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Design and Implementation of a Blood Group Determination Using Image Processing

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Abstract: The human blood is a health indicator; it delivers necessary substances such as oxygen and substance that provides nourishment is necessary. Hence, segmentation of blood cells and identification of blood type is very important. The human blood consists of the RBCs, WBCs, Platelets and Plasma. Presently, lab technicians tests blood groups manually via kit ABO. This method is error able by human eyes, and the data is also not able to be stored. To overcome the problems regarding time, accuracy and cost, a method is proposed based on processing of images acquired from laboratory. The proposed system involves kit ABO, microscope slide, lancet, smartphone camera, mat lab program. The experimental result show high accuracy by using image processing techniques such as segmentation, morphological operations.

CHAPTER ONE

1.1 INTRODUCTION

Blood type determination is a very important step in emergency situations where blood transfusion is needed to save people's lives. Conventional blood-limiting techniques are time-consuming which may delay emergency blood transfusions, and these are performed [1]. Tests are done manually by lab technicians, who are subject to human errors, thus delaying saving lives. This project aims to develop a rapid and accurate automatic blood type determination system using image processing techniques digital. This system is very useful in emergency situations. To perform automatic blood type determination, a blood sample is taken in a slide the test. An image of the blood sample is captured by the camera and then processed using image processing techniques such as thresholding and morphological processes to improve the image. The next step is to use feature extraction algorithms such as counting. Objects and others for accurate blood determination. The project aims to implement these algorithms for accurate blood determination and comparison to adapt the algorithm with the best results based on accuracy and time requirements.

1.2 LITERATURE REVIEW

In this section summarize same related work based on image processing to detect a blood group as a below: Rathod et al. [2] used automatic system for classification blood group via image processing technique in LabVIEW program. The system include capture image, color plane extraction, threshold, morphology, feature extraction, SVM classifier. Experimental result show that this method developed proves to detect the agglutination 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. The advantages for system a result is sent to the hospital by modeling communication, also count RBC, WBC, low error for detection blood group and low for

execution time. However, the system was not calculate the accuracy for detection. Rahman et al. [3] studied detection blood group by using image processing via matlab software. The system involves an original image, Grayscale, Binary, method segmentation, edge detection, and result for detection. Experimental result show that detecting a blood group via matlab software. The system have several advantages such as low cost, detect blood group via shape and pattern detection. However, it is not indicates the processing time and measure accuracy foe system.

Sahastrabuddhe et al. [4] presented an image processing techniques for blood group detection via matlab program. The system involves phone camera, real image, segmentation, morphological operations, and result for image. Experimental result show that the system is divided into three significant phases: Blood group detection, red and white blood cell counting via matlab program. In addition, the measurement of accuracy is about 90 %. The system have several advantages such as low cost, used simple tools, and fast processing.

Jamil et al. [5] studied detection blood group by using An inductive segmentation technique based on granulometry and automatic thresholding has been explained by Ref. The system involves image conversion, image enhancement, morphological operation, RBC segmentation and counting. Experimental result show that the developed system offers good segmentation and recognition accuracy using random blood samples. The GUI was created using MATLAB software package. The system have several advantages such as The created application is friendly user, even those with no previous knowledge of MATLAB software or its specific tools or experience with the execution of complex blood image treatment tasks, to apply the program. It also offers interactivity and user friendliness.

Dalvi et al. [6] studied detection blood group by using image processing via matlab software. The system involves a pre-processing techniques, thresholding, morphological operations involves a segmented and edge, HSL plane and quantification. Experimental result show that the system would achieve high percentage of sensitivity and specificity which will be useful in determining the blood group in emergency situations. The system have several advantages such as low cost, used simple tools, and fast processing. Dada et al. [7] detected blood group by using image processing using plate method. The system include ABO blood group, Threshold Segmentation, HSV, Histogram, Binary image, Clusters and Patch. Experimental result show that this method can quickly and accurately identify whether the serum and antibody agglutination reaction, and then get blood type determination, to meet the needs of automated rapid blood type analyzer. In addition, this method gives the accurate result. The system have several advantages such as count red, white blood cell, low error for detection blood group and low for execution time.

