International Journal of Engineering Technology, Management and Applied Sciences

IJETMAS

www.ijetmas.com January 2017, Volume 5, Issue 1, ISSN 2349-4476

Determination and Classification of Human Blood Types using SIFT Transform and SVM Classifier

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ABSTRACT

Determining of blood types is very important during emergency situation before administering a blood transfusion. Presently, these tests are performed manually by technicians, which can lead to human errors. Determination of the blood types in a short period of time and without human errors is very much essential. A method is developed based on processing of images acquired during the slide test. The image processing techniques such as thresholding and morphological operations are used. The images of the slide test are obtained from the pathological laboratoryareprocessed and the occurrence of agglutination are evaluated. Thus the developed automated method determines the blood type using image processing techniques. These papers discuss the methodology& result discussion of work. The developed method is useful in emergency situation to determine the blood group without human error.

Keywords: *Blood types, Image processing, MATLAB, SIFT, SVM classifie*

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I. INTRODUCTION

1.1 Introduction: Before the blood transfusion it is necessary to perform certain tests. One of these tests is the determination of blood type and this test is essential for the realization of a safe blood transfusion, so as to administer a blood type that is compatible with the type of receiver.There are certain emergency situation which due to the risk of patient life, it is necessary to administer blood immediately. The tests currently available require moving the laboratory, it may not be time enough to determine the blood type and is administered blood type O negative considered universal donor and therefore provides less risk of incompatibility. However, despite the risk of incompatibilities be less sometimes occur transfusion reactions that cause death of the patient and it is essential to avoid them, administering blood based on the principle of universal donor only in emergencies. Thus, the ideal would be to determine the blood type of the patient even in emergency situations and administering compatible blood type from the first unit of blood transfusion. Secondly, the pre-transfusion tests are performed manually by technician's analysts, which sometimes lead to the occurrence of human errors in procedures, reading and interpreting of results. Since these human errors can translate into fatal consequences for the patient, being one of the most significant causes of fatal blood transfusions is extremely important to automate the procedure of these tests, the reading andinterpretation of the results.

Blood group is classification of blood based on the presence or absence of inherited antigenic substances on the surface of red blood cells. These antigens may be proteins, carbohydrates, glycoproteins or glycolipids depending on the blood group system. The ABO system is the most important blood group system in human blood transfusion.The associated anti-A and anti-B antibodies are usually immunoglobin M. Rh blood group system is the second most significant blood group system in a human blood transfusion with currently 50 antigens. The most significant Rh antigen is the D antigen.

Blood transfusion is generally the process of receiving blood products into one's circulation intravenously. Transfusions are used for various medical conditions to replace lost components of the blood. Early transfusions used whole blood but modern medical practice commonly uses only components of the blood such as RBCs, WBCs, plasma, clotting factors and platelets. India faces blood deficit of approximately 30-35% annually. The country needs around 8 to 10 million units of blood every year but manages a measly 5.5 million units on top of it 94% of blood donation in the country made by men while women contribute only 6%.

There is a scope for determining blood types and the software developed using image processing techniques. The slide test consist of the mixture of one drop of blood 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. The agglutination reaction means that occurred reaction between the antibody and the antigen, indicating the presence of the antigen appropriate. The combination of the occurrence of agglutination, or non-occurrence, determines the blood type of the patient. Thus, the software developed based in image processing techniques allows, through an image captured after the procedure of the slide test detect the occurrence of agglutination and consequently the blood type of the patient.

1.2 Literature Review

The blood phenotyping based on the slide test and on image processing techniques such as thresholding morphological operations, and the secondary operationslike dilation, erosion, opening and closing to determine the occurrence of agglutination.Errors have occurred in blood transfusions since the technique began to be used. One requirement was the mandatory reporting of all fatalities linked to blood transfusion and donation. The humans will inevitably make errors and that the system design must be such that it decreases errors and detects residual errors that evade corrective procedures.The use of automated techniques reduces the impact of human errors in laboratories and improves standardization and quality of achieved results.

Image segmentation of an image is a process of dividing an image into non overlapping regions which are homogeneous group of connected pixels consistent with some special criteria. There are lots of ways to define the homogeneity of a region in the segmentation process. For example, it may be calculated by color, depth of layers, grey levels and textures etc.

Image segmentation is the fundamental approach of digital image processing. Among all the segmentation methods, Otsu method is one of the most successful methods for image thresholding because of its simple calculation. Otsu is an automatic threshold selection region based segmentation method.

