iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35896

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Blood Group Detection using Matlab

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Abstract: ***Blood group testing is one of the vital tasks in the area of medicine, in which it is very important during emergency situation before victim requires blood transfusion. Presently, the blood tests are conducted manually by laboratory staff members, which is time consuming process in the emergency situations. Blood group identification within shortest possible time without any human error is an important factor and very much essential. Image processing paves a way in determining blood type without human intervention. Images which are captured using high resolution microscopic camera during the blood slide test in the laboratory which are used for blood type evaluation. The image processing techniques which include thresholding and morphological operations are used. The blood image is separated into sample wise and blood type is decided based on the agglutination effects in those sample images. This project facilitates the identification of blood group even by common people who are unaware of the blood typing procedure.***

Keywords: Blood group, Monoclinic antigen solutions, Agglutination, Image processing, Thresholding, Morphological operations

I. INTRODUCTION

During accidents or attacks, if any victim requires blood transfusion, the blood testing procedure is essential to conduct. In emergency cases, the patient needs the blood immediately in order to save his/her life. The testing procedure is mostly done in laboratories which takes more time in critical situations. Sometimes O negative blood is administered which is also known as universal donor and it has lesser chance of risk. The remedy is to know the blood group of the patient in advance. The tests which are conducted by laboratory technicians take lot of time to find blood type. The tests which are performed by common people without awareness can arise errors. These human errors can lead towards death possibilities, this needs to be avoided.

There is a possibility in identification of blood groups through image processing mechanism. Image features, such as colour, texture, shapes are analysed. The blood slide consists of antigens mixed with blood samples and agglutination effects are observed. Agglutination is the process of reaction of antigen serum with the blood sample. The effect of agglutination determines the blood response with antigen solution thus the blood type can be determined. If the clumping of blood cells is observed when antigen is mixed with blood, then the blood is agglutinated, otherwise the blood is not agglutinated. The agglutination effect on the blood samples provide access to identify blood type. Image processing techniques are utilized on blood slide images to evaluate blood type.[5] and [6].

II. LITERATURE SURVEY

Ana Ferraz proposed a system which centrifugation of blood is conducted. Here six slides are considered. Respective reagent drop is added to image of the sample which is taken and uploaded into the system for future process. Using image processing techniques, the presence of agglutination is determined using centrifugation classification algorithm and used for analysing the blood group from the taken blood samples [1].

Tejaswini H V proposed that antigens are introduced with the blood samples. Later agglutination formation takes place or not. Slide image is captured and MATLAB processing is done using image processing tools. This proposed work includes techniques such as gray conversion, colour plane extraction and quantification [2].

Mehedi Talukder, Mohammed Rabiul Islam and others in 2015, on “Improvement of accuracy of human blood groups.” The group proposed that blood group can be identified by image processing using plate method. This method gives the accurate result [3].

Professor R. A Rathod performed digital image of blood sample is collected from the laboratories in hospitals, three samples of blood which is mixed with antigens are captured and pre-processing steps are carried. A software is developed where the result is interpreted based on the agglutination occurrence or non- occurrence and blood group is determined. The images are processed using techniques such a color plane extraction, thresholding, morphological operation, feature extraction, classification and determination of blood group [4].

Vue-fang Dong paper has mainly focused on the development of small and fact blood analyser. Blood sample which is to be identified is placed on the disk, this disk has four quadrants. Centrifugation and several oscillations are carried for the proper mixture and uniform distribution of reagent and blood samples without any bubbles, and then for certain period of time reaction of blood sample with reagents is observed. Based on the reaction, the blood group is determined [5].

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III. PROPOSED METHODOLOGY

Blood testing is the process of analysing the blood samples with the monoclinic antigen solutions to evaluate the blood type. First of all, a clean glass slide is taken and three monoclinic antigen solutions of type Anti-A, Anti-B and Anti-D are added drop-by-drop respectively on glass slide. Next a drop of blood is added in each antigen solution droplets and mixed with three different cotton swabs. Note that the swab which is used to mix one blood drop sample is not used for the neighbouring blood drop sample. Different swabs are used to mix the blood droplets so that one swab used for mixing one anti solution should not interfere with other anti-solution. The blood droplets are mixed with respective antigen solutions for about four to five minutes. While mixing we can observe the agglutination effects (also known as clumping of blood cells) in some areas [5] and [8].

Figure 1. Blood testing on glass slide

Figure 1 shows the blood testing procedure on the clean glass slide with monoclinic antigen solutions of type 'Anti-A', 'Anti-B' and 'Anti-D'. Further the blood slide images are captured using microscopic camera in the blood testing laboratory. The blood slide images are used to evaluate the blood type using image processing techniques which are shown in flowchart. The flowchart of blood group detection is shown below [6] and [7].