Ferraz et al. [8] used automatic system for classification blood group via image processing technique in LabVIEW program. The system include blood types, image processing, IMAQ vision and plate method. Experimental result show that The obtained images were analyzed and processed with a custom application developed with IMAQ vision from national instruments, allowing the automatic blood type classification of the sample under test. The system have several advantages such as less expensive and less risky but it takes a long time. Ravindran et al. [9] used automatic detection of agglutination and determines the blood type of the patient in a short interval of time. The system include Blood samples, morphological techniques, Luminance, and quantification. Experimental result show that effective and efficient method to detect the agglutination and determines the blood type of the patient accurately. The system have several advantages such as detect blood group via shape and pattern detection.Dhande et al. [10] used image processing with method such as measurement of linear primitives and circular primitives, color information extraction, object segmentation based on niblack, feature extraction. The system include ABO blood group, threshold segmentation, HSV, histogram, binary image, clusters, patch. Experimental result show that this method can quickly and accurately identify whether the serum

and antibody agglutination reaction, and then get blood type determination, to meet the needs of automated rapid blood type analyzer. The system have several advantages such as effective and efficient method to detect the agglutination and determines the blood type of the patient accurately.

1.3 PROBLEM STATEMENT

1. Human errors due to reading in terms of noticing the grains
2. Slow to show results
3. The examination is time limited

1.4 OBJECTIVES

1. Reduce effort on the reader.
2. Accuracy of information compared to the human eye.
3. Speed in getting results.
4. Save result on the computer.

CHAPTER TWO

2.1 INTRODUCTION

The digital images is a representation of two-dimensional images on the computer by zero and one. Each digital image on a computer is made up of a pixel, which is the smallest unit in an image [10]. Each image is an array containing rows and columns of pixels. The more pixels, the clearer the image. Digital images are divided into: binary image, grayscale image, and color images [11]. Binary Image is an image that contains only black and white, and each pixel contains either a zero or one [12]. Grayscale Image is the image that contains black and white with grayscale and its intensity is represented by numbers from 0 to 255, where one represents the white color and the intensity when it is 256, the color for this pixel is black and when representing this image on the computer is represented by equal columns equal rows of pixels, each pixel having 8 bits, specifying the intensity from 0 to 255 [13].

Color images are digital images that support colors by allocating three boxes in each pixel to determine the intensity of the three primary colors (red, green and blue) and each box contains 8 bits to write on, for example, the intensity of green may be 00100000, meaning that there are 24 bits in each pixel, but some images may have only 8 bits and contain only 256 colors [14]. The multi-spectral image is taken by special cameras in which there are many bands, which may sometimes reach hundreds of bands, and when working on them, these bands fall in a certain way called (mapping) planning or tabulation so that they correspond to the third type of images. I mean, it becomes from multiple to a colored image (i.e.. combines, for example, red gradients merged with red) by the process of projecting on the image so that the image becomes only three primary colors [15].

2.2 SYSTEM MODULE

The proposed system include of main tool, sample, smartphone, and matlab program, as shown figure 1. Firstly, main tools involves a lancet, microscope slide, cotton, alcohol, and kit for blood detection (i.e. Antibody A, B, and D). Next, take blood samples from volunteers by using the lancet, take three drops of blood and then put them on the slide. Then, smartphone using application HD camera to snapshot an image for sample. Finally, using image processing via matlab program to display a result.

Figure 1. Block diagram for proposed system.

2.2.1. Main tools

Involves a lancet, microscope slide, cotton, alcohol, and kit for blood detection (i.e. Antibody A, B, and D). Firstly, lancet (It is used to prick a volunteer's finger), secondly, microscope slide (It is used to put three drops of blood on it) . Next, cotton, alcohol (It is used to sterilize the puncture site). Finally, kit It is used for blood detection (i.e. Anti-A: It is an antigen of antibody A , Anti-B: It is an antigen of anti-B antibody and Anti -D: detects Rh factor).

