Determination of Blood group using Image processing

Ankita Dalvi, Hanu Kumar Pulipaka
Xavier Institute of Engineering

Abstract— Blood group determination is done before a blood transfusion in emergency situations or while checking blood group of a person for donation. It is a fast and easy way to ensure that you receive the right kind of blood during surgery or after an injury. If you are given incompatible blood, 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. Also, experts are needed. Due to these reasons, automation of evaluation process is of high importance.Based on the processing of digital images acquired during the slide test, a software is developed in image processing to determine the blood group during emergency situations without any error. The images obtained are then processed, occurrence of blood clumping is checked and accordingly the blood group is determined. Thus, using image processing techniques, this developed automated method will be useful in determining the blood group.

Index Terms— ABO system, agglutination, Blood samples, morphological techniques, Quantification.

1 Introduction

Blood types were discovered by Austrian Karl Landsteiner in 1901. ABO blood group system and the Rh D blood group system are the most important blood group system used for determining blood group of a person and the test used for determining the blood group is blood typing. The blood groups are defined by the presence or absence of a specific antigen on the surface of a red blood cell. There are four ABO blood groups: A, B, AB and O. They refer to the presence of different antigens on the red blood cells and antibodies in the blood. Blood group O means you have neither antigen present on the surface of RBC and antibodies A and B in the blood, but blood group AB means you have both the A and B antigens present and no antibodies in the blood. Blood group A has antigen A present on the surface and antibody B in the blood, while blood group B has antigen B present on the surface and antibody A in the blood. Referring to Rh D blood group system, one more antigen called Rh D is involved while determining the blood group. If D antigen is present on the red blood cells of a person then he/she is Rh D positive, while one who does not have D antigen on the red blood cells is Rh negative.

While having a blood transfusion, blood grouping is very important. If there is any incompatibility while transfusing blood, it can be fatal causing intravenous clumping in the patient's blood. Antigens on the red blood cells in the blood of the person receiving blood can be attacked by the antibodies produced in the blood due to incompatibility. Naturally occurring anti-bodies are not present in the blood of a person having blood group O, hence person with blood group O can safely donate blood to a person with any other blood group[. Similarly, a person with blood group AB can receive blood from a person having any other blood group safely due to absence of antibodies in the blood. A person with positive blood group can be given either Rh D positive or Rh D negative blood, but a person with negative blood group can only receive blood from a person with Rh D negative blood. Hence, a person with O -ve blood group is an universal donor whereas one with AB +ve blood group is a universal receiver.

There is a scope for determining blood group and the software developed is by using image processing techniques. Three samples of blood are taken on a slide, each mixed with reagent anti-A, anti-B and anti-D respectively. After sometime, agglutination occurs and the result is interpreted according to the occurrence of agglutination. The agglutination reaction is the occurred reaction between the antibody and the antigen, indicating the presence of a particular antigen. The condition of the occurrence of agglutination determines the blood group of the patient.

Thus, the software developed based on image processing techniques allows detection of agglutination on the slide through an image captured after mixing specific reagents and consequently the blood group of the patient is determined.

2 Proposed System

Firstly, three samples of blood are mixed with three different reagents namely anti-A, anti-B and anti-D are taken on a slide. After sometime, agglutination may or may not occur. After the occurence of agglutination, the slide containing three samples of blood mixed with three different reagents is captured as an image and allowed to process in MATLAB image processing toolbox. This system reduces the chances of false detection of a blood group. Image processing techniques used for blood group detection are :

1. Pre-processing techniques
2. Thresholding
3. Morphological operations
4. HSL plane
5. Quantification

Figure 1 clearly explains the block diagram of the system.

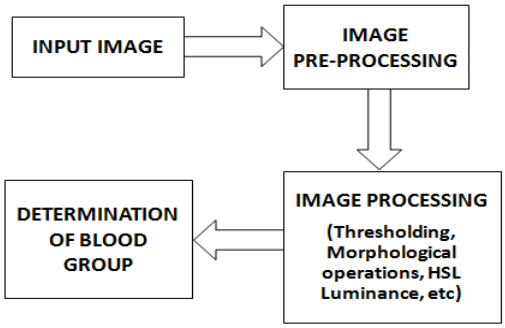

Fig.2.Block Diagram of the system

3 METHODOLOGY

Figure 1 clearly depicts the flowchart of the system.

