Detection of Blood Group Type and Red Blood Cell Count

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Abstract: Blood group detection and RBC count are significant for blood transfusion and diagnosis of various diseases. Correct determination of blood group is important because if wrong blood group is detected, it may pose a threat to a person's life during blood transfusion. We use the plate test combined with the image processing techniques to detect the accurate blood group. The second part of the paper gives a fool-proof technique of determining the Red Blood Cell (RBC) count. As many life threatening diseases can be diagnosed through RBC count, it is important to determine the RBC count accurately. We use image processing algorithms to determine the exact RBC count. Hence, our paper consists of two parts-first part gives the blood group detection and the 2nd part gives the RBC count.

Index Terms- blood transfusion, agglutination, Hough Transform.

1. Introduction:

Our objective behind combing the two different processes is to avoid the use of laboratories and both can be done simultaneously. RBC count which is usually done manually, requires a substantial amount of time. Combining the module of RBC count with the blood group detection module, will save a lot of time and eliminate the necessity of laboratories. The software is flaw efficient. This system is very useful for common people.

1st part: Blood group detection is an important process which is generally carried out before blood transfusion. Detection done through plate or tube test doesn’t always give accurate results. Therefore to eliminate the risk of wrong detection completely, we use the plate test combined with image processing. First few drops of blood and reagent will be added on the plate. Live and on the spot photo of the plate will be captured and given to the software for further analysis of blood group detection. This technique not only gives an accurate result but is also efficient. The software which we developed for module is completely feasible and can be used by the common people. This technique can find its way in emergencies like road accidents or can be used in hospitals.

2nd part: the second part of our paper is the counting of RBCs. It does not use the photos of the 1st part. Here, we use a dataset of blood images to determine the count using image processing algorithm-Hough transform. We developed a different module to analyse the images and determine the RBC count. Deadly diseases can be diagnosed through RBC count and hence it is important.

Thus, we are combining both the modules in one software for better results and eliminating the need of laboratories.

2. Literature Survey:

Blood group detection is generally done using the plate test and the tube test [10]. These tests require minimal cost and the apparatus is less costly. But absolute accuracy and efficiency is not obtained by these methods. The probability that correct blood group will be determined by the above tests is less. The other methods are microplate testing and gel centrifugation [10]. They need to be handled by trained laboratory technicians. Though these methods guarantee accuracy, the apparatus used in these methods is very costly. They are not used commonly. All the above mentioned techniques possess some disadvantage or the other. As our method uses image processing and plate testing, it overcomes the faults and disadvantages of earlier methods.

RBC count is mandatory for diseases like anaemia and lukemia and all other related to low RBC count. Generally the counting is done manually with the help of a microscope [4]. The blood sample is taken on a plate and it is observed under the microscope for the RBC counting. As this technique includes human involvement, obtaining a correct count cannot be expected. An error margin is generally present. This may pose a risk to the person as medication may be given based on the count obtained by manual technique.
We overcome this flaw by using image processing algorithm [1]. As the process gets automated, risk factor gets reduced to a greater extent. Also it can be carried out in an environment other than laboratories.

3. Proposed system for Blood Group Detection:

1. add few drops of blood and reagents
2. agglutination takes place
3. capture live images of blood sample
4. send the images to the software
5. perform image processing techniques on it
6. give the result

![Flow chart of blood group detection](image1.png)

Our system provides an easy way to administer the blood group detection process. TransClone Anti-RH1 (D), TransClone Anti-RH2 (C) and TransClone Anti-Kel1 (K) are the reagents added to the sample. The reagents and few drops of blood sample are taken on the plate. After agglutination happens, images are captured of the plate and sent to the software for image processing [4].

Below given image processing techniques are applied to the image after sending it to the software:

1. Colour plane Extraction: The colour plane of an image contains the information of the image. Here the RGB components of the image are taken into consideration [5]. No mapping is done, only extraction is done to retrieve the component which has maximum value.

![Colour plane extraction](image2.png)

2. Thresholding: In this, clustering and auto-thresholding is performed. It is an operation for image segmentation. Binary images are obtained from this.

3. Morphological Operations: these operations include hole-filling, removal of smaller objects, removal of border objects. Operations such as closing and erosion are performed. They help in reducing the noise level in the images.

![Auto-thresholding](image3.png)

![Hole-filling](image4.png)

![Removal of small objects](image5.png)

4. HSL Luminance plane: HSL is the abbreviation for Hue, Saturation and Lightness. It is the cylindrical representation of the RGB colour model.

![HSL luminance plane](image6.png)

5. Pattern Matching: Here pattern matching is performed to obtain the accurate blood group. Geometrical pattern matching is also performed here.