(a)

(b)

Figure 2: (A) Main Tools , (B) Kit For Blood Detection

Take blood samples from volunteers by using the lancet, take three drops of blood and then put them on the slide. then When you add this reagent it will changes that occur to the blood sample added to two types of laboratory fluids are observed, one of which contains antibodies to antigen A and the other contains antibodies to antigen B; Where the antigen present on the red blood cells interacts with the antibody to it in the laboratory fluid, and this reaction appears in the form of clumping and clustering of red blood cells together to indicate the type of antigen present, so antigen A interacts with the antibody to it to indicate blood type A , and antigen B reacts with its antibody to indicate blood type B, while no reaction occurs with either of them in the case of blood type O. Then the test is done in reverse; Where blood plasma free of red and white blood cells is used, to know the type of antibodies present in it, and this is done by adding a sample of blood plasma to two types of well-known laboratory solutions, one of which contains a blood sample of type A and the other contains a sample of blood type B, and it is noted The reaction and resulting cell agglomeration are as in the previous step, and the previous result must agree with this result to ascertain the type of blood type.

2.2.2. Sample

Samples were collected by volunteers for the purpose of testing the system on all blood types.

Figure 3: Sample

2.2.3. Smartphone

Using the camera in mobile phone via program (HD-camera) application to snapshot sample image then insert image to Matlab program for detection ablood group.

Figure 4:HD-camera program

2.2.4. Matlab

In proposed system used an image processor via graphical user interface (GUI) in Matlab program version R2013. The laptop proprieties with a processor (lntel ®Core (TM) i7-4510U @2.00GHz 2.60GHz).

Digital image processing is one of the branches of computer science (informatics), concerned with performing operations on images with the aim of improving them according to specific criteria or extracting some information from them [16]. The traditional image processing system consists of five successive stages, which are in order:-

a. Image acquisition by an optical sensor (e.g. a camera, laser sensor, etc.)
b. Pre-processing is the filtering of an image from noise or converting it to a binary image.
c. Segmentation to separate important information (eg any object in the image) from the background.
d. Features extraction classification of features and linking them to the pattern to which they belong and identifying pattern.
e. Image understanding image processing systems are used in many applications, especially in applications of automatic control, robotics, computer vision, etc.

The importance of image processing can be used to determine the details of the illumination of a particular image or to determine the structure of the image in return through accurate (microscope) values, through which values are extracted from the digital image that can be taken through image maps, for example, satellite images or moon images industrial [17]. Itcan also convert and process images through the computer in digital formats through several sources:

a. Digital Camera converts images into digital images with extremely high definition and color clarity.
b. Any photo Graph any photogram can convert an image into a digital format, such as the Scanner
c. A program that adds some modifications to the image, whether adding, deleting, or any modification that suits that.

CHAPTER THREE

EXPERIMENT

This section using Graphical user interface (GUI) in MATLAB program involves main operations and display image. The main operations include several pushbutton. In addition, display image include several axes, as shown Fig (4)