Clustering in image processing is the grouping togetherof pixels from an image, depending upon the calculated similarity between them. Clustering can be often defined as an unsupervised classification of pixels. The color image data is naturally clustered in three-dimensional color space (usually RGB). All dominant colors in the image create dense clusters in the color space.

Thresholding plays a major in binarization of images. Thresholding can be categorized into global thresholding and local thresholding. In images with uniform contrast distribution of background and foreground like document images, global thresholding is more appropriate. In degraded document images, where considerable background noise or variation in contrast and illumination exists, there exists many pixels that cannot be easily classified as foreground or background. In such case, local thresholding is more appropriate[7].

II. METHODOLGY

The digital images of blood samples are obtained from the hospital/laboratory consisting of a color image composed of three samples of blood and reagent. These images are processed using image processing techniques namely color plane extraction, thresholding, morphological operations. The steps involved in image processing are shown in the Fig.1.

International Journal of Engineering Technology, Management and Applied Sciences

www.ijetmas.com January 2017, Volume 5, Issue 1, ISSN 2349-4476

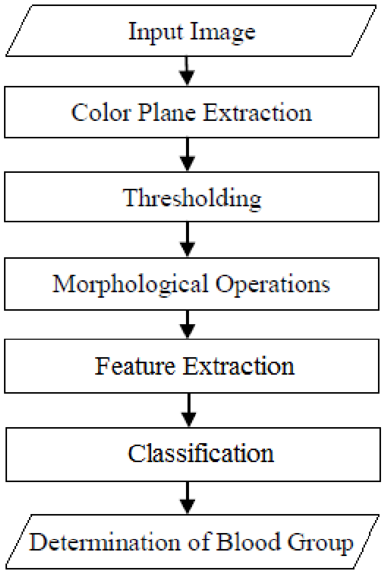


Fig.1.steps of determination of blood types using image processing

1. Data Collection

The images were obtained from laboratory are digital images stored in JPEG format. These images are pre-processed using color plane extraction. The original slide test image obtained from laboratory is as shown in Fig.2.

Fig.2. original image

2. Color plane Extraction

The color plane contains color information in images. The foreground and background color of each image has different values. The colors in the color plane are not modified by any color display mapping. In this work only green color component is extracted because it contains maximum value in the RGB color plane. The green color plane extraction is as shown in Fig.3.

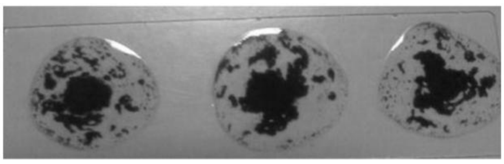


Fig.3color plane extraction

3. Thresholding

It is the simplest method of image segmentation. From a grayscale image thresholding operation is used to create binary images. The gray scale samples are clustered into two parts as background and object [8]. It may beviewed as an operation that involves tests against a function T of the form

$$T=T[x,y,(p(x,y),f(x,y)] \qquad (1)$$

Where f(x, y) is the gray level at the point (x, y) and p(x,y) denotes some local property of the point. A threshold image is defined as

g(x,y)={1 if f(x,y)>T

{0 if f (x,y)≤T (2)

Thus pixels labelled 1 corresponds to objects and pixels labelled 0 corresponds to background. If T depends only on f(x,y) the threshold is global, if T depends on both f(x,y) and p(x,y) the threshold is called local, if T depends on the spatial co-ordinates x and y the threshold is called dynamic/adaptive

When T depends only on f (x, y) (in other words, only on gray-level values) and the value of T solely relates to the character of pixels, this thresholding technique is called global thresholding. Clustering is the task of grouping a set of objects in such a way that objects in the same group are more similar to each other than to those in other groups .It can be observed that both background and object are separated as shown in Fig.4.

Fig.4auto thresholding

4. Niblack Function

Nib lack's Algorithm calculates a pixel-wise threshold by sliding a rectangular window over the gray level image [9]. The computation of threshold is based on the local mean m and the standard deviation s of all the pixels in the window and is given by the equation,

$$T_{niblack} = m + k * s (3)$$

Where m is the average value of the pixel, and k is fixed to -0.2 and s is the standard deviation.

If threshold T depends on both f (x, y) and p(x, y), this thresholding is called local thresholding. This method divides an original image into several sub regions, and chooses various thresholds T for each sub region reasonably. It can be observed only the segmented part of an image as shown in Fig. 5.

