Application of Image Processing for Blood Group Detection

Mr. Sudhir G. Panpatte **Mr. Akash S. Pande** **Miss. Rakshanda K. Kale**

Abstract:**It is very crucial to determine human blood groups in any emergency situation. Blood typing is system which basically used to detect specific blood group of human. It is mandatory that everyone should know their blood group. Investigation of appropriate blood type within the short interval of time plays vital role in blood transfusion, donation, accident and other emergency situations. Currently, these tests are performed manually by technicians in the laboratory, when the test is handled with larger number of samples, it is monotonous to do and it may lead to human errors. The aim of this system is to providea result within theshortest possible time with precision and accuracy along with storage of result for further use. The system uses image processing algorithm to performed blood test based on ABO and RH blood typing system. Thus,this system is helpful in an emergency situation to determine blood group without human error.**

Keywords:**Antigen, Blood Samples, Feature Extraction, Histogram, LBP (local binary pattern), Nearest Neighbor Search, Image Processing, SVM Classifier.**

I. INTRODUCTION

Blood group identification is the key step to ensure blood transfusionsafety. Blood Detection is most important and essential activity. It is essential before blood transfusion, donation and accidents and other emergency situations. In the case of emergency blood transfusion, rapididentification of the type of blood is essential, directly related to the survival of the patient.In recent years, with the rapid development of image processing technology, the research and development of automatic recognition system based on machine vision technology have become an urgent need in the field of blood group identification. The classification in human blood is due to the presence or absence of certain protein molecules named as antigens and antibodies. The antigen is any foreign substance that causes an immune response either alone or it forms a complex with a large protein molecule. Antibodies are the proteins produced by the immune system to defend against the foreign substances that may cause harm to our body; therefore, they are the guards of our body. Theaim of the system is to develop a methodology to classify different blood group within a fraction of a second with great accuracy. The system helps in reducing human interventions, transfusion reaction risks. The system uses image processing techniques using MATLAB. Images after slide tests are processed and detect the occurrence of agglutination.

For slide test, one drop of the blood sample and one drop of each reagent antigen A, antigen B, antigen D are mixed. The reaction occurred between antigen and antibody indicates the presence of antigen appropriate called agglutination reaction. Presence and absence of agglutination in blood samples determines the blood type of human. Thus, the system is used for automatic and effective diagnosis of blood group with precision, accuracy and fast response time without human error which contributes greatly to emergency needs.

II. TYPES OF BLOOD GROUP

A blood group is determined by the blood based on the presence or absence of inherited antigenic substances on the surface of red blood cells (RBCs). These antigens may be proteins, carbohydrates, glycoproteins, or glycolipids depending on the blood group system. Blood groups are identified by antigens and antibodies in the blood.

There are many types of blood group. But, the major two types of blood groups are:

- ABO blood system
- Rhesus blood system

The ABO blood system is the most important blood group system in human blood transfusion. The ABO blood group system is found and identified as the first human blood group system by Austria Rand Steiner in early nineteenth Century, according to the surface of red blood cells have no the distribution of specific antigen AlB, blood is divided into four types: A, B, AB, and O.

Classification of blood group by the presence or absence of two antigens A and B on the surface of red blood cells:

Group A – has only the A antigen on red cells, the serum has anti-B lectin.

Group B – has only the B antigen on red cells, the serum has anti - A lectin.

Group AB – has both A and B antigens on red cells, have noanti-A and anti-B lectin hormone in serum.

Group O – has neither Antigen A nor Antigen B in their blood a cell, the serum has anti- A and anti B lectin.

The red blood cell which has antigen A can agglutinates with anti A lectin; anti B lectin can agglutinate with B antigen of red blood cells, based on this principle, ABO blood group identification can use red cell agglutination test, and then through the method of system vision to determine blood type by whether the results obtained agglutination.

III. SLIDE TEST

The system is based on slide test for classification blood groupsand the software design using image processingtechniques. The slide test consist of the mixture of one drop ofblood and one drop of each reagent, anti-A, anti-B, and anti-D, being the result interpreted according to the occurrence or not of agglutination. Theagglutination reactionmeans that occurred reaction between the antibody and theantigen, indicating the presence of the antigen appropriate. Thecombination of the occurrence of agglutination or non-occurrence determines the blood type of the patient.Thus, determination of blood types and the software design using image processing techniquesallow, through an image captured after the procedure of theslide test detect the occurrence of agglutination andconsequently the blood type of the individual.