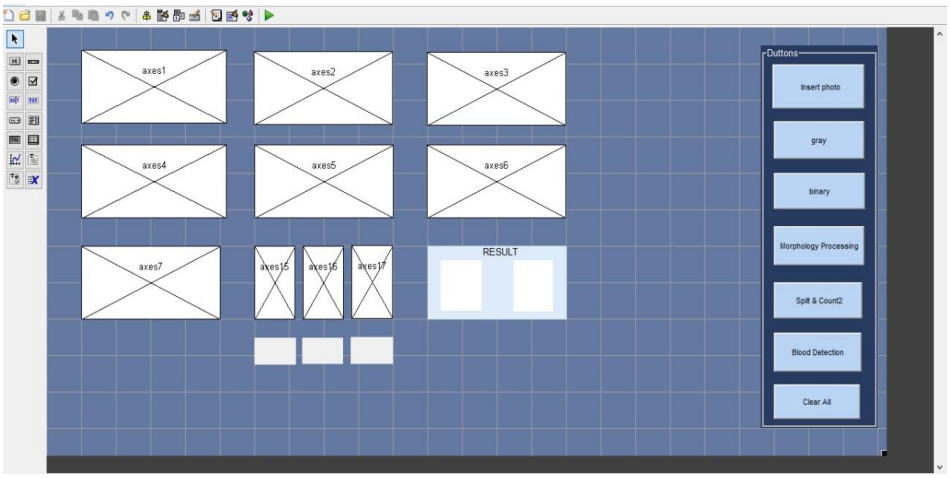


Figure 5: The Main Interface

The main operations include an insert photo to insert image of the blood sample (the image are displayed as GIF, Bmp, JPEG, PNG, RAW and others)from desktop folder into the workspace, Then Display the image to axes1. In addition, convert to gray images by eliminating the hue and saturation information while retaining the luminance. Gray scale means that the value of each pixel represents only the intensity information of the light. Such images typically display only the darkest black to the brightest white. In other words, the image contains only black, white, and gray colors, in which gray has multiple levels. Then Display the gray image to axes2. More, convert the gray image to binary image. This image displayed as black and white. Numerically, the two values are often 0 for black, and either 1 or 255 for white. Using this processing because they allow easy separation of an object from the background. The process of segmentation allows to label each pixel as 'background' or 'object' and assigns corresponding black and white colors .Then Display the binary image to axes3.Morphology processing for applied the Morphological opening to the binary image, Morphological opening is simple operations based on the shape of an image usually performed on a binary image. It takes our input image and a structuring element (kernel) which decides the nature of the operation, it useful for removing small objects and thin lines from an image while preserving the shape and size of larger objects in the image. It consists of edge process and Threshold process. Edge process It reduces the amount of data in an image and preserves the structural properties of an image. Threshold process it's isolates objects by converting gray scale images into binary images, An image processing method that creates a bitonal (aka binary) image based on setting a threshold value on the pixel intensity of the original image. Then Display the images to axes4, axes5, axes6, axes7.

To split the image into three sections (three images) where each image represents a blood drop Interaction with a one antigen (Three images because there are three drops of blood interact with three antigens), And in order from left to the right, the first image (on the left) represents the blood Interaction with Anti-A, the next image represents Interaction with Anti-B, the Last image represents Interaction with Anti-B. Then Display the three images on axes15, axes 16, axes17. Then count the number of Granules found on the surface of the drops of blood after their interaction with the antigens, as previously mentioned, the first image Represent blood type A, the second image Represent blood type B, the last image is Represents the RH (if the type of blood is positive or negative), Then Display the numbers on static text 8, static text 9, static text10 to display the blood type and Rh(+RH, - RH) on gui interface. In which blood type display on static text 11, and the Rh (+RH, - RH) display on static text12. Clear all the image from all axes and clear all number from static tex

CHAPTER FOUR

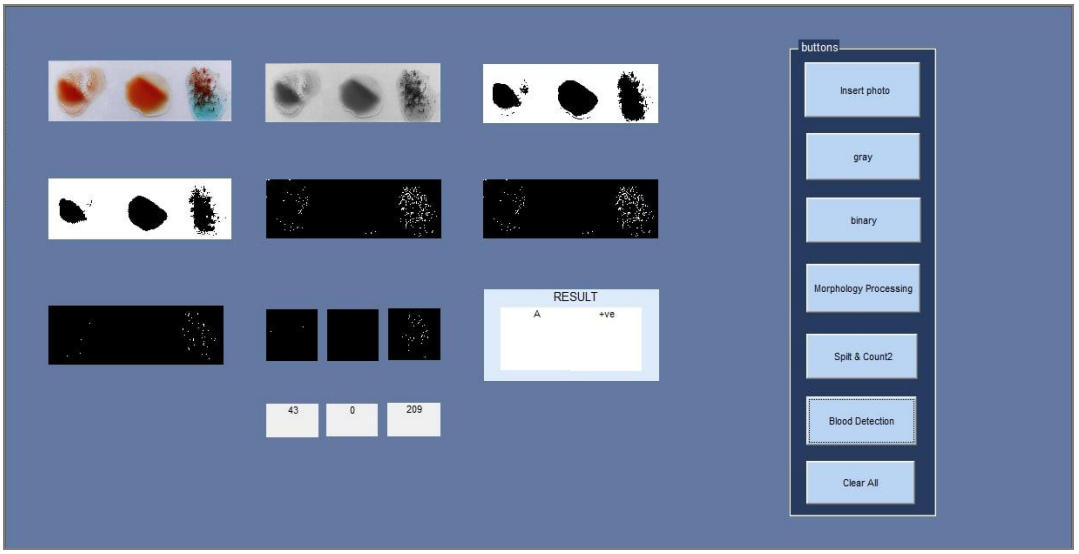
RESULTS AND DISCUSSION

For the purpose work for blood group detection, the granules are counted using Matlab by the bwlabel feature, then the granules count for the three antigens (Anti-A, Anti-B and Anti-D) appears in the gui interface. The following figures represent the eight type of blood, shown Figure 6.

