Automated Blood Type Detection System Using Image Processing And Gpu

#1 Rahul Deshpande, #2 Shradha Abhang, #3 Supriya Bhosale, #4 Prof. Yogita Hande

1 rahuuldeshpande@gmail.com
2 shradasabhang@gmail.com
3 supzbhosale@gmail.com

#1234 Department of Computer Engineering, STES’s, Sinhgad Institute of Technology and Science
Narhe, Pune-411041, India

ABSTRACT

Determination of blood type is important before administering a blood transfusion in an emergency situation. Currently, these tests are performed manually by technicians in the laboratory, when the test is handled with a large number of samples, it is monotonous to do and it may lead to human errors. The proposed system aims to develop an embedded system which uses Image processing algorithm to perform blood tests based on ABO and Rh blood typing systems. The proposed system helps in reducing human intervention and perform complete test autonomously from adding antigens to final generation of the result. The proposed system aims in developing results in shortest possible duration with precision and accuracy along with storage of result for further references. Also for obtaining the results quickly and with good precision GPU is used which performs parallel computations Thus, the system allows us to determine the blood type of a person eliminating traditional transfusions based on the principle of the universal donor, reducing transfusion reactions risks and storage of result without human errors.

Keywords— GPU, Blood Samples, pattern matching, Image Processing.

I. INTRODUCTION

Blood Typing system is basically used to determine the blood group that the person possesses. Blood Detection is most important and essential activity. The differences in the blood group of individuals are due to presence or absence of certain protein molecule named as antigens or 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.

[1][2][3] There are 4 major blood groups based on presence or absence of antigen on the surface of RBC (Red Blood Corpuscles) Group A has only the A Antigen on the blood cells. Group B has only the B antigen on the blood cells. Group AB has both Antigen A and Antigen B on their blood cells. Group O has neither Antigen A nor Antigen B on their blood cells. Based on the compatibility of blood groups the blood transfusion is done. Not all the blood groups are compatible with each other. So for safe transfusion of blood determining the blood group is mandatory.

Nowadays blood group detection is done manually by lab technicians but there are some drawbacks of this traditional method like this technique consumes more time. Also in some cases if appropriate blood group is not detected then it may result in the death of an individual.

An automated blood detection system will detect the blood group within a fraction of a second. Also, the manual intervention is less so human errors are completely eradicated.
II. SURVEY ANALYSIS

An A google form has been created to take views about the proposed system from the people who come from a medical background. Their responses have been recorded as shown in the figures. 15, 16, 17 below. The link for the respective google form is https://docs.google.com/forms/d/1nFv2kYGOC_NgJMx96jNGuLMm_zky_Kq3KOGW27DNc/viewform?c=0&w=1

III. PROPOSED SYSTEM

1) Blood Samples
The following are the blood samples of various blood groups taken under the microscope after adding the antigens [4].

A. O Positive Group

Fig.4 shows the O Positive blood group sample on adding Antigen-A, Antigen-B and Antigen-D and 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 respectively.

B. O Negative Group
Fig.5 shows the O Negative blood group sample on adding Antigen-A, Antigen-B, and Antigen-D respectively.

C. B Positive Group
Fig.6 shows the B Positive blood group sample on adding Antigen-A, Antigen-B, and Antigen-D respectively.

D. B Negative Group
Fig.7 shows the B Negative blood group sample on adding Antigen-A, Antigen-B, and Antigen-D respectively.

E. A Positive Group
Fig.8 shows the A Positive blood group sample on adding Antigen-A, Antigen-B, and Antigen-D respectively.

F. A Negative Group
Fig.9 shows the A Negative blood group sample on adding Antigen-A, Antigen-B, and Antigen-D respectively.

G. AB Positive Group
Fig.10 shows the AB Negative blood group sample on adding Antigen-A, Antigen-B, and Antigen-D respectively.
H. AB Negative Group
Fig.11 shows the AB Negative blood group sample on adding Antigen-A, Antigen-B and Antigen-D respectively.

I. Invalid blood sample
Fig.12 shows the invalid state of a blood sample on adding Antigen-A, Antigen-B and Antigen-D respectively.

2) Image transformations
After adding antigens (A, B, D) to the blood sample, the image is captured as shown in fig. 13

This image is then converted into a black and white image as shown in fig.14 below.

This image is then converted into an HDR image for further processing.

After obtaining HDR images of a blood sample, histogram evaluation is performed on it. As shown in fig.16 below.

3) Steps in image classification
In the Fig. 17 CL1, CL2, CLn refers to the classes or categories that images are classified into. Input the process is the original image captured. In step 1, pre-processing is required before applying any image analysis methods. The original images are normalized, converted into a black and white image and then are converted into High Dynamic Range (HDR) format and passed further for performing histogram equalization. This step 1 is collectively called as the pre-processing stage of images in the image classification process. In step 2, feature extraction, using the suitable transformation to decompose an image is done. The features of images are the input to our classification system. Finally, images are classified into the responsive classes by the SVM. The conversions are done Graphical Processing Unit (GPU) for faster computations in the process of image classification.
4) Image Feature Extraction

The extraction of image features is the necessary step for image classification [5]. There are various types of features for image classification’s aim as follow: color and shape features, statistical features of pixels, and transform coefficient features.

5) Support Vector Machine

In machine learning, support vector machines (SVMs)[6][7] are supervised learning models with associated learning algorithms that examine data and identify patterns, used for classification and regression analysis. Support Vectors Machines have recently shown their ability in pattern recognition and classification. Given a set of exercise examples, each marked for belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier.

<table>
<thead>
<tr>
<th>Antigen</th>
<th>A</th>
<th>B</th>
<th>D</th>
<th>Control</th>
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<tbody>
<tr>
<td>O+</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>O-</td>
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<td>A+</td>
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<td>A-</td>
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<td>AB-</td>
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Table 1: SVM Result

An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on. SVM is one of the best-known methods in pattern classification and image classification. It is designed to separate a set of training images into two different classes,

\((X_i, y_i), (x_2, y_2), (x_n, y_n)\) where \(x_i\) in Rd, d-dimensional feature space, and \(y_i\) in \{-1, +1\}, the class label, with \(i=1...n\) [1]. SVM builds the optimal separating hyperplanes based on a kernel function (K). All images, of which feature vector lies on one side of the hyperplane, are belong to class -1 and the others are belong to class +1. Given a set of points which belong to either of two classes, a linear SVM finds the hyperplane leaving the largest possible fraction of points of the same class on the same side while maximizing the distance of either class from the hyperplane.

IV. CONCLUSION

The proposed system aims to develop an embedded system which uses Image processing algorithm to perform blood tests based on ABO and Rh blood typing systems. The input taken to this system is a blood sample whose images are captured and forwarded to the image processing algorithm. It uses SVM for classification of images and pattern matching algorithms for matching of images. It makes use of GPU for faster computation of the process of blood detection.

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