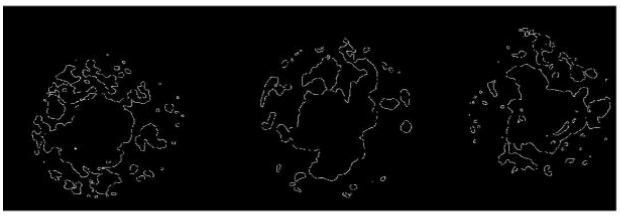


Fig.5 local thresholding

5. Morphology

It includes pre or post processing operations such as dilation, erosion, morphological filtering and granulometry. The fundamental operations are dilation and erosion. The erosion operation uniformly reduces the size of the objects in relation to their background and dilation expands the size of the objects. By using dilation and erosion secondary operations like opening and closing can be done. Morphological operations are used to eliminate noise spikes and ragged edges [10].

Closing operation is used to fill the holes and gaps. It is the process of dilation which is followed by erosion. The closing of a set A by structuring element Bis defined and it is given by the equation

$$A \bullet B = (A \oplus B) \ominus B \quad (4)$$

It can be observed that the segmented image is filled using closing operation is shown in Fig. 6.

Opening operation is used to smoothen the contours of cells and parasites. It is process in which erosion is followed by dilation. The opening of a set A by structuring element Bis defined and it is given by the equation

$$A \circ B = (A \ominus B) \oplus B \quad (5)$$

Fig.6filling holes

Therefore, the opening of A by Bis the dilation of A by B, followed by the erosion of the result by B.It can be noticed that it smoothens the contours of cells by removing small objects is shown in Fig 7.

Fig.7 Remove small objects

6. Feature Extraction

The SIFT algorithm takes an image and transforms it into a collection of local feature vectors. Each of these feature vectors is supposed to be distinctive and invariant to any scaling, rotation or translation of the image. In the original implementation, these features can be used to find distinctive objects in different images and the transform can be extended to match location in images.it consist of four phases: extreme detection, key point localisation, orientation assignment and descriptor computation.

7. SVM Classifier

The support vector machine (SVM) is a popular classification technique. A classification task usually involves separating data into training and testing sets. Each instance in the training set contains one target value and several attributes. The goal of SVM is to produce a model (based on the training data) which predicts the target values of the test data given only the test data attributes. In the parlance of SVM literature, a predictor variable is called an attribute, and a transformed attribute that is used to define the hyper plane is called a feature. The task of choosing the most suitable representation is known as feature selection. A set of features that describes one case is called a vector. So the goal of SVM modelling is to find the optimal hyper plane that separates clusters of vector in such a way that cases with one category of the target variable are on one side of the plane and cases with the other category are on the other size of the plane. The vectors near the hyper plane are the support vectors.

III. DEVELOPED SOFTWARE

To store the information resulting from the analysis of the agglutination detection performed through the image processing techniques and the result of the classification algorithm (blood type), a database was constructed. The built database can store images captured and used in image processing techniques (each image contain four samples of blood and reagent). The developed software allows by an image captured by a CCD camera detecting the occurrence of agglutination, through image processing techniques developed for determine the occurrence of agglutination. Secondly allows determine the blood type of the patient through the classification algorithm developed. Finally, allows store the information in a database built. Result obtained by using MATLAB software.

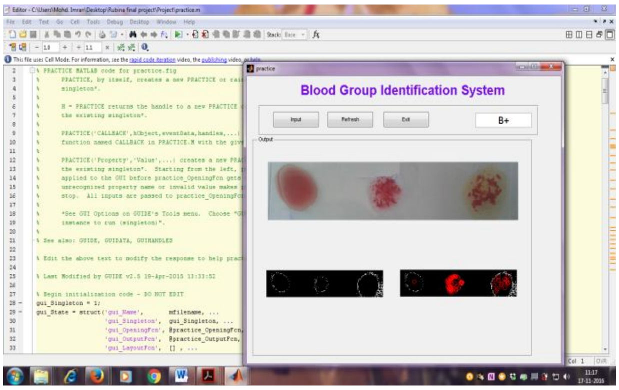
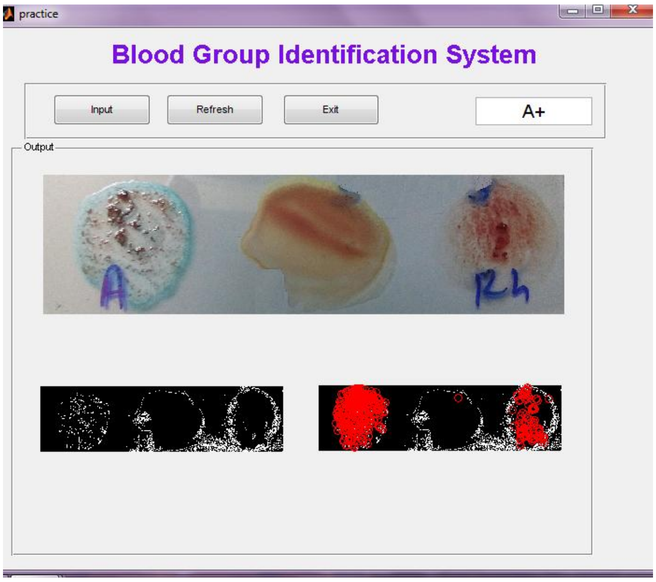