IV. METHOD

The results of slide test are captured by a camera Consisting of a color image composed of the bloodsample and reagent.

This image goes under various transformations as below:

Step 1: Collection of raw microscopic images of blood samples from laboratory and the internet.

Step 2: Convert a color image to gray scale image.

Step 3: Apply Local Binary Pattern (LBP) to the image.

Step 4: carry out histogram comparison

Step 5: Perform feature extraction operation.

Step 6: Classify data using Support Vector Machine (SVM).

Step 7: Display result

Block Diagram of themethods is shown in figure1.

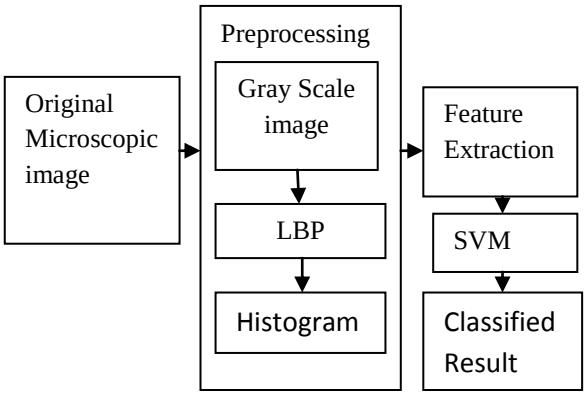

Figure 1: Block diagram of method algorithm.

The flow chart of the system is as shown in figure 2.

Flowchart:

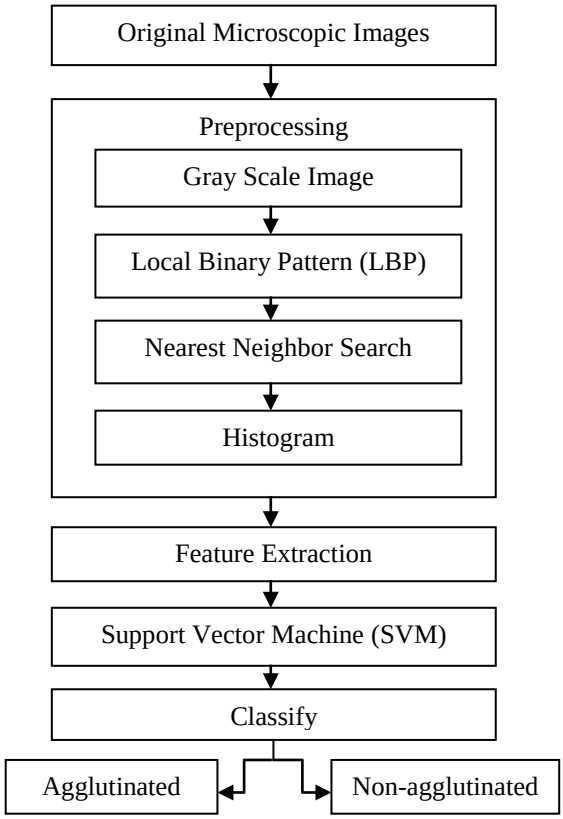

Figure 2: flow chart of the system**.**

A. Data collection: Humanly belongs to 8 different types of blood groups A +ve, A -ve, B + ve, B – ve, AB + ve, AB – ve, O + ve, O - ve. The first step is to collect data samples from laboratory and the internet.

B. Preprocessing: The used of preprocessing is to segment the interesting pattern from the background. The preprocessing is a compact representation of the pattern. In preprocessing noise filtering, smoothing and normalization are done in this step and thereby improve the quality of the images. Preprocessing includes conversion of color image to black and white image. A system uses Local Binary Pattern i.e. one of the visual descriptors. After the histogram comparison most necessary task is feature extraction.

C. Gray scale image: Grayscale or Grayscale digital image is an image in which the value of each pixel is a signal sample, thatis, it carries only intensity information. Sorting of images are also known as black-and –white, are composed exclusively of shades of gray, varying from black at the lowest intensity to white at the largest intensity.

