Blood Group Detection using Image Processing

Swati Halvegar[1] Sayali Kambli[2] Shekhar Naik[3] Saili Shetgaonkar[4]
[1,2,3,4]BE Student
[1,2,3,4]Department of Computer Engineering
[1,2,3,4]Agnel Institute of Technology and Design, Goa, India

Abstract— Blood Group Detection is performed manually by laboratory technicians. It can lead to human errors. Image processing techniques can also be used to detect blood groups. The images of the slide test are taken from the clinical/pathological laboratory. Then Image Processing concepts like Image Pre-processing, Thresholding, Morphological operations, Segmentation, Image Recognition are performed to obtain final result i.e. type of blood group which can be A+, B+, AB+, O+, A-, B-, AB-, O-. This process will give accurate results and save time.

Key words: Blood Group Detection, Image Processing

I. INTRODUCTION

A blood group is a classification of blood based on the presence and absence of antigens and inherited antigenic substances in red blood cells. Determining blood types is very important for blood transfusion. Image processing is a way to convert an image into digital form and perform some operations on it. Image processing techniques are used to get an enhanced image or to extract some useful information from it. Therefore, Image Processing methods are very useful in medical fields.

II. PRESENT WORK

To detect blood group, RBC are mixed with different antibody solutions. If antibodies in solution and antigens in RBC are same, it will clump together, forming agglutination. If the blood does not react to any of the anti-A or anti-B antibodies, it is blood group O. If the blood reacts to both of the anti-A and anti-B antibodies, it is blood group AB. If the blood reacts to anti-D antibodies, blood group is Positive Otherwise Negative. In existing system, blood group is determined by technician.

In this system, solutions such as anti-A, anti-B, anti-D are added to the three samples of blood. After some time depending upon the agglutination occurrence, blood group is determined by the lab technician manually.

Disadvantages of this system are more chances of human errors are possible as only experienced people can tell the blood type by seeing at the agglutination process.

III. PROPOSED SYSTEM

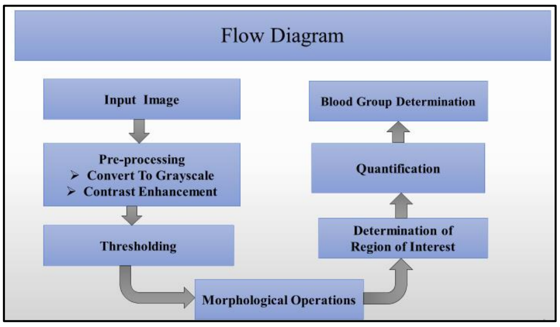

Fig. 1: Flow Diagram

A. Input Image

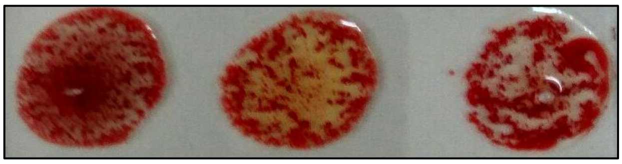

Fig. 2: Original image

B. Image Pre-Processing

1) Grayscale Conversion

A greyscale image is one in which the value of each pixel is a single value representing all three-color components. It is also known as black-and-white or monochrome. It is made of shades of gray, containing black as the weakest intensity and white as the strongest. [8]

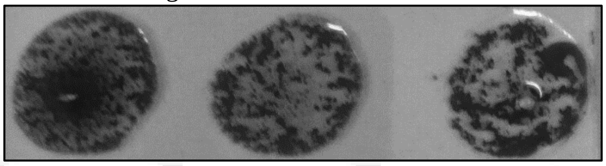

Fig. 3: Grayscale image

Red, Green and Blue components are extracted from pixel and new gray value is assigned to that pixel. New gray value is calculated using this formula:

$$Gray=(Red + Green + Blue) / 3 \quad (1)$$

C. Contrast Enhancement

Contrast is difference between higher and lower intensity present in gray scale image. Contrast stretching is process to distribute intensities between some ranges. This process is useful for low contrast images. First, we Compute histogram i.e. for each pixel value find count of that value in image.

Also compute cumulative distribution values for each function.

Then compute

$$h(v) = round((cdf(v)-cdf_{min})/(M*N) * (L-1)) \quad (2)$$

Where cdf_{min} is the minimum non-zero value of the cdf.
M is width and N the height of image.
L is the maximum grey level value that need to be used.