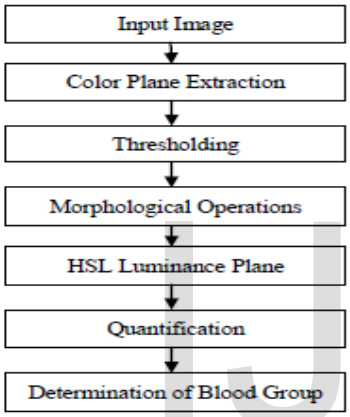

Fig.2.Flowchart of the system

3.1 Data collection

Three samples of blood are taken on a slide, each mixed with reagent anti-A, anti-B, anti-D respectively and images of slide are taken. These images are digital images stored in JPEG format and they are pre-processed using colour plane extraction.

The original slide test image used as input is as shown in figure 3.

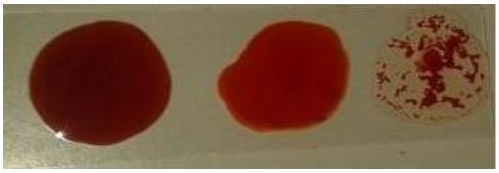

Fig.3.Input image

3.2 Colour plane extraction

The colour plane contains colour information in images. 'Comparing' sections in an image is the concept used in image processing. Comparison in Gray scale involves simple scalar algebraic operators. In colour plane extraction, we first convert the RGB image in to a gray image and then filter the obtained result using median filtering.

Figure 4 shows the result of pre-processed image obtained in colour plane extraction.

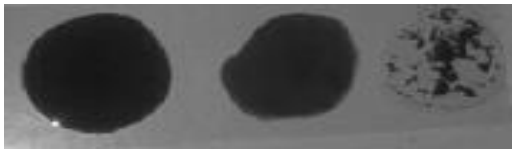

Fig.4.Pre-processed image

3.3 Thresholding

Thresholding operation in image processing is used to create binary images. The gray scale samples are clustered into two parts as background and object.

In this case, multilevel thresholding is performed using Otsu's method. More than one threshold are determined for a given image and segmentation is done creating certain regions. One background with many objects is the result of this multilevel thresholding. It is a clustering-based image thresholding.

Figure 5 shows the result of multilevel thresholding using Otsu's method.

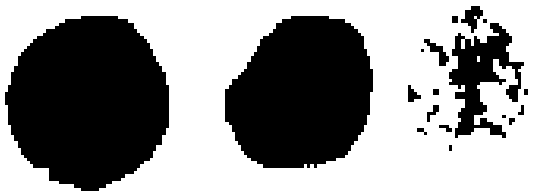

Fig.5.Thresholded image

3.4 Morphological operations

Morphology is a tool of extracting image components that are useful in the representation. In morphological operation, there are two fundamental operations such as dilation and erosion, in terms of the union of an image with translated shape called a structuring element. Here, closing operation is performed where dilation is followed by erosion. Also, edge detection using Canny edge detection technique is performed. Morphological operations are used to eliminate noise spikes and ragged edges.

Figure 6 shows the result of closing operation (segmented image).

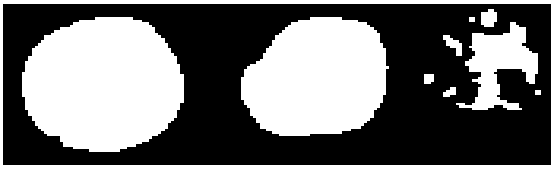

Fig.6.Segmented image

Figure 7 shows the result of edge detection.

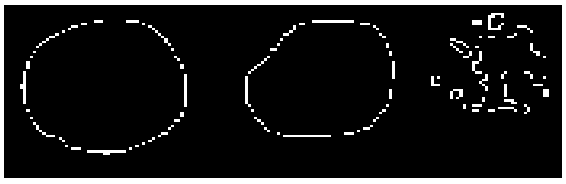

Fig.7.Edge detection

3.5 HSL plane

HSL plane stands for Hue, Saturation and Luminance. It is the

representation of RGB colour model. Hue is expressed in a degree around a colour wheel, while saturation and brightness are set as a percentage. Figure 8 shows the result of HSL plane.