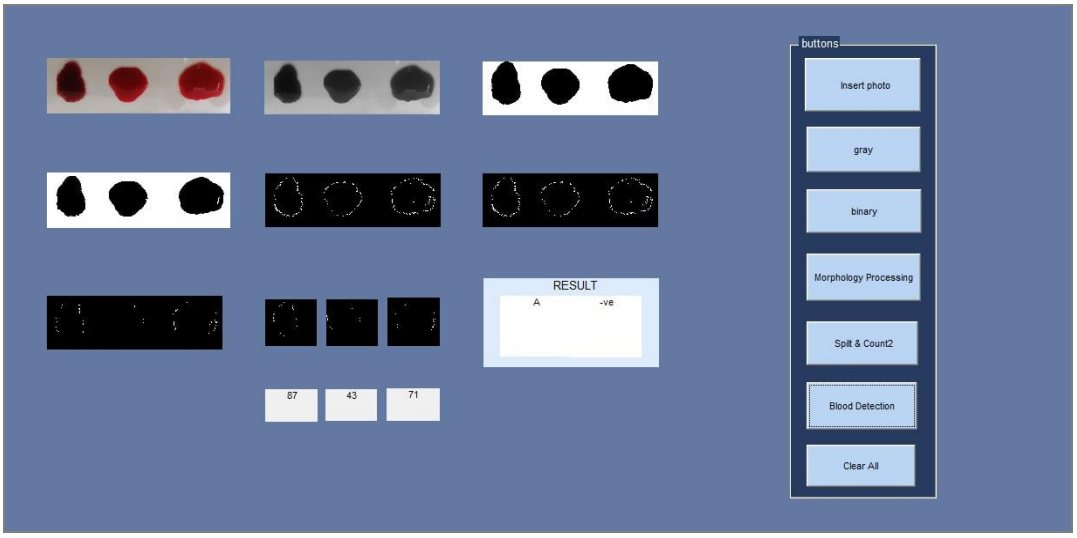
Figure 6 a the blood group A+ was detected, showing a set of numbers for each antigen, where the number 43 is for Anti-A, the number 0 for Anti-B, and the number 209 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type. Where, Figure 6 b the blood group A- was detected, showing a set of numbers for each antigen, where the number 68 is for Anti-A, the number 37 for Anti-B, and the number 49 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type. In addition, figure 6 c the blood group AB+ was detected, showing a set of numbers for each antigen, where the number is for 43 Anti-A, the number 0 for Anti-B, and the number 209 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type. Where,

Figure 6d the blood group AB- was detected, showing a set of numbers for each antigen, where the number 107 is for Anti-A, the number 54 for Anti-B, and the number 46 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type.