Antigen	A	B	D	Control
O+	0	0	1	0
O-	0	0	0	0
A+	1	0	1	0
A-	1	0	0	0
B+	0	1	1	0
B-	0	1	0	0
AB+	1	1	1	0
AB-	1	1	0	0

D. Local binary pattern (LBP):LBP is the local binary pattern (LBP) operator was developed as to the "amount" of texture in image Local Binary a gray-scale invariant pattern measure adding more information Pattern-Local binary patterns (LBP) is a type of visual descriptor used for classification in computer vision. LBP is the particular case of the Texture Spectrum model proposed in 1990.
LBP wasfirst described in 1994. It is found to be a powerful feature for texture classification.

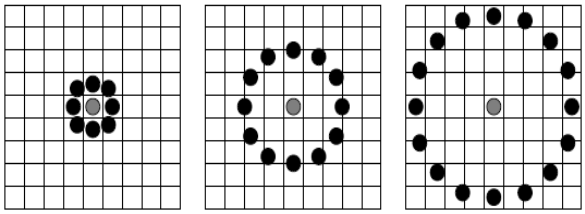

Figure 3: Circularly symmetric neighbor sets of LBP

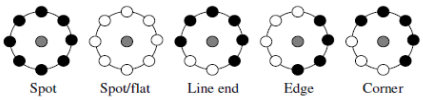

Figure 4: Different texture primitives detected by the LBP

E. Nearest Neighbor Search: Nearest Neighbor
Search is performed on the image to identify the agglutinationof the blood sample. This step is performed to calculate the histogram of the blood sample.

F. Histogram comparison: Then perform a chi-square histogram comparison operation to compare two histograms (H1 and H2), first we have to choose a metric d (H1, H2) to express.

$$d(H_1, H_2) = \sum_I \frac{(H_1(I) - H_2(I))^2}{H_1(I)}$$

This step compares the blood sample with the data set and identifies whether the image is agglutinated or non-agglutinated. If images are agglutinated it represents 1 else it represents 0.

Table 1: The images are then checked against the following table to identify blood group of a patient.

G. Feature Extraction: For image classification purpose, there are different types of features can be extracted such as Mean, Standard deviation, texture histogram, R value, G value, B value, Color features. These are some parameters for feature extraction. Gray level co occurrence matrix (GLCM) is a way to extract second order statistical features. The standard deviation is the parameter that allowsdistinguishing with superior exactness and effectiveness the occurrence or not of agglutination.
We calculate the standard deviation (SD) using MATLABaccording to the following equation:

$$SD = \sqrt{\frac{1}{2}\sum_{i=1}^{N}(x_i - \mu)^2}$$

Where,
N =Total number of values
xi =ith Position value
μ =Mean value

Table 2: Standard Deviation calculated data:

No.	Antigens	Standard deviation
1	Antigen - A	16.80
2	Antigen-B	31.26
3	Antigen - D	51.17

Analyzing the above table,The standard deviationis less than 20, by a large number of experimental datavalidation, we define the image of the standard deviation isless than 20 for non-agglutination.
Standarddeviation is greater than 20 of the images for agglutination. Here Anti-A and Anti-B determine the human blood type (A,B,AB,and O) and Anti-D determines whether the blood group is positive or negative.

H. SUPPORT VECTOR MACHINE (SVM): The support vector machine (SVM) is a popularclassification technique. A classification task usuallyinvolves separating data into training and testing sets. Eachinstance in the training set contains one target value andseveral attributes. The aim of Support vector machine is to develop thesystem (based on

the training data) which predicts the target values of the test data given only the test data attributes.

The system uses Support Vector Machine which is a powerful classifier.SVM model represents examples as a point in space and the examples of different classes are divided by a clear gap. New examples mapped in same space and predict belongs to the category.

Thus, it separates the set of training images into different classes.SVM finds the best separating line. Capable of generalizing well. Even in large data, it has fast learning speed. So, the system can classify appropriate blood group with fast response.

V. System Design

The system made for the determination of person's blood group using blood sample images. In this technique, the individual's blood group can be decided on the basis of variations in the blood images Because of antigen and antibody reaction in the blood, or we can say agglutination reaction occurs.

