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Implementation of Blood Group Detection using CNN and Python

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Abstract: **Blood group determination is done before a blood transfusion in emergency situations or while checking blood group of a person for donation. There is worldwide demand for an affordable Blood Group Measurement solution, which is a particularly urgent need in developing countries. It is necessary to ensure that you receive the right kind of blood during surgery or after an injury. If incompatible blood is given, it can be fatal resulting in agglutination. Hence, before the blood transfusion it becomes necessary to perform certain tests. Determining blood group is one of the tests before transfusing the blood during emergency situations. Microscopy has intermittently proved inefficient since it is time consuming and also the results are difficult to reproduce. Due to these reasons, automation of the evaluation process is of high importance. Image Processing, which is the most penetrated tool in both rich and resource constrained areas, would be a suitable choice to build this solution. Based on the processing of images acquired from the NIR sensor the blood group of a person is known during emergency situations without any error. This Project proposes a noninvasive Blood Group detection process. This project involves use of image processing algorithms to calculate blood groups and comparing different aspects of data collection and processing techniques to see which methods are most effective at accurately determining blood types. This can have important implications for medical diagnosis and treatment, as it could potentially lead to the development of new, non-invasive methods for accurately determining blood types in patients using machine learning algorithms to train detection models that can accurately classify the image into different blood types.**

IndexTerms **- Transfusion, Agglutination, NIR Sensor, Blood group determination**

I. INTRODUCTION

Blood is a vital fluid that circulates throughout the human body, carrying essential nutrients and oxygen to all the organs and tissues. The circulatory system carries carbon dioxide and other waste materials from the body's cells to the lungs, kidneys, and digestive system, where these waste products can be removed from the body. In the lungs, carbon dioxide is exchanged for oxygen through respiration, and in the kidneys and digestive system, waste products are filtered out of the blood and excreted from the body. The classification of blood into different blood groups is based on the presence or absence of specific proteins called antigens on the surface of red blood cells. The two most widely recognized blood group systems are the ABO system and the Rh system. The ABO system classifies blood into four main groups: A, B, AB, and O, depending on the presence or absence of the A and B antigens. The Rh system classifies blood as Rh-positive or Rh-negative based on the presence or absence of the Rh antigen. Understanding blood groups is important in transfusion medicine because incompatible blood transfusions can cause serious reactions, including hemolytic transfusion reactions, which can be life-threatening.

The two main types of blood group are: 1) ABO blood system 2) Rhesus blood system in human blood, the ABO blood group system contains two antigens and two antibodies. The two antigens are antigen A and antigen B. The two antibodies are antibody A and antibody B. Antibodies are found in serum, while antigens are found in red blood cells. Based on the antigenic characteristics of the blood, all people can be classified into four groups: those whose antigen A is group A, those whose antigen B is group B, those who have both antigen A and B as group AB, and those who have neither antigen as group O. Antibodies present with antigens can be found as follows: a) Antigen A and antibody B b) Antigen B with antibody A c) Antigen AB does not contain antibodies d) Antigen zero (group O) with A and B. agglutination reaction between similar antigen and antibody (for example , antigen A agglutinates antibody A and antigen B agglutinates antibody B). Thus, blood transfusion can be considered safe as long as the recipient's serum does not contain antibodies against antigens of the donor's blood cells.

Problem Statement: Detecting the correct blood group is a critical aspect of human survival, especially for patients with Thalassemia who require frequent blood transfusions. Accurate identification of the blood group is crucial in emergency situations, blood donation, and transfusion, as an ABO incompatibility reaction may occur if the patient receives the wrong type of blood. This reaction is caused by pre-existing antibodies in the patient's blood attacking the donor blood cells, which can lead to severe consequences such as fever, chills, chest or back pain, bleeding, increased heart rate, shortness of breath, kidney damage, and even mortality. Therefore, it is vital to ensure the compatibility of blood groups before transfusion to ensure patient safety and prevent life-threatening complications.

