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Employing Image-Based Canny Edge Detection Method for Blood Group Detection

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AB S T RAC T

In emergencies, quickly and accurately determining the blood types is very critical before performing a blood transfusion. So, if the method of testing blood is done effectively at less cost, with the technology available and without the possibility of human error, it will be a very efficient and potentially life-saving approach. In this paper, we propose a blood group detecting system that is fast, accurate, and reliable. The method where the blood sample image is subjected to a series of algorithms like grayscale, binary, and canny edge detection. The detected edges will then be counted, and compared with the dataset to detect the blood group.

Keywords*: Tranfusion; humanerror; algorithms; grayscale; binary; cannyedge*

INTRODUCTION .

An average of 12,000 people die each year as a result of injuries sustained in road accidents, according to a report released by the Accident Research Centre of the University of Alberta, Edmonton (BUET). It is often important to conduct an emergency blood transfusion in accidents, and it is vital to quickly identify the victim's blood group. Detecting blood groups in crisis or remote areas where knowledge is inaccessible is sadly difficult. Transfusions of the wrong blood groups can be disastrous. As a consequence, it's important to know the blood types of both donors and recipients. Due to a scarcity of qualified technicians, the traditional blood typing method can prove to be life-threatening. In these cases, health technicians must make fast decisions about which procedures to use to provide the best care for the patient. In the above emergency cases, where human blood typing is not possible. and in such cases, it is very usual to go for the option of universal donor blood. As a

consequence, certain reactions can occur, placing the patient's life at risk and reducing the amount of blood available from universal donors. This paper describes an automated device that can meet the requirements of the most primary pre-transfusion tests, which are speed, effectiveness, safety, and consistency, and therefore can be used even in remote locations. To make this possible, an image processing technique is used for the collection of data, related to blood, to obtain the required results from the image of the glass slide initially. This is followed by numeric values to ensure the accuracy of the results

LITERATURE REVIEW

Blood is an essential fluid in the human body that carries oxygen and nutrients across the body. However, in addition to pH regulation, blood performs several other functions. There are three main groups of red blood cells (RBCs): oxygen carriers, red blood cells (RBCs), and white blood cells (WBCs). (WBS), which aids in the immune system and aids in the battle against infection procedure. Platelets, a third important factor, are yet another important substance in blood composition. When an injury occurs, it aids in the clotting of the blood. In the event of an emergency, a blood transfusion is needed if the patient has sustained a serious injury and has lost a significant amount of blood. More than 30 blood types have been found so far in the twenty-first century. Before conducting any transfer, it is important to extract the blood carefully and correctly compare it with the récipient, ensuring that the category of blood of the récipient matches that of the donor. A concept of defining a formal blood transfusion method for finding our correct blood transfusion process, which is more accurate and has less possibility of errors when compared to existing methods is introduced in this paper. [1] It is generally observed that the transfusion of blood generally becomes a reason for the transmission of contagious diseases like HIV/AIDS, HBV, etc. [2]. A more reliable methodology for testing the blood samples to find out the type of blood that can automatically carry out the plate test is proposed by the authors. Here an image processing technique that uses the occurrence of blood agglutination is utilised for the testing of the blood sample. [3] How the image processing technique can be utilized for testing the blood samples is discussed in this work. The authors have proposed a system for blood analysis and have described a step-by-step methodology for processing the images, along with producing more accurate and reliable results. [4]. As a result, in this paper, we suggest a method that will classify the blood type and provide an accurate result in a short period.

METHODOLOGY

In this paper, the procedure produces reliable results, but it takes longer to obtain the result, i.e. determining the blood type using image processing techniques [5]. Several papers have been published on the topic of blood group detection methods. However, in this project, the greyscale, binary conversion, segmentation, and canny approach are all part of a four-step phase. Grayscale is used to transform an image into a grayscale image in which each pixel represents a spectrum of light intensity. Afterward, the process of converting to binary is utilized to produce two potential values for every pixel. Following this, the image of the glass slide is divided into three separate images using segmentation. Eventually, the canny approach is a system of edge discovery in image processing that works by finding out discontinuities occurring in the region. The accuracy of this model is 100 %. The different steps incorporated in this are as follows:

Obtaining the image
Image Pre-processing image splitting of image.
Finding of Blood type.

