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Blood Group Detection By Using Fingerprint

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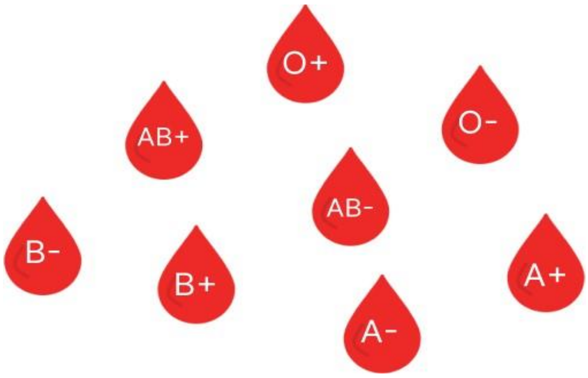
Abstract: Before performing blood transfusions in severe situations, blood group detection is necessary. It is done before a blood transfusion in an emergency or when checking a person's blood group for donation. Currently, lab personnel perform tests manually in the laboratory. This takes time and may result in human mistake when determiningblood type. The goal of the study survey is to use image processing to reduce the amount of physical labor required to identify blood groups. The presence or absence of agglutination reaction of blood with antigen will be used to determine the blood group.

Keywords: Blood transfusion, Blood group detection, Image processing, Agglutination reaction, Antigen, Bloodsample analysis

I. INTRODUCTION

Blood is an essential to life. It circulates through human body and brings oxygen and nutrients to all the parts of body so that they can keep working. It carries carbon dioxide and other waste material to the lungs, kidneys and digestive system so that waste material to be removed from the system. Blood group is a classification of blood based on the presence or absence of antigenic substances in blood cells. Blood types where first discovered by an Austrian physician, Karl Landsteiner. In 1901, he observed that there are substances in the blood like antigen and antibody that form clumping of red cells when one type of blood is added to another type of blood. Based on this herecognizes three type of blood groups as A, B and C. He defined that group A agglutinates with group B, similarly group B agglutinates with group A but group C blood is different because it agglutinates with both A and B. Thus, he discovered two antigens and two antibodies. In 1910, Ludwik Hirszfeld and Emil Freiherr von Dungern introduced the term O(null) for the group Landsteiner designated as C which has no antigens but antibodies anti-A and anti-B. The fourth less frequent blood group AB, was discovered by Sturli and von Decastello, whichhas both A and B antigens but no antibodies. The Rh blood group was discovered in 1940 by Karl Landsteiner and A. S. Weiner, they classify blood group according to the presence or absence of Rh antigen.Following are the blood groups present in human body



1) Group A positive or A negative:

A antigens are present on surface of blood cells. Anti-B antibodies are present in the plasma.

2) Group B positive or B negative:

B antigens are present on surface of blood cells. Anti-A antibodies are present in the plasma.

3) Group AB positive or AB negative:

A and B antigens are present on surface of blood cells. There are no antibodies in the plasma.

People with group AB positive blood can usually receive from any group.

4) Group O positive or O negative:

There are no antigens are present on surface of blood cells. Both anti-B and anti-A antibodies in the plasma.

O is a universal donor. People with O blood group can donate blood to people with any blood group.

Blood group identification is very important to make sure blood transfusion safety. Blood grouping is essentialfor many major medical procedures. Blood Detection is the most important and essential activity in human life. Patients with Thalassemia require a regular blood transfusion. So, it is important to identify the correct blood group before blood transfusion, donation, and other emergency situations, which may directly relate to the survival and life of the patient.

An ABO incompatibility reaction can occur if a patient receives the wrong type of blood during a blood transfusion. Where ABO incompatibility reaction is nothing but, antibodies that the patient already has in his or her blood will attack the donor blood cells and destroy them. This will cause some dangerous effects on the immune system such as fever, chills, chest or back pain, bleeding, increased heart rate, shortness of breath, kidney damage andhuman death is also possible.

The traditional method of determining blood type in the laboratory can be replaced by a digital method using image processing technology. Image processing is helping in many ways to achieve their goals, especially in the security and medical fields. In the medical field, image processing is used for various tasks like PET scan, X-ray imaging, medical CT, UV imaging, cancer cell image processing, and much more. Nowadays image processing techniques are widely used for blood group detection. It only takes a short time to determine the blood type and there should be no errors.

There are image matching algorithms such as scale invariant feature transform (SIFT), speed-up robust feature (SURF) and oriented fast and rotated brief (ORB) algorithm which are used to find out the similarities in the image.