There are several compelling reasons for working on a blood group detection project. Firstly, the accurate identification of an individual's blood group is crucial for safe blood transfusions and other medical procedures, which can be lifesaving for patients with certain medical conditions. Secondly, traditional laboratory-based methods of blood grouping can be time-consuming, costly, and require specialized skills and equipment. In contrast, image processing technology offers a more convenient and efficient way of performing blood tests. Furthermore, the use of image processing technology in medical applications has gained significant traction due to its potential to improve healthcare outcomes and enhance patient safety. Therefore, developing a blood group detection system using image processing technology can bring significant benefits to the medical field and society at large.

Objectives of the Project

To pre-process the human palm Near Infrared (NIR) images. To implement a model for identifying blood group is A, B, AB or O (Positive or Negative) category. To create an interface between a user and model/system. To provide result within the shortest possible time along with storage of result for further use.

II IMPLEMENTATION OF BLOOD GROUP DETECTION USING NIR IMAGES

Proposed Methodology

- A noninvasive (without blood sample collection) approach involves data obtained from image sensors, spectroscopic information, and output of a NIR sensor to determine the Blood Group.
- An Image Processing-based tool as a potential alternative to invasive clinical blood testing is rapidly attracting attention because of the advantages of availability and user-friendliness.

Block Diagram

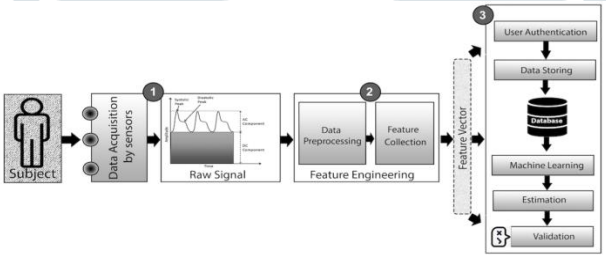


Fig.1 Block Diagram

- **Subject:** To determine blood type using NIR sensors, the person's palm is placed over a sensor that emits light in the near-infrared range. The sensor measures the amount of light absorbed by the haemoglobin molecules in the blood. Since each blood type has a unique haemoglobin composition, the spectral signature of each blood type is distinct. The sensor then analyses the spectral signature of the person's palm to determine their blood type accurately.
- **Data Acquisition by sensors**: The process of data acquisition using NIR sensors for blood group detection involves several steps. First, the person's palm is placed in front of the NIR sensor, which emits near-infrared light. The light penetrates the skin and interacts with the molecules in the blood, causing some of the light to be absorbed and reflected. The sensor captures this reflected light, producing a raw image that contains information about the absorption and reflection of near-infrared light by the blood in the palm.

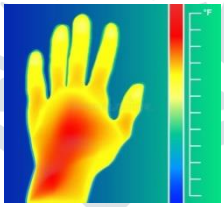


Fig.2 NIR Image

- **Data Pre-Processing:** Data pre-processing involves a series of operations aimed at preparing the raw images for further analysis. This includes image acquisition, formatting, and cleaning. NIR imaging is particularly useful for blood group detection since it allows for non-invasive imaging and can provide high-contrast images of the blood sample. However, the images obtained through NIR imaging can be noisy and may contain artifacts that can interfere with further analysis. Thus, pre-processing of the images is critical to remove any unwanted noise and artifacts. The first step in data pre-processing is image acquisition. In NIR imaging, a camera is used to capture images of the blood sample, which are then stored as digital files.
- **Feature Extraction / Engineering:** Feature extraction or engineering is an essential step in the process of blood group detection using Near Infrared Spectroscopy (NIR) sensors. In this process, the common features of all collected samples with different raw signals are separated and stored in a database with different file locations. This database serves as a reference for future analysis and can be used to classify new samples accurately.
- **User Authentication:** User authentication is a critical step in the process of blood group detection using Near Infrared Spectroscopy (NIR) sensors. This step ensures that only authorized users can access the software and its data. The process of user authentication involves verifying the user's identity based on their login id and password.
- **Database and Data storage:** Data storage and database play an essential role in the blood group detection system. After processing the NIR images and detecting the blood group, the data needs to be stored and managed in a database for further analysis and record-keeping. Data storing is an important process in which the data collected from various

sources is saved in a storage medium. In the blood group detection system using NIR images, the data is collected from the NIR images of blood slides.