Image Acquisition

Three blood samples are placed on a slide, each combined with different reagents. The reagents generally used are anti-A, anti-B, and anti-D, the photographs of which are taken on the slide. These images are JPEG-formatted digital images as shown in Fig 1

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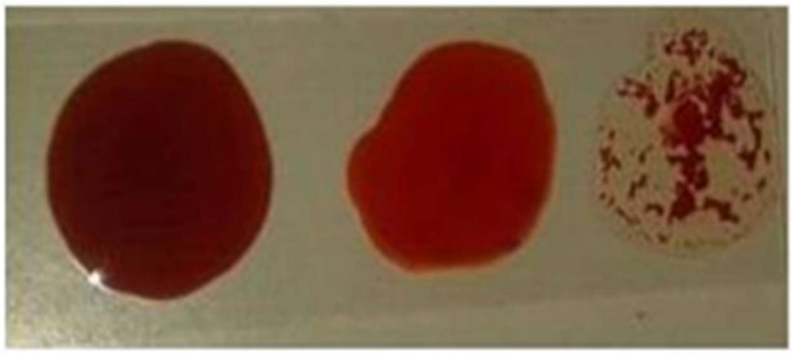


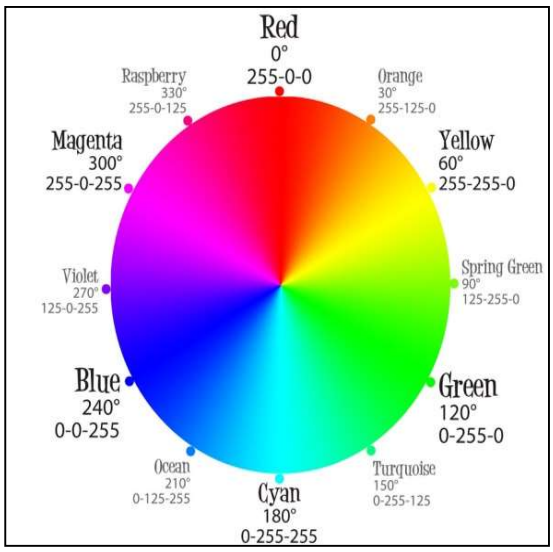
Fig 1. Input Images

Image Preprocessing

Preprocessing of an image involves resizing the image to obtain a specific configuration so that further image processing algorithms can be applied. Further include Grayscale Conversion, Binary Conversion, Image segmentation, and Canny Edge Detection Algorithm as discussed below:

Greyscale Conversion.

RGB photograph is dependent on the RGB Color Model. In this model, Red, Green, and Blue colours are in a variety of ways to impersonate a wide range of colours. The name of the model is derived from these primary colours. The approach used in this model is to illustrate and view images in an electronic environment. It's a colour model that's device-dependent, meaning that different devices will detect the same RGB value.



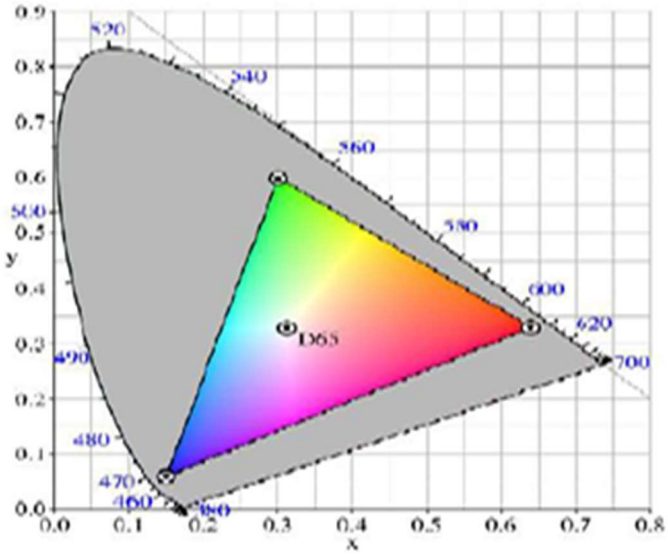


Fig 2. RGB Color Model

Fig 3. Primary Colors observed in Color Triangle D65

Figure 2 illustrates the RGB Color Model, where every colour component (red, green, and blue) constitutes a portion of the overall colour. The subjective nature determines the intensity of these three components. Because the three light beams are combined. Here their light spectras are combined to create a final color range by compromising on wavelengths. As a result, the colour model used is additive. The subtractive colour mode is the polar opposite of this model.