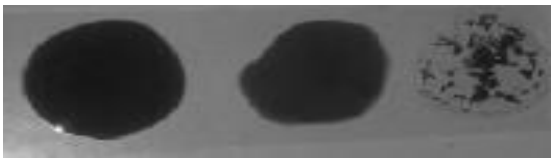

Fig.8.HSL plane

3.6 Quantification

Quantification is expressed as a number or measure of quantity. It measures intensity only in the region of interested area. Area (percentage of surface examined for full image), mean (average value of the pixel), standard deviation, minimum and maximum values of pixel intensity are determined. Also, region properties are extracted. Using the value of standard deviation, occurrence of agglutination is identified and accordingly the blood group is determined.

6 Results

Figure 9 shows the result of A+ve blood group.

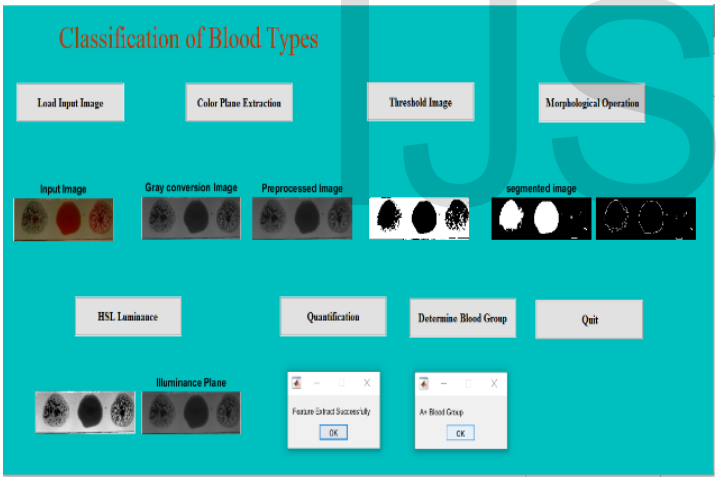

Fig.9.Result of A+ve

Figure 10 shows the result of B+ve blood group.