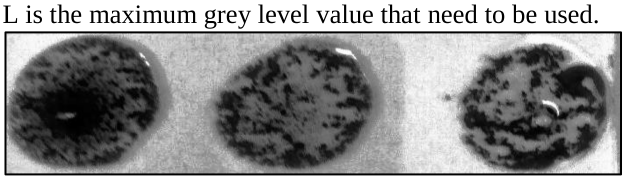

Fig. 4: Contrast Enhancement

D. Thresholding

Thresholding process is used to create a binary image. It uses some constant threshold value T. Each pixel in an image is replaced with a black pixel if its intensity is less than T and with white pixel otherwise. Otsu's method is used here for thresholding. [7]

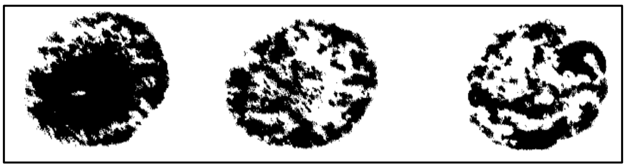

Fig. 5: Thresholding Result

E. Morphological Operations

Morphological processing contains different operations with structuring elements and images. In morphological operation the first operand, be the image and second operand are structuring element, which is usually smaller than image.

It deals with shape of the object. 2 basic operations are Dilation and Erosion.

1) Dilation

Dilation is the process of growing the objects in an image.

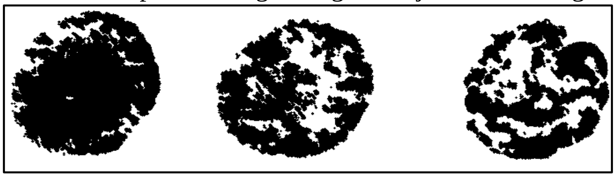

Fig. 5: Dilation Result

2) Erosion

Erosion is the process that shrink or thinners the objects in an image. It is used for removing background noise.

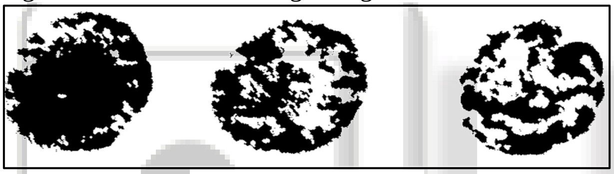

Fig. 6: Erosion Result

F. Region of Interest

It the process of extracting the desired part from the image which will be the region of interest and it will be the sample input for the next processing techniques.

We have proposed following algorithm to extract the region of interest:

1) Divide the slide image into 3 equal parts
2) Take the first part of the image and calculate the width and height of it
3) Initialize
   Top = (1/4) * height
   Right = (3/4) * width
   Bottom = (3/4) * height
   Left = (1/4) * width
4) For calculating the Top, Initialize
   Low=0
   High=height/2
   Center=0
5) While High-Low not equal to 1 do
a) Calculate Center = (High + Low) / 2
b) Iterate from Left to Right Scanning each pixel
   if Black pixel is found while Scanning then
   High = Center
   else
   Low = Center
6) Initialize Top value as Low [Actual Value]
7) For calculating the Right, Initialize
   Low = width/2
   High = width
   Center = 0
8) While High-Low not equal to 1 do
a) Calculate Center = (High + Low) / 2
b) Iterate from Top to Bottom Scanning each pixel
if Black pixel is found while Scanning then
   Low = Center
else
   High = Center
9) Initialize Right value as High [Actual Value]
10) For calculating the Bottom, Initialize
   Low = height/2
   High = height
   Center = 0
11) While High-Low not equal to 1 do
   a) Calculate Center = (High + Low)/2
   b) Iterate from Left to Right Scanning each pixel
   if Black pixel is found while Scanning then
   Low = Center
   else
   High = Center
12) Initialize Bottom value as High [Actual Value]
13) For calculating the Left, Initialize
   Low=0
   High=width/2
   Center=0
14) While High-Low not equal to 1 do
   a) Calculate Center = (High + Low) / 2
   b) Iterate from Top to Bottom Scanning each pixel
   if Black pixel is found while Scanning then
   High = Center
   else
   Low = Center
15) Initialize Left value as Low [Actual Value]
16) Now Use Top, Right, Bottom, left to extract the Region

Fig. 7: Part 1 Part 2 Part 3

G. Quantification

Standard deviation is a measurement of spreading of data values. A low standard deviation means that the data points are to be close to each other in the set, while a high standard deviation means that the data points are spread out in the set.