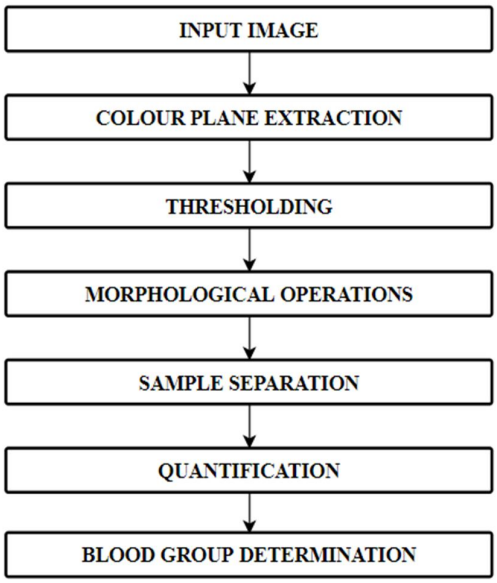

Figure 2. Flowchart of blood group detection

Figure 2 shows the flowchart of blood group detection. The steps involved in blood group detection are given below.

- First the resized blood slide image is given as input.
- The blood slide image undergoes colour plane extraction. Here green colour plane is extracted from the image.
- The green colour plane extracted image of blood image undergoes thresholding with the threshold value T = 100. After thresholding operation, the sample pixels are black in colour. Since we want to work on the sample pixels, the samples are foregrounded i.e., samples are converted into white by reverse thresholding operation.

- After highlighting the foreground samples, we can observe there are small holes in the samples. The holes in the samples are to be filled by white pixels in this operation.
- The filled holes with white pixels undergo morphological operation. Morphological operations process digital images depending on their shapes. Here Opening operation is performed with the 'disk' structuring element of radius 5. The randomly spread white pixels are gathered in disk shape by performing this operation.
- Sample separation is the process of dividing the images which contains samples in it. Here morphological image is separated into three sub-images which consists of sample 'A' (blood mixed with 'Anti-A' solution part), sample 'B' (blood mixed with 'Anti-B' solution part) and sample 'Rh' (blood mixed with 'Anti-D' solution part).
- The separated sample images undergo quantification process. Quantification is the method of measuring pixel intensity for the sample images. Standard deviation of sample images 'A', 'B' and 'Rh' are measured. The agglutinated samples have standard deviation values in the range (0.1, 0.4) whereas the non-agglutinated samples have standard deviation values in the range (0.46, 0.5). So, the threshold standard deviation value of sample sd=0.45 is chosen. If value of sample has standard deviation greater than 'sd' it is considered as not-agglutinated, whereas if value of sample has standard deviation lesser than 'sd' it is considered as agglutinated.

IV. RESULTS & DISCUSSION

This work has been implemented in MATLAB R2013a. The following results depict the blood group detection for various blood slide images. The blood slide image undergoes colour plane extraction, thresholding, morphological operations to evaluate the blood type. Agglutination action can determine the blood grouping for the given blood sample. If the clumping action of blood cells is observed in the blood sample when antigen solution is mixed with blood, the blood is said to occur agglutination. Similarly, if there is no clumping action observed when the antigen solution is added with blood, the blood is non-agglutinated.

Figure 3. Evaluation of blood group result for blood test image 1

Figure 3 shows the blood group evaluation for blood test image 1. In the sample 'A', the blood is agglutinated. In the sample 'B', the blood is agglutinated. In the sample 'Rh', the blood is agglutinated. The blood type is displayed in the message box labelled as 'Blood Group is AB+' to the end user.