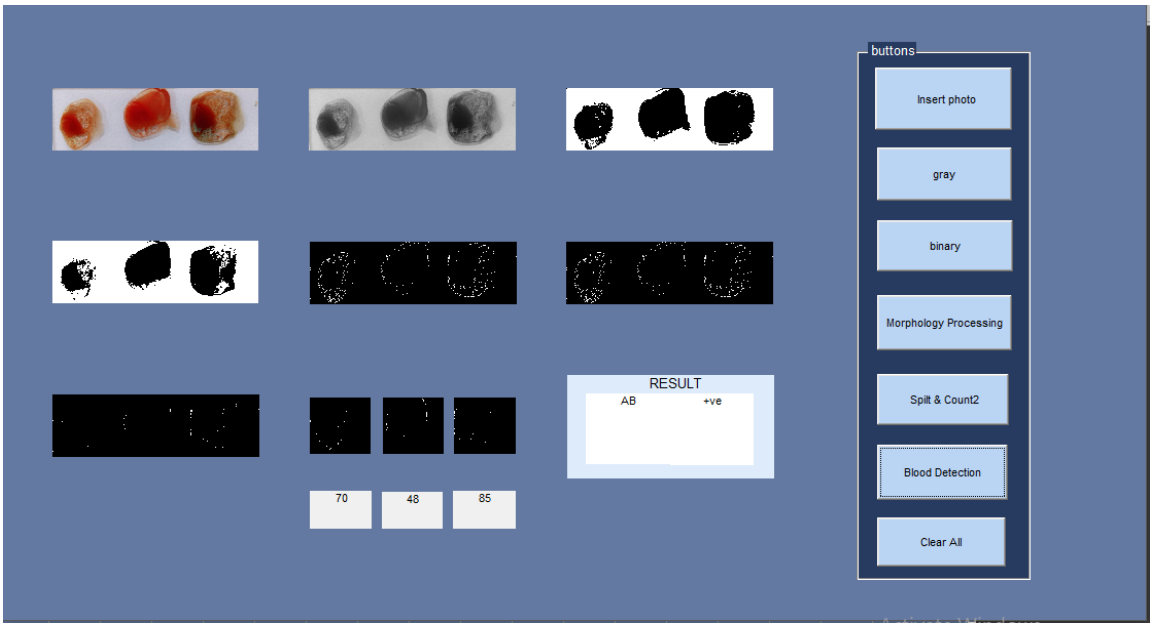
Figure 6e the blood group B+ was detected, showing a set of numbers for each antigen, where the number 28 is for Anti-A, the number 119 for Anti-B, and the number 53 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type. More, Figure 6f the blood group B-was detected, showing a set of numbers for each antigen, where the number is for 34 Anti-A, the number 59 for Anti-B, and the number 47 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type. Furthermore, Figure 6g the blood group O+ was detected, showing a set of numbers for each antigen, where the number 30 is for Anti-A, the number 14 for Anti-B, and the number 68 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type. Where, Figure 6h the blood group O- was detected, showing a set of numbers for each antigen, where the number 41 is for Anti-A, the number 28 for Anti-B, and the number 16 for Anti-D. Where it was compared with the number within several equations in order to detect this blood type.



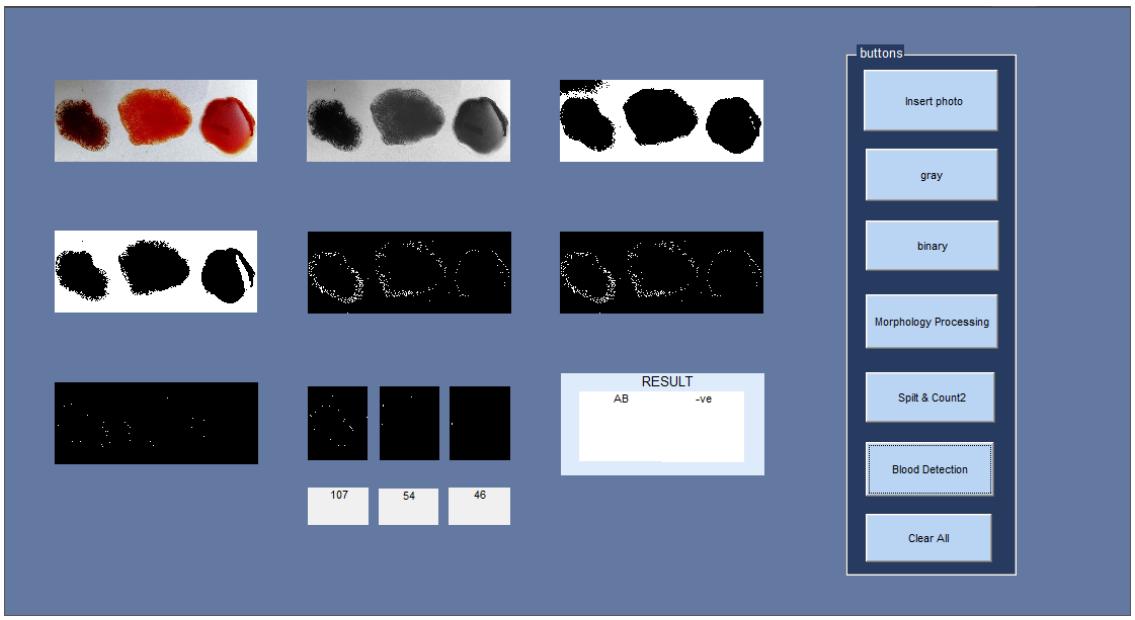
(a)