Fig. 8 developed software

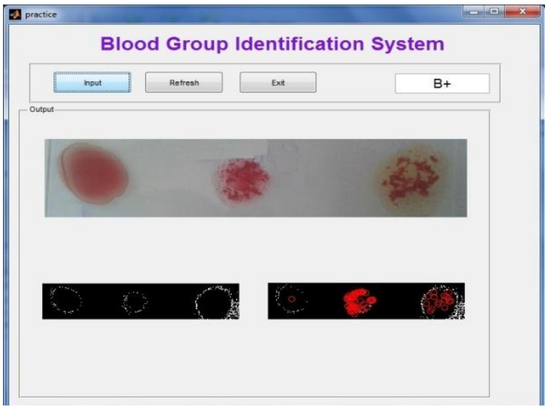
IV. RESULTS & DISCUSSION

The images of slide test were captured by a camera consists of a color image composed of three samples of blood and reagent. The image processing method is experimented on the several images acquired. These images are processed using MATLAB software. The image processing techniques such as color plane extraction, thresholding and morphological operations were performed on the images. The image obtained after applying auto thresholding clustering function it can be observed that the object and background are separated. In the next step, local threshold operation using Niblack function is applied it calculates a pixel-wise threshold and it can be noticed only the border segmented image. Image obtained by the application of advanced morphology, it can be observed that the segmented image is filled using closing operation. Advanced morphological operation Opening is performed it can be noticed that it smoothens the contours of cells by removing small objects. Then the images obtained by applying the color plane extraction, feature extraction using SIFT algorithm and SVM classifier.Finally the blood group can be determined

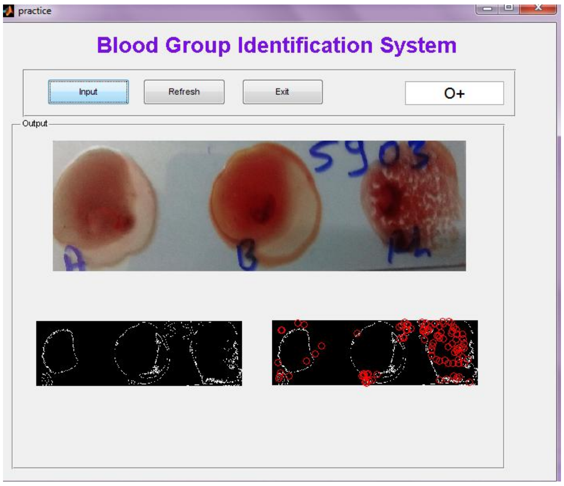
The different blood types are as shown in Fig. 10.The result of A+ is shown in Fig. 8 (a). The result of B+ is shown in Fig 8 (b).The result of O+ is shown in Fig (c)



(A) Result of A+



(B) Result of B+



(C) Result of O+

The method was tested for 30 slide test images obtained from laboratory. The comparison between the experimental result and the manual result is as shown in table.

Table: comparison between the experimental result and the manual result

Sample	Manual Result	Experimental Result
1	A^+	A^+
2	B^+	B^+
3	AB^-	O^+

V. CONCLUSION

The method developed is proves that it 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. The method is suitable and helpful in emergency situations. UsingSIFTS& SVM classifier blood group can be determined. In future it is intended to improve the system developed 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

VI. ACKNOWLEDGMENT

I would like to thank our Principal **Dr. S.K Biradar** and management ofMSS CET Jalna for providing utmost support for performing experiment and completing project work. I also thanks to Head of E & TC Engineering department Prof.A.SPatel.

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