In the case of the additive colour model, the combination of these three colours results in the formation

of white, which is significantly different from physical colours. In the absence of light, each component produces the most pitch-black colour, while in the presence of light, every component produces white. The brightness of these colours is determined by the existence of the primary light source.
Fig 3 indiçâtes the Primary Colors Observed in Color Triangle D65, When various levels of brightness are present, the outcome can vary in saturation, subject to the contrast between the high and low intensities of the main colour. If one component of colour is having a higher intensity, the colour is a hue of primary colour. To get the RGB colour model's numerical expression, we have to find out how much, of the red green, and blue colours are being used. The portion of each colour will vary from zero to a given maximum value when expressed as an RGB triplet (r, g, b). When the values of all the colour components are reduced to zero, the outcome is a black colour, and when they are increased to their highest possible value, the outcome is the most shining possible white colour that can be represented.
The process of transforming any colour image from an actual data image to a grey-scale image is shown in Fig. 4. In general, a greyscale image is one in which each of the pixels reflects a specific spectrum of light intensity. A greyscale image in MATLAB is a data matrix with values that reflect intensities within a certain range. MATLAB saves the image as a separate matrix, with each part corresponding to a single image pixel. The image in Fig. 4 was converted to a grayscale image, in which every given region of the image was considered equal to white image points.

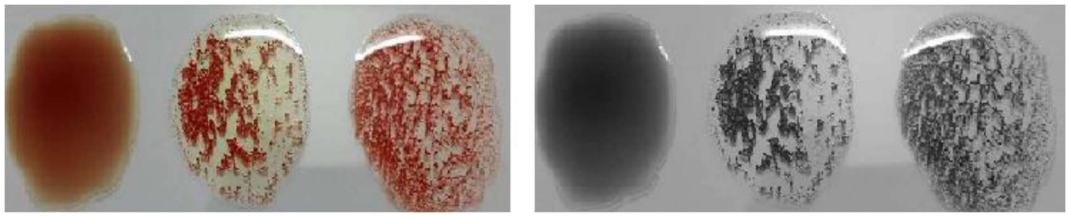


Fig 4. (a) RGB image (b) Grayscale Image

An RGB image is made up of three images built on top of each other. Red, Green, and Blues scale images are thus stacked on each other. In MATLAB, an RGB image can be represented as a M*N*3 array of colour pixels. In every colour, the pixel can be considered as a triplet that matches the colour components of RGB images at a given dimensional position.

A Grayscale image, on the other hand, can be interpreted as a single-layered image. A grayscale image in MATLAB is essentially a M*N array with values scaled to reflect intensities.

Syntax- Output=rgb2gray(Input)

A function denoted by rgb2gray() is present in MATLAB to modify RGB images to grayscale images. Without using the rgb2gray() tool, we can convert an RGB into a grayscale image
Binary Conversion.
A binary image can be considered as a digital image in which each pixel has only two possible values. It is necessary to calculate the histogram of grayscale image binary conversion. The pixel magnitude in frequency distributions is represented by a histogram, which is a one-dimensional matrix. The statistic parameter is a number that is used to calculate the number of images that will be segmented as a result of the segmentation. Mean and standard deviation are used to evaluate the statistic parameters, which are set as a reference.
Syntax- BW = im2bw(I,level)
The above syntax translates the grayscale image I to a binary image BW. This is done by designating the value 1 to all pixels in the input image having a luminance greater than the level. Similarly, a value of 0 is assigned to all other pixels. The largest number of signal levels in this category falls in this range.

As a consequence, a level of 0.5 corresponds to an intensity value that is halfway between the class's

minimum and maximum values. Thresholding is a widely used image segmentation practice. For a greyscale image to convert into a binary image this method is widely used. We choose the highest value in thresholding. Entire grey level values below that value are considered as 0 or black, and all that is equal to or higher than the highest value are considered as 1 or white.
Our grayscale image is transformed into a binary image, and inversion is used to invert the image's black-and-white pixels.