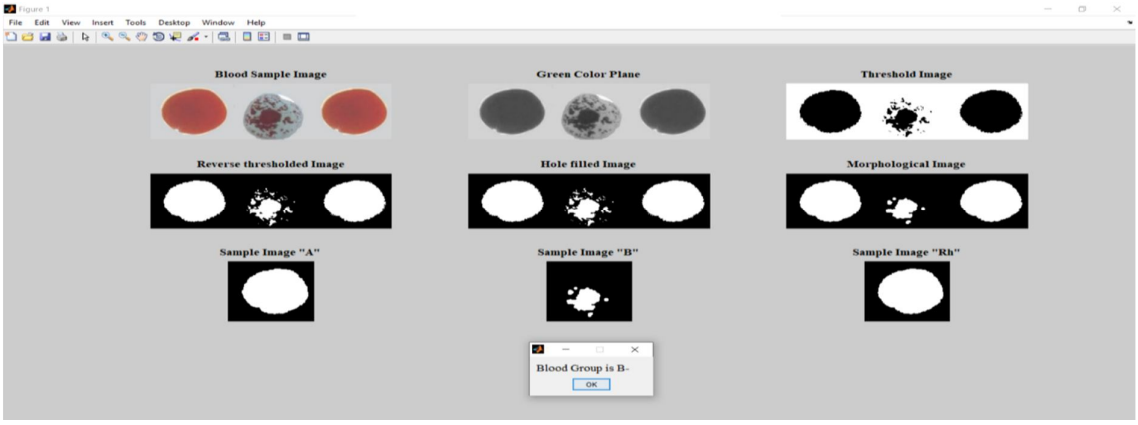

Figure 4. Evaluation of blood group result for blood test image 2

Figure 4 shows the blood group evaluation for blood test image 2. In the sample 'A', the blood is not-agglutinated. In the sample 'B', the blood is agglutinated. In the sample 'Rh', the blood is not-agglutinated. The blood type is displayed in the message box labelled as 'Blood Group is B-' to the end user.

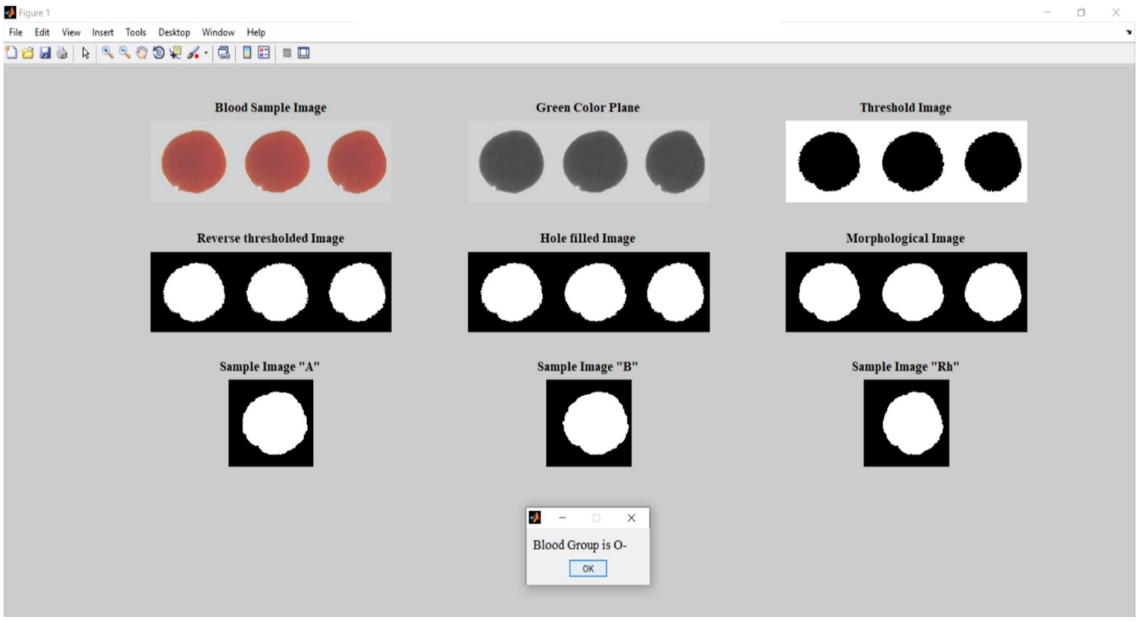

Figure 5. Evaluation of blood group result for blood test image 3

Figure 5 shows the blood group evaluation for blood test image 3. In the sample 'A', the blood is not-agglutinated. In the sample 'B', the blood is not-agglutinated. In the sample 'Rh', the blood is not-agglutinated. The blood type is displayed in the message box labelled as 'Blood Group is O-' to the end user.

The tabular values of standard deviation of samples with the agglutination effects is shown below.

Blood Test Image	Standard Deviation & Agglutination result (A - Agglutinated, NA – Not Agglutinated)			Blood type Result
	Sample 'A'	Sample 'B'	Sample 'Rh'	
Blood Test 1	0.3054 (A)	0.3391 (A)	0.3165 (A)	AB+
Blood Test 2	0.4960 (NA)	0.1485 (A)	0.3222 (A)	B+
Blood Test 3	0.3545 (A)	0.4921 (NA)	0.4917 (NA)	A-
Blood Test 4	0.4881 (NA)	0.4898 (NA)	0.2937 (A)	O+
Blood Test 5	0.2823 (A)	0.4938 (NA)	0.3456 (A)	A+
Blood Test 6	0.3061 (A)	0.3375 (A)	0.4877 (NA)	AB-
Blood Test 7	0.4963 (NA)	0.3039 (A)	0.4961 (NA)	B-
Blood Test 8	0.4935 (NA)	0.4931 (NA)	0.4865 (NA)	O-

Table 1. Standard deviation values of blood test images based on agglutination effects

Table 1 shows the standard deviation values for separated samples of blood test images based on the agglutination effects.

