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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 determining blood type. The goal of the study survey is to use image processing to reduce the amount of physical lab or 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, Blood sample analysis.

1. INTRODUCTION

Blood is very important for our body. It flows through our body and carries oxygen and nutrients to all parts, helping them work properly. It also collects carbon dioxide and other waste from the body and takes it to the lungs, kidneys, and digestive system to be removed. Blood groups are categories of blood based on special substances found on red blood cells. These substances are called antigens and antibodies.

A scientist named Karl Landsteiner discovered blood types in 1901. He noticed that when certain types of blood are mixed, they can clump together. Based on this, he identified three blood types: A, B, and C. Later, blood type C was renamed to O, because it has no antigens.

- Type A has A antigens and anti-B antibodies.
- Type B has B antigens and anti-A antibodies.
- Type O has no antigens but has both anti-A and anti-B antibodies.
- Type AB has both A and B antigens but no antibodies.

The AB blood group was discovered later by two scientists, Sturli and von Decastello.

Another important factor in blood is the Rh factor, discovered in 1940 by Landsteiner and A.S. Weiner. It tells us whether a person has the Rh antigen (positive) or not (negative).

So, the main blood groups are:

A, B, AB, and O, each of which can be Rh positive (+) or Rh negative (–).

Blood group identification is very important to make sure blood transfusion safety. Blood grouping is essential for 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 and human 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

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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 to noise.

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.

2. 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.

3. RESEARCH METHODOLOGY

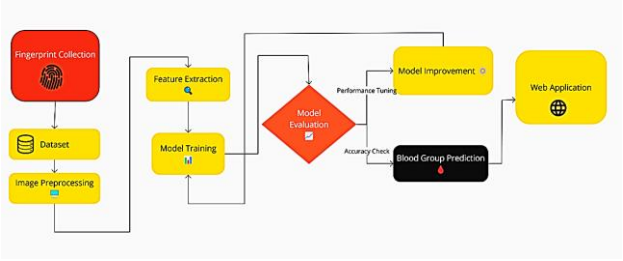


Figure 1 Working Flow

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

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

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

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

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

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

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

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.

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.

4. ALGORITHMS

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.

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.

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.

Key point Detection (FAST)

ORB begins by using the FAST corner detector to identify key points in the fingerprint, focusing on features like ridge endings and bifurcations.

Feature Description (BRIEF)

After assigning orientation, the algorithm computes BRIEF descriptors around each key point. These descriptors are binary, making them compact and efficient for fast matching

5. 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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