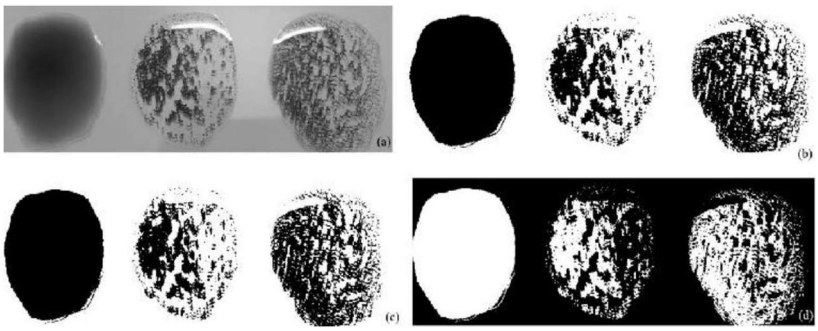


Fig 5 Binary Inversion (b) (c), the technique is employed on Grayscale Image (a), converting a white pixel into a black pixel

Our grayscale image is transformed into a binary image, and inversion is used to invert the image's black-and-white pixels.

Binary Conversion Algorithm:

1. Open the MATLAB environment and load the target image.
2. If the read image is an RGB image, convert it to a grayscale image.
3. Evaluate a T-value (threshold value).
4. Make a new Image Array (say, 'binary') with the same number of rows and columns as the original image array, but with all elements set to zero (zero).
5. Assign 1 to binary(i, j), if the grey level pixel at (i, j) is greater than or equal to the threshold value, T; else assign 0 to binary(i, j). Do the same for all gray-level pixels.

Image Segmentation.

The process of breaking down a digital image into multiple subdivisions within a collection of pixels is known as segmentation. The subdivision process is usually done dependent on two values, with m rows and n columns. A pixel is one of the components in this matrix representation.
If Image illustration I = f(0,0) f(0,1)…….....f(0,N-1) f(1,0) f(1,1)…….....f(1,N-1) f(2,0) f(2,1)…….....f(2,N-1) f(M-1,0)f(M,1)..f(M-1,N-1).
Subdividing is done to break down the image into something more of a mode on P(SI ᵘSJ)P(SI ᵘSJ) (S 1 ,S 2 ,…,S n) (Si ᶺ SJ) P(Si ᵘSJ). In Fig 3.7 the image is broken down into three separate Groups; A, B, and Rh factors employing this segmentation function.

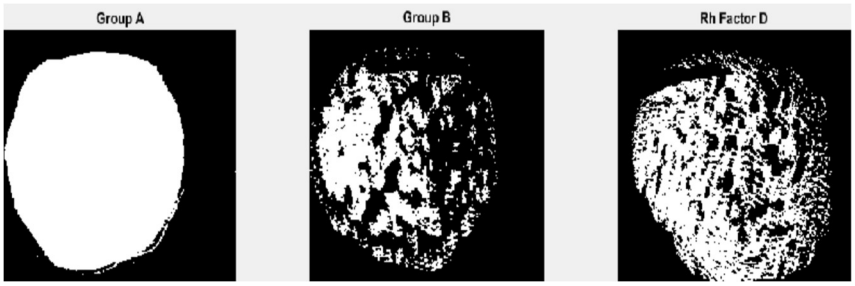


Fig 6 Segmented images of Group A, B, and Rh-factor are illustrated in section (a), section (b), and section (c) respectively

Canny Edge Detection

Detecting the discontinuités in the brightness of the image is the method employed for image processing in the Canny method to edge detection. In this method, a multistep detection algorithm is utilized for counting the edges of pixel images. Then image is smoothened by a Gaussian filter to reduce noise and remove unwanted information and image textures [23].

The mechanism used in the Canny edge detection algorithm can be illustrated in 5 different steps:

1. Smoothen or even off the image to get rid of unwanted noise by employing a Gaussian Filter.
2. The intensity gradients of the image are identified.
3. Removal of false responses in edge detection by employing non-maximum suppression.
4. Finding out the potential edges of the image by employing a double threshold.
5. Finalising the edge by hysteresis: Apprehension of edges by subduing all the other edges that are weaker and not linked to well-built edges.

Fig 7. Edge detection using Canny Method

Edge Computation.