The standard deviation of a random variables, statistical population, data set, or probability distribution is the square root of its variance. Here input for quantification is binary image i.e. only 2 values of pixel are possible (0 and 255). So standard deviation can be calculated in slightly different manner. We need to calculate standard deviations of pixels whose value is 0 (black). It can be done by taking positions of black pixels in one row of image and calculating standard deviation of those values. [6]

$$\text{Standard deviation} = \sqrt{(1/N\sum_{i=1}^{N}(xi-\mu)^2)} \quad (3)$$

xi=position of black pixels in single row.
μ=mean of positions of black pixels in single row.
N=Total number of pixel values in single row.

Standard deviation is calculated of each row.
Based on standard deviation blood group is determined.

Index	1	2	3	4	5	6	7	8
Pixel values	0	0	255	0	255	255	0	255

Standard deviation of indexes having value 0 (black) is calculated.
In given example, standard deviation of {1,2,4,7} is calculated.
Based on some threshold value blood group will be determined. That threshold value will be standard deviation of {1,2,3,4,5,6,7,8}

H. Blood Group Detection

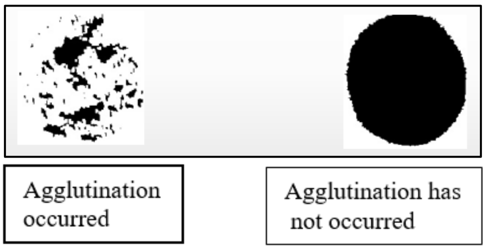

Fig. 8:

IV. Results

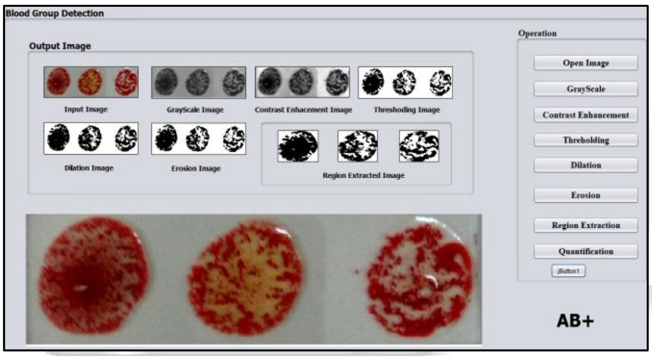

Fig. 9: Result of AB+ Blood Group

V. Conclusion

The method developed is effective and efficient method to detect the agglutination and determines the blood type of the patient accurately. The use of image processing techniques enables automatic detection of agglutination and determines the blood type of the patient in a short interval of time also helpful in emergency situations.

References

[1] G. Ravindran, T.Joby Titus, M. Pravin, P. Pandiyan, "Determination and Classification of Blood Types using Image Processing Technique," International Journal of Computer Application (0975-8887), Volume 157- No 1, January 2017, P.No 12-16.
[2] Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing," third edition.
[3] https://sisu.ut.ee/imageprocessing/book/5
[4] Ana Ferraz, Filomena Soares R and D Centre Algoritmi University of Minho Guimaraes, Portugal Ana.Ferraz@algoritmi.uminho.pt and Filomena.Soares@algoritmi.uminho.pt "A Prototype for Blood Typing Based on Image Processing, SENSORDEVICES 2013: The fourth international conference on Sensor Device Technologies and Applications."
[5] Akshaya P.Sahastrabuddhe, Dr.Sayyad D.Ajij, "Blood Group Detection and RBC, WBC counting: An Image Processing Approach, International Journal of Engineering and Computer Science ISSN: 2319-7242, Volume 5 Issue 10 Oct. 2016, Page No.18635-18639.
[6] https://www.khanacademy.org/math/probability/data-distributions-a1/summarizing-spread-distributions/a/calculating-standard-deviation-step-by-step
[7] https://en.wikipedia.org/wiki/Otsu%27s_method
[8] https://en.wikipedia.org/wiki/Grayscale
[9] https://www.cs.auckland.ac.nz/courses/compsci773s1c/lectures/ImageProcessing-html/topic4.htm