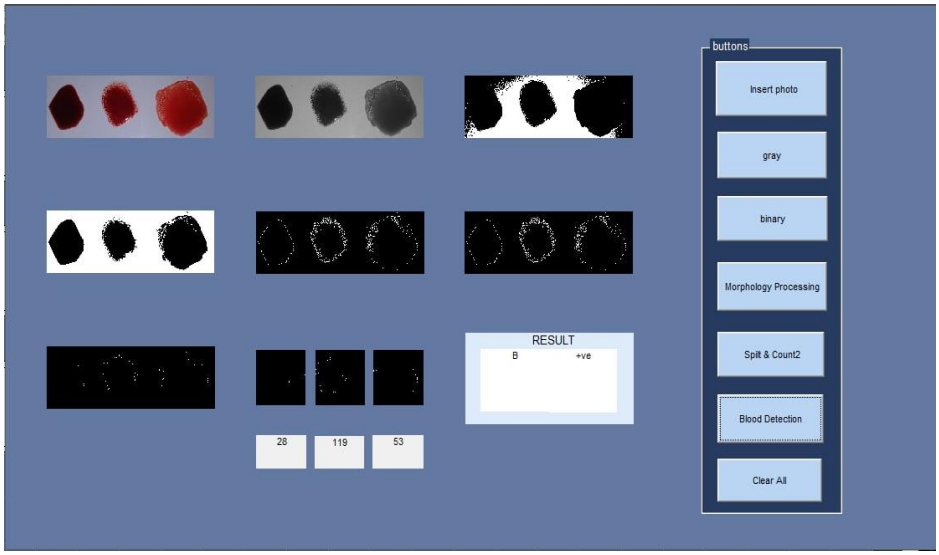
(b)


buttons
Insert photo
gray
binary
Morphology Processing
Spilt & Count2
Blood Detection
Clear All
RESULT
AB
+ve
70
48
85

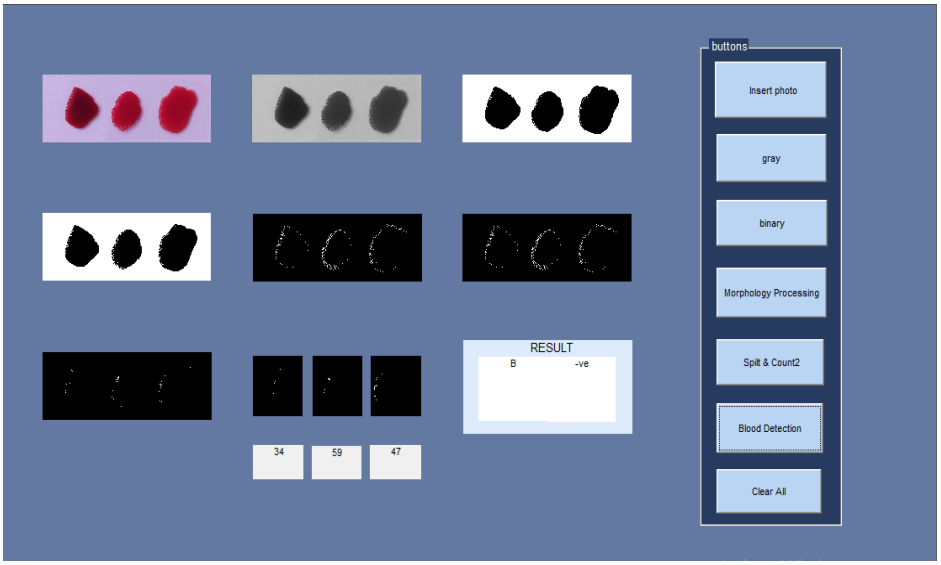
(c)


buttons
Insert photo
gray
binary
Morphology Processing
Spilt & Count2
Blood Detection
Clear All
RESULT
AB
-ve
107
54
46