We will first divide the Fig 7 image into three equal parts, after which we will count the total number of edges in each section. The MAX() function is then used to count edges row by row. Finally, after counting the current edges after image detection (as shown in Fig. 7), we settled on the numeric values as shown in Table 3.
Group A: 18 Group B: 397 Rhfactor: 96

Algorithm:
Input: Color image (I)

Output: Classification of Blood Group based on the color image (I)

1. Convert the input color image (I) to grayscale (gray) using the rgb2gray function.

2. Convert the grayscale image (gray) to binary (B) using the im2bw function.
3. Obtain the complement of the input image (I') to enhance features.
4. Split the complemented image (I') into three equal parts vertically, resulting in three images: img1, img2, and img3.
5. Apply the Canny edge detection algorithm to each of the three images (D, E, F) to highlight edges.
6. Display the edges of img1, img2, and img3, assigning titles to indicate the corresponding blood groups (Group A, Group B, Rh Factor D).
7. Count the edges in each of the edge-detected images (D, E, F) using the bwlabel function, resulting in num, num1, and num2.
8. Set a threshold value (unit) for edge counting.
9. If num is greater than the threshold unit, set flag to 1; otherwise, set flag to 0.
If num1 is greater than the threshold unit, set flag to 1; otherwise, set flag to 0.
If num2 is greater than the threshold unit, set flag to 1; otherwise, set flag to 0.
10. Iterate through a predefined array of blood group strings.
11. If a match is found between the detected blood group (temp) and the array, retrieve the corresponding blood group result (rst) from the array.
12. Display the determined blood group result.

This algorithm aims to classify the blood group based on edge detection in different segments of a color image, with the final result being determined by comparing edge counts with a predefined threshold and matching against a list of blood group strings

RESULTS

The process of determining a blood group is divided into two sections. One aspect is determining the category it belongs to, such as A, B, or O, and the other is determining if it is positive or negative. Both tests are performed on the same slide. When blood samples are mixed with antigens, we can detect agglutination using our proposed process.

Agglutination happens, which means that the current sample contains the sort of blood group. If part A of the slide agglutinates but part B does not, we determine that group A is the detected group for the sample blood. In the same way, if part A has no agglutination and part B has agglutination, we classify the blood sample as group B.

If no agglutination occurs in any of the components, the detected blood group type is O, and if agglutination occurs in both parts A and B, the detected blood group is AB.

We concentrate on the Rh-factor portion of the test to see whether blood is positive or not. If there is some agglutination in the Rh factor portion, the blood can be grouped as positive. On the contrary, if there is no agglutination, the blood can be grouped as negative.

All types of blood groups and their agglutination patterns are mentioned in Table 1. The agglutination of the blood is effectively identified by our proposed method. The number of counted edges of the images is used to detect blood groups. We counted the total edges for Group A, B, and Rh factors using the image processing techniques mentioned above

Group A	Group B	Rh Factor	Result
NA	NA	NA	O-
NA	NA	A	O+

NA	A	NA	B-
NA	A	A	B+
A	NA	NA	A -
A	NA	A	A+
A	A	NA	AB-
A	A	A	AB+

Where NA= Not Agglutinated, A= Agglutinated
Table 1: Agglutination Table

When the count of edges in an image is very large, we can assume that agglutination has taken place, and when the count of edges is very small, we can assume that agglutination has not taken place. Thus it can be considered that the agglutination occurs when more than 85 edges are present in any given group based on the study of 100 blood samples. We counted edges for many images using our data set.

Table 2 shows the number of edges on eight separate images.
Table 2 displays the details we received from our proposed model. We'll do some more calculations with the details from Table 2.
The three variables for parts A, part B, and part of the Rh-factor can be denoted as NA, NB, and NRH. The NA stands for the number of edges in part A. NB stands for the number of edges in part B.
We'll see if NA is greater than 85 now. If the assertion is right, agglutination has occurred, and the value of NA=1 has been set. If the assertion is false, agglutination has not occurred, and the value of NA=0 has been set.
We'll look to see if NB is greater than 85 once more. If the assertion is right, agglutination has occurred, and the value of NB=1 has been set.