6. Quantification: various methods like calculating area, minimum value, maximum value, mean, standard deviation are calculated.

These are the image processing operations which are performed on the images to determine the accurate blood group. It can be done in any environment which has a computer installed with this software. It is easy to use and doesn’t require the assistance or presence of technical laboratory.
staff. Also this system proves to be of great use in the blood donation camps. The plate test method is used because of its fat response time.

4. Proposed System for Red Blood Cell Count:

Blood is a complex structure of many components such as the RBCs, the WBCs, the platelets, etc. As a result obtaining an accurate RBC count manually becomes difficult. Sometimes the cells may overlap resulting in a wrong count of the cells. This may prove to be risky for the patient. Therefore, RBC count is of great importance. Fatigue, breathlessness all are an indication of low RBC count. Hence proper counting of RBCs holds great importance. For proper determination of RBC count, Hough Transform method is used. The proposed system includes 3 parts-various pre-processing techniques, Hough Transform and the isolation and finally counting of the red blood cells. The images are taken from dataset. The operations mentioned above are carried on it. Finally the count is obtained.

1. Pre-processing Techniques: Techniques like edge detection, spatial smoothing filtering and adaptive histogram are applied to the images.

Edge detection is applied to detect sharp edges and to reduce the negative effect of noise on images. We use the Canny operator for edge detection to mark the edges of the cells. The purpose is to capture the important curves and changes in the image.

Spatial smoothing filtering enables to enhance the image intensity. We use the Median filter for filtering. It is an image operation in which each pixel value is change to the intensity in its neighbourhood.

Adaptive histogram equalisation generally helps in improving the contrast of the images.

2. Hough Transform: Feature extraction is the technique applied in Hough Transform [8]. This technique is used to find the red blood cells and segregate them from the other blood components. Generally an edge detector is used to detect the shape of circles or ellipses but they don’t prove to be accurate. Hough transform method is carried out through a voting procedure [3]. This method essentially works by splitting the input image into a set of voting elements. Each such element votes for the hypotheses that might have generated this element. The votes from different voting element pixels are added together into a Hough image. A parameter space is created of an expected range [7]. The range consists of points in two planes. For each edge point in image (i, j), increment all cells which according to the equation of circle could be the centre of circle, these cells are represented by letter ‘a’. Find all possible values of ‘b’ which satisfy the equation:

\[(i-a)^2 + (j-b)^2 = r^2\]

After the voting process local maxima of the cell is searched. Object candidates are obtained from the parameter space. These are used for feature extraction in Hough Transform. Then isolation is performed to separate RBCs from other components.
3. **Counting:** The standard of blood sample is assumed to be 0.1mm. The counting is done per cubic millimetre [9].

\[
\text{RBC count/cumm} = \frac{(\text{RBC counted by Hough Transform/ (input image area/ (magnification*magnification)*film thickness)})*\text{dilution factor}}{\text{dilution factor}}
\]

5. **Results:**

The results obtained for blood group detection through normal procedure and our proposed technique differ through a slight margin. Our proposed system guarantees accuracy of blood group detection. The results obtained for RBC count vary marginally.

<table>
<thead>
<tr>
<th>Image Samples</th>
<th>Radius Range(in pixels)</th>
<th>Blood Counted Manually per cumm(in millions)</th>
<th>Blood Counted methodically per cumm(in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>[2-14]</td>
<td>2.80</td>
<td>2.38</td>
</tr>
<tr>
<td>b</td>
<td>[5-18]</td>
<td>5.82</td>
<td>5.00</td>
</tr>
<tr>
<td>c</td>
<td>[5-14]</td>
<td>3.12</td>
<td>3.02</td>
</tr>
<tr>
<td>d</td>
<td>[5-25]</td>
<td>6.40</td>
<td>6.22</td>
</tr>
</tbody>
</table>

Table 1: calculated result for RBC count

6. **Conclusion:**

Hence, our paper presents a unique combination of detection blood group type and determining the RBC count. The different modules can be used at the same time. Additional time isn’t wasted in laboratories. Using the modules simultaneously enables to achieve time efficiency. Using them in emergency situations is beneficial. Using image processing techniques for RBC count has various advantages like- blood sample is not destroyed during the implementation of the software. Laser based citometers which are used in laboratories destroy the blood sample during the counting procedure. Also this digital image processing technique is available where ever there are provisions for a computer. Our software-module for blood group detection is feasible for common people. Hospitals can use it on a large scale without investing in expensive equipments. Using both the modules in one software provide accurate results.

**References:**