IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 1, November 2024

Blood Group Detection by Using Fingerprint

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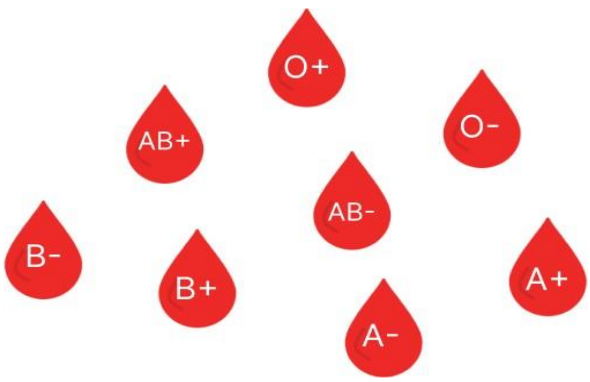
Abstract*: Before performing blood transfusions in severe situations, blood group detection is necessary. It is done before a blood transfusion in an emergency or when checking a person's blood group for donation. Currently, lab personnel perform tests manually in the laboratory. This takes time and 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.



Group A positive or A negative:

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

Group B positive or B negative:

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

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.

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 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 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. PROPOSED ALGORITHM

Login Module:
Objective: Successfully authenticate the user.

Algorithm:
1. Begin
2. Prompt user to enter their **username** and **password**
    a. **If** the credentials are correct:
        i. Display “Login Successful”
        ii. Proceed to the main menu

b. Else:
   i. Display “Login Unsuccessful”
   ii. Allow reattempts or exit
3. Go to entry menu
4. End

Registration Module:
There are two types of registrations: **Employee** and **Patient**.

Employee Registration:
Objective: Register an employee in the system.

Algorithm:
1. Begin
2. Enter all required information for the employee
3. Click the **Submit** button to save the employee details
4. End

Patient Registration:
Objective: Register a patient in the system.

Algorithm:
1. Begin
2. Enter all required information for the patient
3. Click the **Select Slide** button to proceed to the detection module
4. End

Detection Module:
The Detection module is further divided into sub-modules.

Select Slide:
Objective: Select and display a blood slide image for analysis.

Algorithm:
1. Begin
2. Select the desired **blood slide image**
3. Display the selected image on the screen for examination
4. End

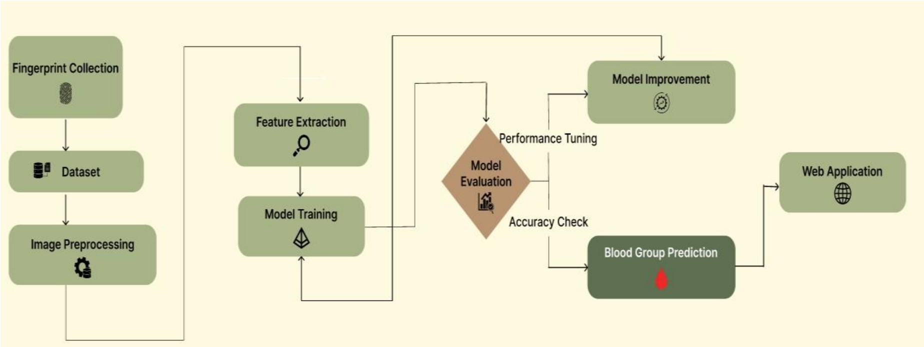


Fig. System Architecture

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III. EXPERIMENT AND RESULT

- **Blood Sample Preparation**: Blood samples were prepared on slides with specific antigens (anti-A, anti-B,and anti-D) to initiate agglutination for ABO and Rh factor detection.
- **Image Capture**: Images of blood slides were taken for processing. The images were captured undercontrolled lighting to reduce noise and enhance visibility of the agglutination.
- **Image Preprocessing**: Images were preprocessed to enhance quality, involving:
  - **Histogram equalization** to balance brightness.
  - **Color correction** for more accurate detection.
  - **Image segmentation** to focus on blood sample regions.
- **Feature Detection**: The system applied **Scale-Invariant Feature Transform (SIFT)** and **Oriented Fast and Rotated Brief (ORB)** algorithms to detect features associated with agglutination patterns.
- **Classification**: Using Convolutional Neural Networks (CNN), the system was trained on sample data to classify blood groups into A, B, AB, or O with positive or negative Rh factors.
- **Prediction and Output**: For new blood samples, the trained model predicted the blood group, which was then stored in the system database.

The results showed high accuracy in detecting blood groups, with the following highlights:

- **Detection Accuracy**: The model achieved a classification accuracy rate of over 90% for blood samples with clear agglutination patterns.
- **Processing Time**: The system processed each sample within a few seconds, making it suitable for rapid blood typing in emergency situations.
- **Limitations**: The system performed poorly with rare blood types such as the Bombay phenotype and showeda slight reduction in accuracy when dealing with low-resolution images.

These results affirm that the image-processing-based blood group detection system is a feasible alternative to traditional methods, offering speed and reduced risk of human error.

IV. CONCLUSION

The blood group detection system developed in this project successfully utilizes image processing techniques to determine blood types with high accuracy and efficiency. By automating the detection process through feature extraction and machine learning, the system reduces the likelihood of human error and provides a faster alternative to traditional manual methods. This approach is particularly advantageous in emergency scenarios where rapid and accurate blood typing is essential.

The results demonstrate the viability of this system in clinical settings, where it can streamline the blood typing process, improving both accuracy and speed. However, limitations exist, such as reduced accuracy with rare blood types and potential dependency on high-quality images. Future enhancements could involve refining the model for broader blood type classifications and implementing a portable version to expand usability across various healthcare facilities.

V. FUTURE SCOPE

For future work, it is intended to develop a low-cost, portable device for automatic determination of blood group. Using portable device employee directly take photo of blood slide and detect blood group. The project is further extended to android application. In android application employees take picture of blood slide directly on their mobile devices to identify their blood type.

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