A. Hardware consists of:

An embedded board

Acamera module

Motorsfor controlling

B. Software:

A GUI interface to interact with the system.

C. The System developed: The developed system, which automatically determines theblood group of a patient.

The system requires that the blood and the reagents are

Manuallyintroduced, in slides, by the user. It is placed on the first slide the reagent anti-A, in second reagent anti-B, in third reagent anti-D and in the fourth slide a sample without adding any antigen is taken we call it as control it is taken as a reference to check if the blood is not mixed with any other thing.

Thereafter, the system moves the slides for the mixing area, the blood and reagents are mixed. This mixture is performed with a DC motor and without contamination between the samples. Ended the mixing, slides are moved to the image capture area, where a motor drives the Webcam Glossy, 5 Mega pixels, along with the sample, capturing an image of each slide. These images are stored for later analysis. The system is controlled by a micro controller.

VI. Result

Figure 5.shows the blood samples of various blood groups taken under the microscope after adding the antigens:

If there is clumping (Agglutinate) in the anti-A drop the blood sample belongs to the A blood group. If the clumping is in the anti-B drop then the blood sample belongs to the B blood group. If there is no clumping in either anti-A or anti-B drop then the blood sample belongs to O blood group. If there is clumping in both anti-A and anti-B drop then the blood sample belongs to AB blood group. If there is no agglutination in the anti-D drop then the blood group is Rh negative, if there is agglutination then it is Rh positive.

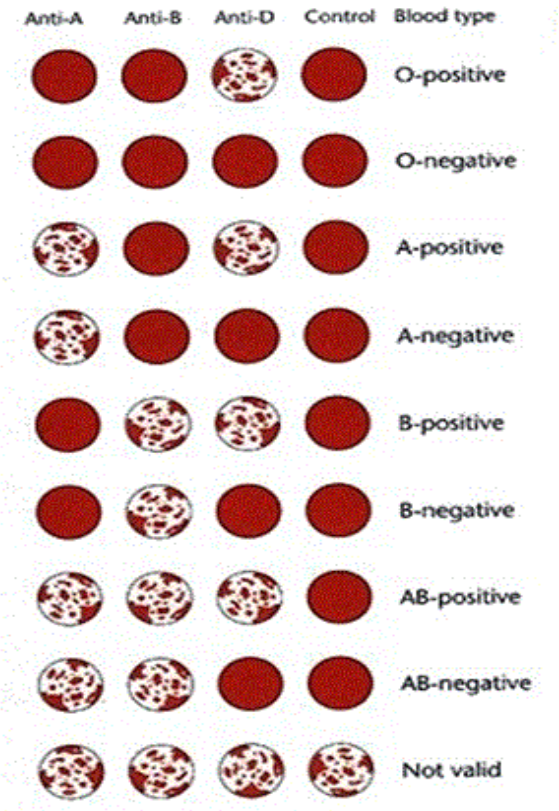

Figure 5: The results of the blood group determination

Conclusion And Future Work

In this paper, detection of blood group method is obtained from the use of image processing techniques enables automatic detection of agglutination and identifies the blood group of the individual in a short interval of time and accurate in the case of emergency transfusion.SVM it is used for classification of blood group and is capable of predicting an unknown sample with good degree of accuracy.

In future the system contribute to undertake safe blood transfusion and to reduce the loss of human lives. Also, it is intended to improve the system by making it smaller so that it can be portable and incorporate GSM technology, to send a message to the mobile of technician of the laboratory in order to avoid unnecessary travel.

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AUTHOR'S PROFILE

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Mr. Rakshanda K. Kale
Bachelor of Engineering in Electronics and Telecommunication
Institute: Jawaharlal Darda Institute of Engineering and Technology, Yavatmal

Mr. Sudhir G. Panpatte
Bachelor of Engineering in Electronics and Telecommunication
Institute: Jawaharlal Darda Institute of Engineering and Technology, Yavatmal

Mr. Akash S. Pande
Bachelor of Engineering in Electronics and Telecommunication
Institute: Jawaharlal Darda Institute of Engineering and Technology, Yavatmal