SIFT is feature detection algorithm in computer vision. This algorithm helps to locate the local features in an image, commonly known as key points of the image. It takes an image and transforms it into a large collection of local features. This algorithm is distinctive where individual features can be matched for large database objects. It provides many features for even small objects. ORB is an efficient alternative to sift or surf algorithms used for feature extraction , in computation cost and matching performance .This algorithm has ability to reduce sensitivity tonoise.

The various Deep Learning methods use data to train neural network algorithm to do a variety of Machine Learning tasks, such as the classification of different classes of objects. Convolutional Neural Network are Deep Learning algorithms that are very powerful for analysis of images.

There are many applications of this blood detection system, as correct blood group is required everywhere in the medical system. For example, before donating blood at a blood donation camp, correct blood group of donors is required, in rural areas, laboratories are not available to detect correct blood type, in such cases people can use this system to detect the blood group.

II. Problem Statement

Develop a non-invasive method to accurately determine an individual's blood group using their fingerprint patterns, aiming to provide a rapid, cost-effective alternative to traditional blood typing techniques.

III. Research Methodology

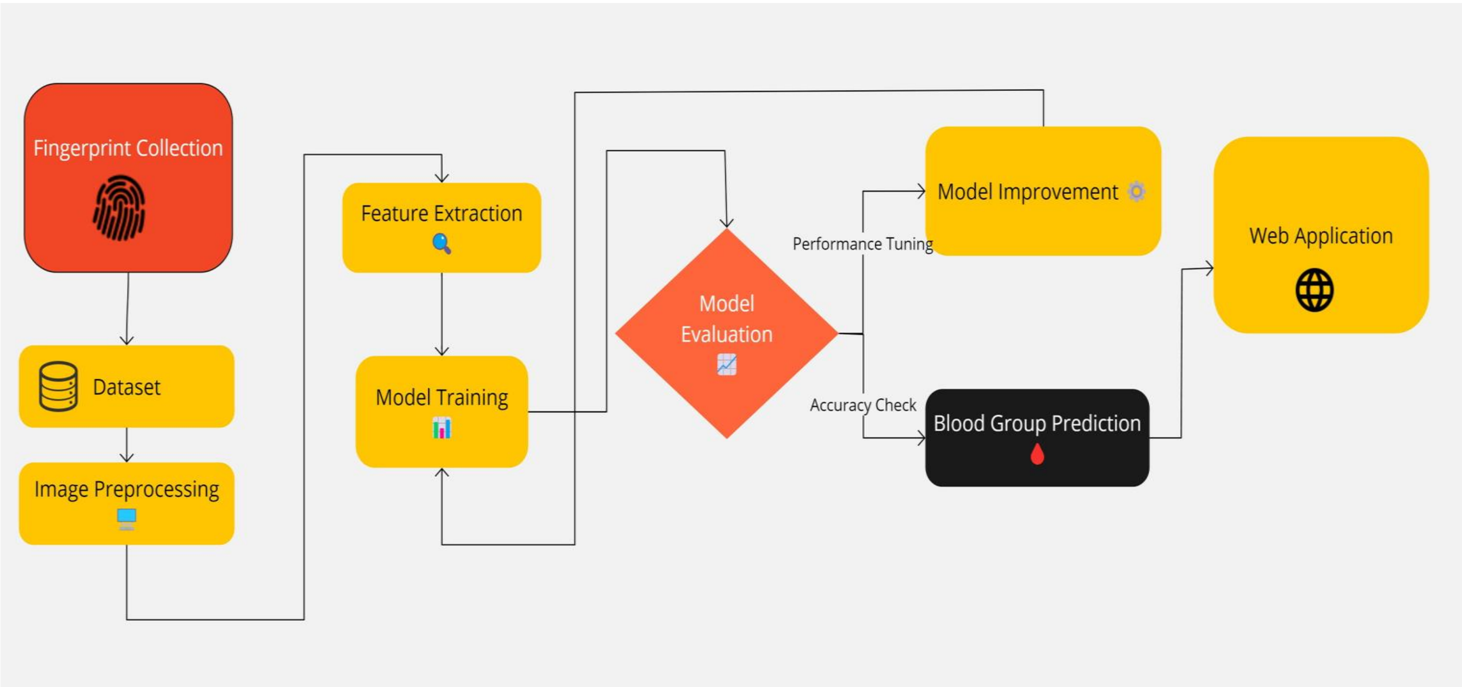


Fig 1: Working Flow

Working of the Architecture

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1. Fingerprint Collection

- The process starts by collecting fingerprint images from users using a scanner or image input device.
- These images form the **primary input** for the system.

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2. Dataset Creation

- The collected fingerprints are compiled into a **dataset**.
- Each fingerprint image in the dataset is labeled with the individual's blood group (A, B, AB, O – positive or negative).
- This labeled dataset is essential for training a supervised learning model.