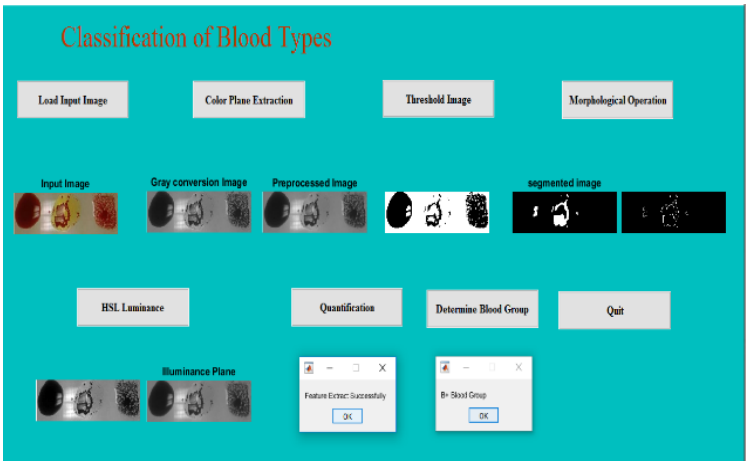

Fig.9.Result of B+ve

Figure 11 shows the result of AB+ve blood group

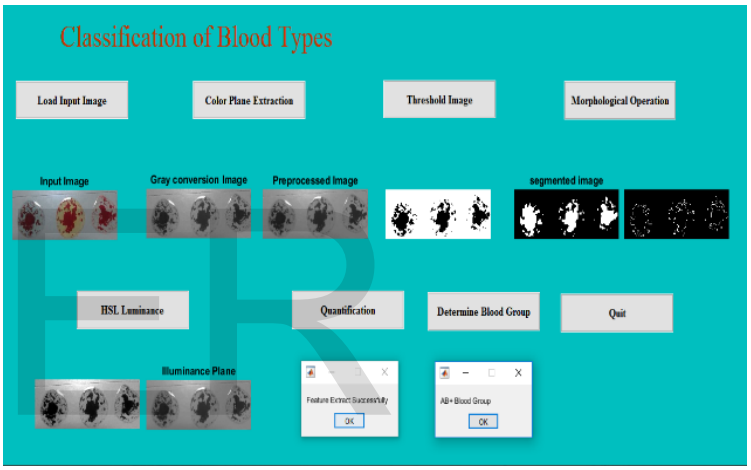

Fig.11.Result of AB+ve

Figure 12 shows the result of O+ve blood group

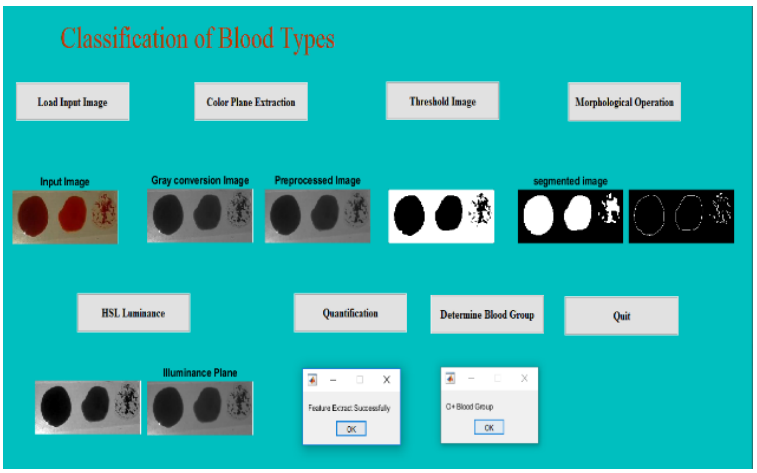

Fig.12.Result of O+ve

Figure 13 shows the result of O-ve blood group

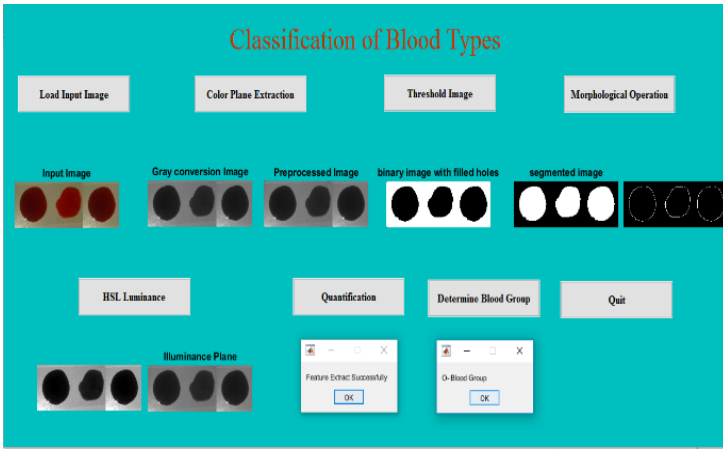

Fig.13.Result of O-ve

6 Conclusion

The system is developed in a robust manner so that it is unaffected by the exceptional conditions. The software developed in image processing is efficient and it effectively detects the occurrence of agglutination and consequently the blood group of the patient in a short interval of time. The system would achieve high percentage of sensitivity and specificity which will be useful in determining the blood group in emergency situations.

References

[1] Ravindran G., Pandiyan P., Pravin M. ,"Determination and Classification of Blood Types using Image Processing Techniques ", *International Journal of Computer Applications (0975 – 8887),* Volume 157 – No 1, January 2017.

[2] Yamin A., Akbar U., Imran F. ," Image processing based detection & classification of blood group using color images", *IEEE Xplore*, May 2017.

[3] Neha Srivathsa; Dhananjaya Dendukuri, "Automated ABO Rh-D blood type detection using smartphone imaging for point-of-care medical diagnostics" *IEEE Conference Publications*, Year: 2016, Pages: 4345 – 4348.

[4] Miss. Madhuri G. Bhamare "Automatic Blood Cell Analysis By Using Digital Image Processing: A Preliminary Study, "Vol. 2 Issue 9.

[5] B. A. Myhre, D. McRuer."Human error - a significant cause of transfusion mortality," Transfusion, vol. 40, Jul.2000, pp. 879-885.