V. CONCLUSION

The developed methodology which is used in blood group detection paves a way for the future to identify their own respective blood types and if any person is willing to donate his/her blood to other person who met with an accident in emergency situation, the donating person can check his blood group status using image processing techniques efficiently and faster in shortest time possible. The traditional laboratory consultation for blood group detection need not be necessary which is time-consuming process. Through this project, even common person can identify his/her blood type without the additional support from outside lab technicians.

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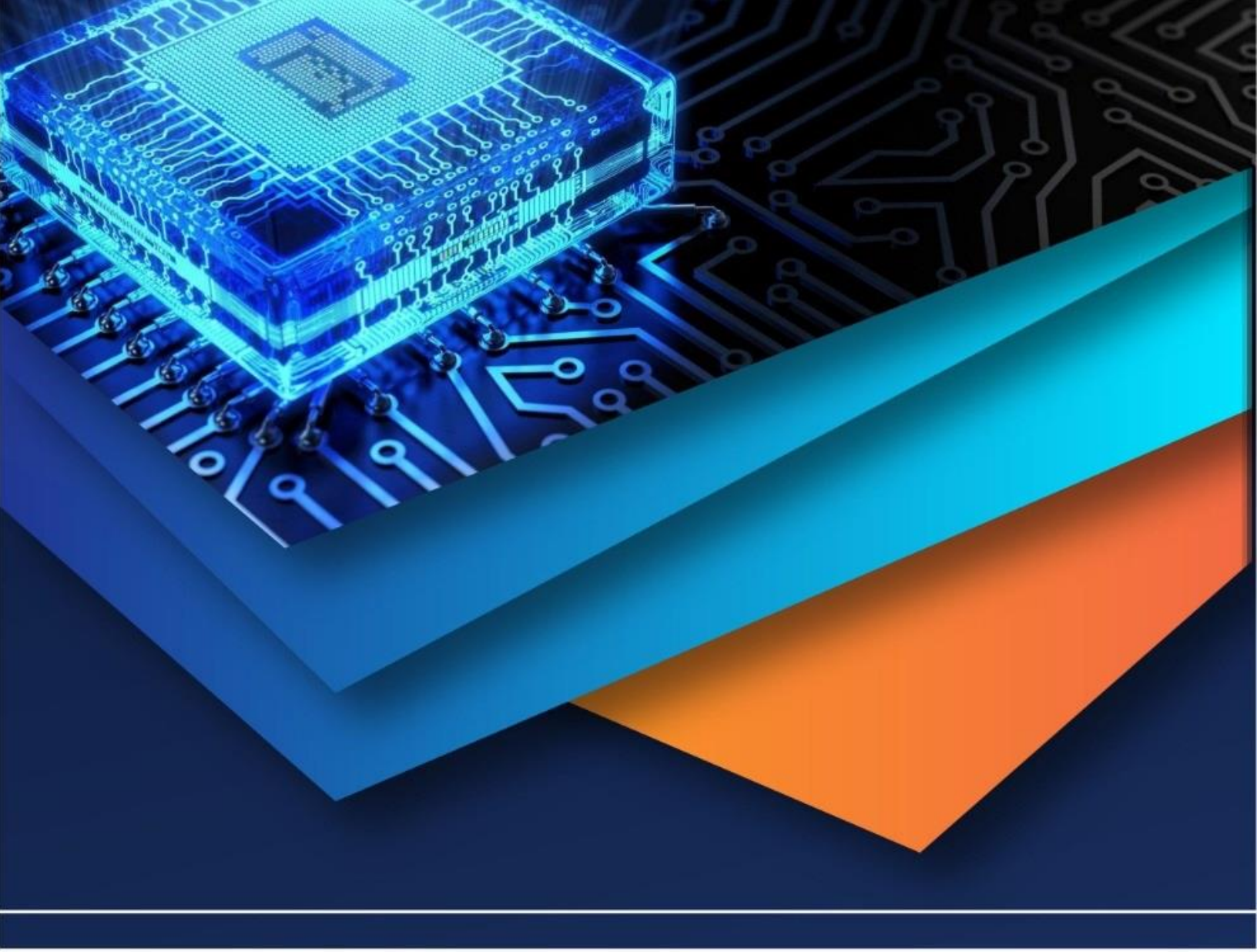

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