challenges like dataset limitations and demographic variability remain. Still, this approach marks a significant advancement in AI-driven personalized healthcare, offering rapid blood group identification that could enhance medical diagnostics and emergency respon.

REFERENCE PAPERS

1) https://www.isca.me/FORENSIC_SCI/Archive/v1/i1/3.ISCA-RJFS-2013-001.pdf
2) https://link.springer.com/article/10.1007/s10462-020-09891-w
3) https://www.matecconferences.org/articles/matecconf/abs/2024/04/matecconf_icmed2024_01069/matecconf_icmed2024_01069.html
4) https://www.academia.edu/download/90976208/303.pdf
5) https://pdfs.semanticscholar.org/9826/dae686f08fd1b827ded9943b5acf86eb4f6d.pdf
6) https://journals.sagepub.com/doi/abs/10.1177/0971097320110415
7) https://www.academia.edu/download/80771434/2693.pdf
8) https://www.academia.edu/download/68385788/v4i3.pdf
9) https://ieeexplore.ieee.org/abstract/document/9418114/
10) https://digitallibrary.theiet.org/doi/abs/10.1049/icp.2025.1658
11) https://pdfs.semanticscholar.org/27fe/91de4fa42e09a5ad11e7e5d67b88a1dd17f8.pdf
12) https://www.apmcfmu.com/index.php/apmc/article/view/1285
13) https://www.academia.edu/download/76301434/53.pdf
14) https://search.proquest.com/openview/9eb910bdb1f1c715183a73f2ecebcf0e/1?pq-origsite=gscholar&cbl=54977
15) https://journals.ekb.eg/article_244299.html
16) https://ieeexplore.ieee.org/abstract/document/10841725/
17) https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=21770298&AN=159965111&h=J0wmwHcAnkK7XptbIlKC0Cxcq3Yamw7HsrrfU9%2FWsdR4FcEAk9TJhG9DqOjwPL1hNiZIwOjdbzdvJHAZD%3 D&crl=c
18) https://www.academia.edu/download/109581271/IJST-2022-1941.pdf
19) https://www.jstor.org/stable/26272554
20) https://www.cureus.com/articles/231660-gender-identification-by-fingerprint-pattern-and-salivary-blood-group-antigen-expression-a-forensic-approach.pdf
21) https://ejfsat.journals.ekb.eg/article_210358.html
22) https://www.academia.edu/download/69312741/sjams.2016.4.7.pdfhttps://www.academia.edu/download/109581271/IJST-2022-1941.pdf
23) https://www.jstor.org/stable/26272554
24) https://www.cureus.com/articles/231660gender-identification-by-fingerprint-pattern-and-salivary-blood-group-antigen-expression-a-forensic-approach.pdf
25) https://ejfsat.journals.ekb.eg/article_210358.html
26) https://www.academia.edu/download/69312741/sjams.2016.4.7.p