3. Image Preprocessing

- The raw fingerprint images undergo preprocessing to enhance their quality and make them suitable for feature extraction.
- Common preprocessing steps:
    - **Grayscale conversion**
    - **Noise reduction**
    - **Contrast enhancement**
    - **Resizing to a fixed dimension**
    - **Normalization** for consistent pixel value distribution

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4. Feature Extraction

- From the preprocessed images, important fingerprint features are extracted.
- Tools used:
    - **CNN layers**: Automatically learn features like ridges, valleys, and patterns.
    - Optionally, **SIFT** or **ORB** may be used to extract robust local descriptors from fingerprint images.

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5. Model Training

- The extracted features are fed into a **deep learning model** (typically CNN).
- The model learns to **map fingerprint features to specific blood groups**.
- This stage includes:
    - Training the model on the dataset
    - Validating its performance on unseen data

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6. Model Evaluation

- After training, the model is evaluated for:
    - **Accuracy**: How well it predicts blood groups
    - **Loss**: Error between predicted and actual blood groups
    - **Precision/Recall** if needed

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7. Model Improvement

- Based on evaluation metrics, the model is improved using:
    - More training data
    - Data augmentation (rotations, zooms, etc.)
    - Hyperparameter tuning (learning rate, batch size, etc.)
    - Deeper or better-structured CNN architecture

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8. Blood Group Prediction

- After optimization, the trained model is ready to **predict blood groups** from new fingerprint inputs.
- The user uploads a fingerprint, and the system returns the predicted blood group in real time.

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9. Web Application

- The model is integrated into a **web application** built using technologies like Flask, HTML, CSS, and JS.
- Features:

- Upload fingerprint image
- View predicted blood group
- Admin functionalities like adding users, viewing results, etc.

End Result:
A fast, accurate, and **non-invasive blood group detection system** using just a fingerprint image, accessible through a web interface

IV. Algorithms

1. Convolutional Neural Network (CNN) : is used to detect blood groups by analyzing images of blood samples. First, the images are preprocessed through normalization and data augmentation.
The CNN model then extracts important features from the images using convolutional and pooling layers.

2. SIFT :(Scale-Invariant Feature Transform)

- **Purpose:** In the context of blood group detection using fingerprints, SIFT helps extract stable features from fingerprint images. These features can be used for matching fingerprints across different scans or aligning multiple fingerprint images for comparison.

3. ORB (Oriented FAST and Rotated BRIEF):

- **Purpose**: **ORB** stands for **Oriented FAST and Rotated BRIEF**, a feature detection and description algorithm. In blood group detection using fingerprints, ORB can be used to extract key features from fingerprint images for matching and identification.

1. **Keypoint Detection (FAST)**:
   ORB begins by using the FAST corner detector to identify **keypoints** in the fingerprint, focusing on features like ridge endings and bifurcations.
2. **Feature Description (BRIEF)**:
   After assigning orientation, the algorithm computes BRIEF descriptors around each keypoint. These descriptors are binary, making them compact and efficient for fast matching.

V. Result

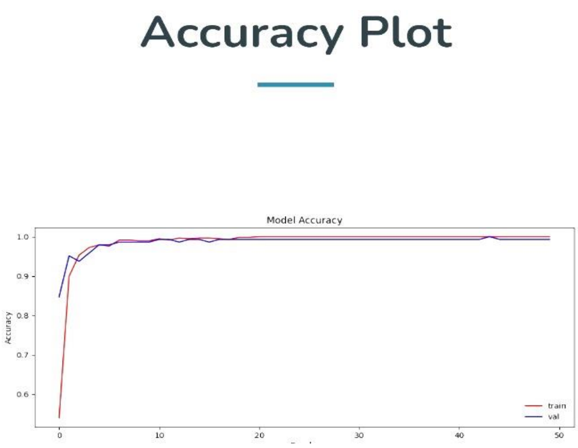

Fig . Accuracy Plot

VI. Conclusion

This paper presents a novel, non-invasive approach for predicting human blood groups using fingerprint images and machine learning techniques. By leveraging the unique patterns within fingerprints and applying advanced image processing and deep learning—specifically Convolutional Neural Networks (CNNs)—we have demonstrated the potential for accurate blood group classification without the need for blood samples. This system significantly reduces dependency on traditional, invasive methods, making it a cost-effective and rapid alternative, especially beneficial in emergency medical situations and remote areas with limited healthcare facilities. The successful integration of the model into a web application further enhances its practical usability and accessibility. Future enhancements can include expanding the dataset, improving model accuracy, and deploying the system on mobile platforms for real-time use in healthcare and forensic applications.

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