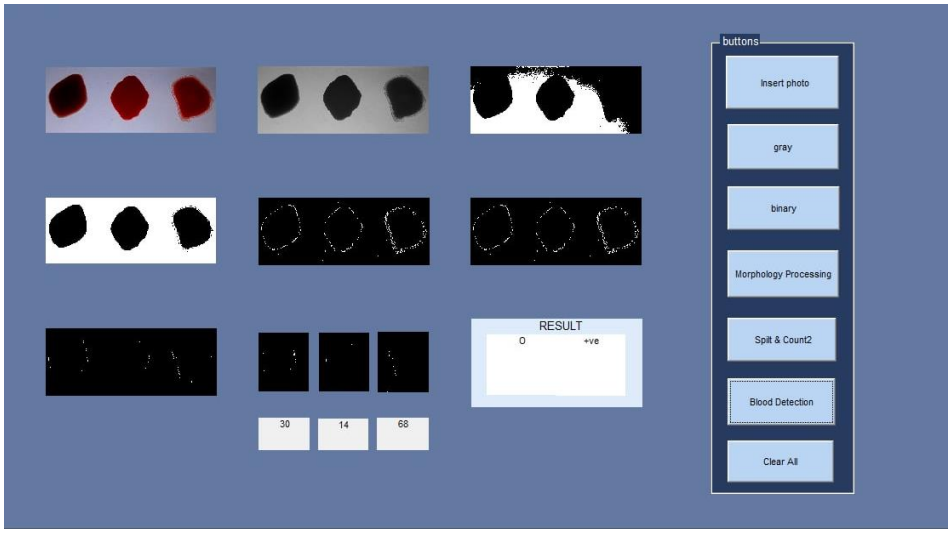
(d)


buttons
Insert photo
gray
binary
Morphology Processing
Spilt & Count2
Blood Detection
Clear All
RESULT
B +ve
28
119
53

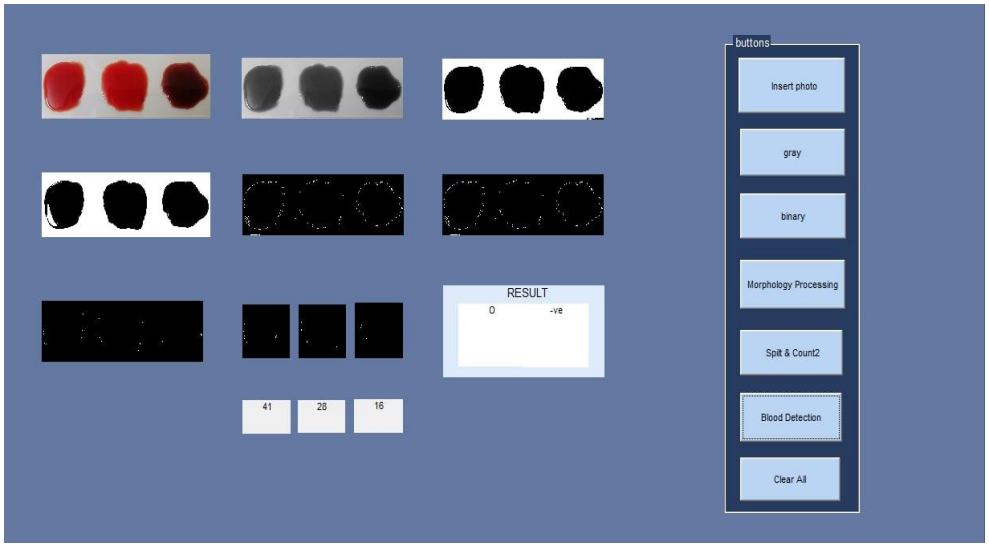
(e)


buttons
Insert photo
gray
binary
Morphology Processing
Spilt & Count2
Blood Detection
Clear All
RESULT
B -ve
34
59
47

(f)


buttons
Insert photo
gray
binary
Morphology Processing
Spilt & Count2
Blood Detection
Clear All
RESULT
O +ve
30
14
68

(g)



(h)

Figure 6. Snapshot GUI screen for blood group detection: (a) A+, (b) A-, (c) AB+, (d) AB-, (e) B+, (f) B-, (g) O+, (h) O-

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

The method developed proves that it is an effective and efficient method to detect 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. In the future it is intended to improve the system developed by making it faster via using camera video without using the image, to send a message to the mobile technician of the laboratory in order to avoid unnecessary travel. In addition, reduce the error from the eye human. Moreover, calculate the time for processing

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