- **Blood group estimation:** Blood group estimation is the final step in the process of blood group detection using Near Infrared Spectroscopy (NIR) sensors. In this step, machine learning algorithms are used to compare the processed image from the NIR sensor with the original blood group images, and then the blood group is detected. The first step in blood group estimation is to preprocess the raw image obtained from the NIR sensor. Preprocessing involves adjusting the image's contrast and brightness, removing noise and artifacts, and enhancing the image's overall quality. This ensures that the image is suitable for feature extraction and classification.

Detailed Descriptio of Methods

Check_login (): This method is responsible for checking the user's login credentials before granting access to the system. It ensures that only authorized users can access the system.
.Select_image (): This method enables users to select slide images to be analyzed. Users can choose images from their local storage or other sources.
Split_image (): This method is responsible for splitting the selected blood image into three separate images. This step is necessary for further comparison of the blood image.
Detection (): This method is responsible for finding the matching distance between each split image and the standard image. Based on the matching distance, the method detects the blood group. This step is crucial in determining the blood group accurately.
Prediction ():This method loads the trained image model and uses it to predict the blood group of the selected image. The method tests the selected image against the trained model to predict the blood group with a high degree of accuracy.

III MOTIVATION

There are several compelling reasons for working on a blood group detection project. Firstly, the accurate identification of an individual's blood group is crucial for safe blood transfusions and other medical procedures, which can be lifesaving for patients with certain medical conditions. Secondly, traditional laboratory-based methods of blood grouping can be time-consuming, costly, and require specialized skills and equipment. In contrast, image processing technology offers a more convenient and efficient way of performing blood tests. Furthermore, the use of image processing technology in medical applications has gained significant traction due to its potential to improve healthcare outcomes and enhance patient safety. Therefore, developing a blood group detection system using image processing technology can bring significant benefits to the medical field and society at large.

IV RESULTS AND DISCUSSIONS

After running the program file in python, a web address is displayed on the screen. Copy the address and paste it in any browser. A webpage will be displayed as shown in the below figure. Enter the Username and the password. Click on login.

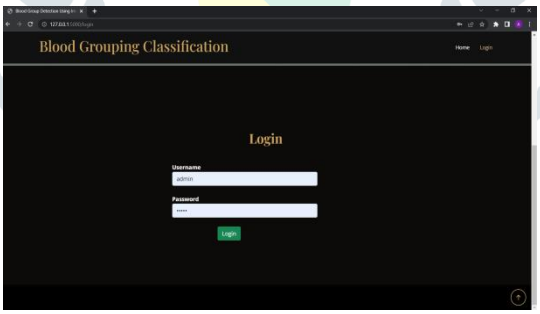


Fig.3 Login Page

Fig.4 Page after logging in with correct details

Click on Choose Blood and select the NIR Image of the test sample, then the data is sent for further processing of the image sample for which backend machine learning algorithm is used which predicts the blood group of person or patient and result i.e., Blood group is displayed on the webpage as shown in the below figures for various blood groups.