Sample No	Number of edges in part A	Number of edges in part B	Number of edges in Rh factor
1	166	2	14
2	232	248	5
3	23	397	492
4	8	6	128
5	11	1	1
6	13	144	4
7	155	352	343
8	250	55	121

Table 2: Number of count edges for A, B, and Rh from eight samples of blood

If the assertion can be considered misleading and the agglutination can be considered to have not occurred, and the value of NB=0 is set. Finally, we'll see if NRH is greater than 85. If the statement is valid, agglutination has occurred, and the NRH value is set to 1. If the assertion is faulty, and therefore agglutination has not occurred, and the NRH value is set to 0.
We're looking for a

1= "agglutinated". 0= “Not agglutinated”
Now, we'll validate the data obtained with the data in Table 1, and we'll get the result based on Table 1's pattern.

Sample No	Value of NA	Value of NA	Value of NA	Results
1	1	0	0	A-
2	1	1	0	AB-
3	0	1	1	B+
4	0	0	1	O+
5	0	0	0	O-
6	0	1	0	B-
7	1	1	1	AB+
8	1	0	1	A+

Table 3: Result of the sample mentioned in Table 2

The following is an example of how Sample No. 1 of Table 2 was calculated:
The total edges of part A in sample no 1 is 166, i.e. (NA=166) is greater than 85. The blood sample for Type A has agglutinated in this case. Part B has the same number of edges as part A, which is two. As a result of (NB=2) 85, the blood sample did not agglutinate.
The detected edges are 14, just as it is for the Rh factor. (NRH=14)85 indicates that the blood sample is not agglutinated. As a result, we discovered A- blood type. We determine the perfect blood group of the proposed blood sample by integrating all of the results. The other samples were all weighed in the same way.
Table 4 shows that the suggested method's results have all exceeded the real-time results. Every calculation for Table 2's sample has been shown in this section. We checked our method on 100 images in real time, and the results obtained were found to be similar to the actual results every time.

Sample No.	Real-Time Result	Proposed model’s Result	Result Matched
1	A-	A-	Yes
2	AB-	AB-	Yes
3	B+	B+	Yes
4	O+	O+	Yes
5	O-	O-	Yes
6	B-	B-	Yes
7	AB+	AB+	Yes
8	A+	A+	Yes

Table 4: Accuracy Table
Some blood group identification models are already in use. A. Ferraz suggested the concept of using the image's threshold value as the basis for a quantification process. He also calculated some standard deviation values to see if agglutination was present. For the agglutination to be considered to happen, the standard deviation used for the study is 16. If the resulted standard deviation value is greater than 16, then agglutination can be considered to taken place; and if it is less than 16, agglutination has not happened. Also, another group using the same formula recommended in which the standard deviation be set to 20. The first and second cases gave right on their own data sets, but when we swapped the data sets and submitted them, they began to show incorrect results. The outcome ranges between 16 and 20 percentiles. Because of this flaw, none of the researchers' models

is 100 percent accurate. In any data set, blood group identification should be reliable. Unlike other methods, the one we suggest is special. We took a different approach than estimating the minimum, maximum, mean, and standard deviation. When blood agglutinates, it produces a smattering of tiny edges. We counted the edges and then made our decision based on them.

CONCLUSION .

In this paper, we propose a new and powerful digital blood group detection model that can be applied to image sets obtained from hospitals. A mobile device records image collection, which is then processed using special image processing techniques and also utilized different algorithms. We'll count the edges in each image and interpret the data to practically determine the type of blood in case of a real-life blood sample. The experiment results with our collected data set, as well as the contrast with real-time diagnostic results, point to a promising process of successful success. With image processing techniques, this project will represent a modern and efficient model of blood group detection. We worked with a real-time dataset made up of ten blood samples. After segmenting the blood sample into three sections, we used clever edge detection. The blood group of the sample will then be calculated by counting the detected edges. The experimental results, as compared to the real-time diagnostic results, show that the method of successful performance is promising.

The device is designed to be stable and unaffected by severe conditions. Image processing software has been developed that is effective in detecting the occurrence of agglutination and, as a result, the patient's blood group in a limited period. The machine will have a high sensitivity and precision, making it useful for identifying blood groups in emergencies. We would experiment with finding the blood groups from microscopic images in a similar manner by applying an image shape and image pattern method, where an antibody reacts with antigen, eliminating the need for tests to be conducted in pathology. Our blood group identification system is simple enough for the average person to use. Diagnostic centers can capture photographs to gather data and provide reliable results.

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