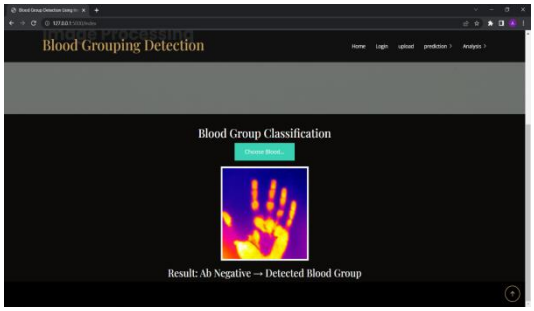


Fig.5 AB–ve blood group

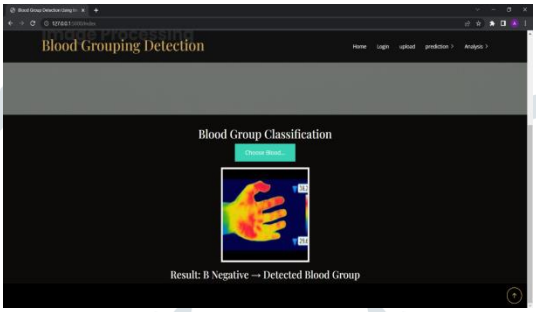


Fig.6 B–ve blood group

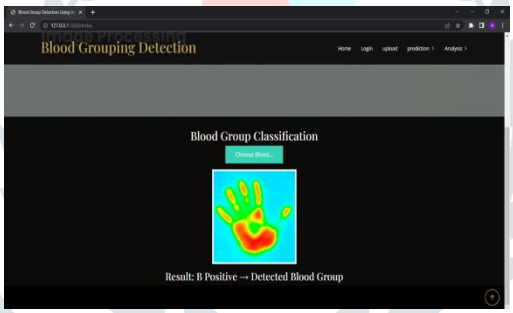


Fig.7 B+ve blood group

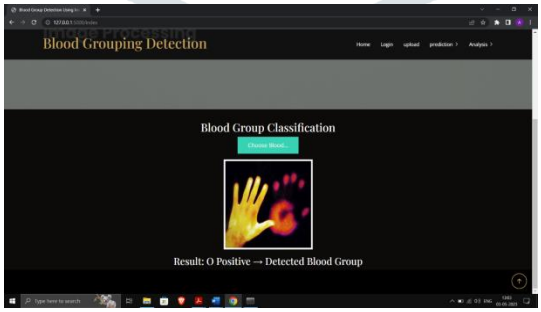
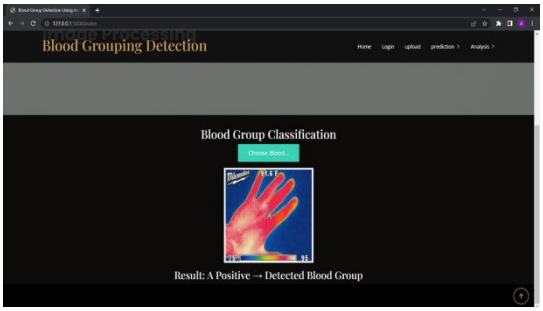


Fig.8 O+ve blood group



` Fig.9 A+ve blood group

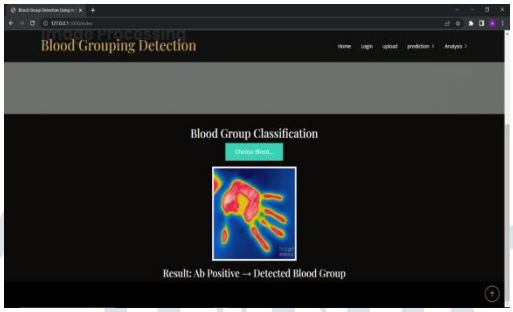


Fig.10 Ab+ve blood group

V CONCLUSION

This project is based on image processing which is based on a neural network concept which is been implemented by using Tensor Flow and keras. Different layers like sequential, dense, dropout are used in model. This algorithm produces a probability for image classification. The logic of image matching techniques such as SIFT and ORB are been implemented the entire selected image to recognize a blood group. This recognition of blood group is important for donation purpose and for further classification of detail study blood group. The use of non-invasive and cost-effective image processing techniques can improve the accuracy and speed of blood group detection, which is critical for many medical procedures. The accuracy of blood group detection using image processing techniques can vary depending on the complexity of the sample and the image processing algorithm used. Several studies have shown promising results in using image processing for blood group detection. However, it's essential to validate the results of any image processing algorithm against traditional laboratory tests to ensure their accuracy and reliability.

VI TRAINING AND TESTING ANALYSIS

Table.1 CNN model with different percentages testing and training datasets

Training (Dataset)	Testing (Dataset)	Accuracy (%) Approx.
60	40	72
70	30	75
80	20	78

VII FUTURE SCOPE

Blood group detection using image processing has promising future scope for various applications in the field of medical diagnosis and treatment. For future work, it is intended to develop a low-cost, portable device for automatic determination of blood group. Using portable device any person can directly take photo of blood slide and detect blood group. It can also be further extended to android application. In android application you can take picture of blood slide directly on their mobile devices to identify their blood type.Overall, blood group detection using image processing has potential future scope in improving medical diagnosis and treatment, which can benefit patients and healthcare providers. Further research is required to develop robust image processing algorithms that can provide accurate and reliable blood group detection results.

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