DESIGN AND DEVELOPMENT OF BLOOD SAMPLE ANALYZER USING INTELLIGENT MACHINE VISION TECHNIQUES

Dr.HENRY

Department of Mechanical Engineering, Adhi College of Engineering and Technology, Chennai, India.

Email: nalini1221@gmail.com

ABSTRACT

The implementation of a new methodology to design and develop an intelligent portable blood analyzing device to detect blood group identification and blood count applications in RBC and WBC. The analysis of blood testing is done using the feature extraction of blood samples in image processing and by using an adaptive Hough transform techniques. The aim of this project is for switching over from manual method of blood grouping to the automated method which is used to decrease the risks of human error and ensure reliability and traceability in each step of the test performed. The simulation of blood group identification is done with the help of MATLAB 15 software. The hardware is done using the python language in Raspberry pi processor.

The blood cell smears and blood group images were obtained from APOLLO Specialty Hospital, Perungudi. The proposed image processing based identification of blood groups of different patients will be very helpful for automatic, sleek and effective diagnosis of the groups and the diseases.

I. INTRODUCTION

The practice of analyzing blood cells to find the behavior of antigens that are available in a blood sample is called as Blood Group (BG) typing. Blood Group types deals with a unique chemical reaction between a particular antibody and BG antigens to observe agglutination or blood clamping. In this way, the needed information about the behavior of those particular antigens can be acquired. There is a broad distinct analytical exams and tools for BG typing, including some classical ones, such as tube or slide tests, whereas micro plate and gel centrifugation are comparatively modernized technique for blood group typing. In addition, nucleic acid amplification techniques are feasible, especially in those cases where BGs are difficult to identify by serological methods. The ultrasound back scattering strategy was also exploited for blood typing to monitor the agglutination reaction. This method offers suitable quantitative information about the agglutinated particles at an early stage and it also explains the effect of shear stress on agglutinate equilibrium. In both classical and advance techniques, there is a compromise between sensitivity, time of analysis and ultimate cost of that specific test. Furthermore, in some techniques, highly-trained personnel are required for interpreting blood typing analysis reports. Therefore, it is difficult to prefer a single testing method that offers sensitive and speedy results at a relatively low cost.

Before performing a blood transfusion, it is necessary to perform certain tests that are properly standardized. One of these tests is the determination of blood type and this test is essential for the realization of a safe blood transfusion, to administer a blood type that is compatible with the type of receiver. However, there are certain emergency situations which due the risk of patient's life, it is necessary to administer blood immediately. In these cases, as the tests currently available require moving the laboratory, it may not be time enough to determine the blood type and is administered blood type 0 negative considered universal donor and 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 and interpretation of the results.

In routine clinical analysis, there is a wide range of established procedures and practices for blood typing, where nearly all of them deal with the formation of agglutinates. Even though some of these classical methods are not highly sensitive, nonetheless, they still hold importance in ABO grouping tests. There is a wide range of blood typing techniques, which differ from each other in terms of sensitivity, reagents and equipment required, the time of operation and throughput analysis. Herein, we describe some general approaches of blood grouping along with their inbuilt advantages and drawbacks.

II. LITERATURE SURVEY

An overview for my proposed work involved the following list of survey papers discussed:

Richard R. Jahan-Tigh, Et al., **"Flow Cytometry"**, Journal of Investigative Dermatology (2012) explains the information on various cellular process and measures the characteristics of individual cells. It is also capable of sorting cells. The causes of this technology are that, there is a requirement of highly trained operators, the installation costs of flow cytometry are very expensive and it provides enormous amount of information that we do not need for any kind of analysis,Thejashwini M & M C Padma **"Counting of RBC's and WBC's using Image Processing Technique"**, International Journal on Recent and Innovation Trends in Computing and Communication Volume:3 Issue:5, determines the counting of blood cells that has been done in three microscopic blood image of each patient which is done manually using the formulae after image processing and Hough transform. So, the manipulation error occurs and YogitaNamdeo Pore, Yoginath R. Kalshetty**"Review on Blood Cell Image Segmentation and Counting"**, International Journal of Application or Innovation in Engineering & Management(IJAIEM) Volume:3 Issue:11, investigates the number of methods and algorithms to review the performance of blood cell segmentation and counting. The disadvantage is that there is no single method gives the absolute results and each method has its own drawbacks.

III. PROPOSED METHOD

The slide test is relatively the least sensitive method among others for BG determination, but due to its prompt results, it is very much valuable in emergency cases. In this method, a glass slide or white porcelain support is divided into three parts, as for each part, a drop of donor or recipient blood is mixed with anti-A, anti-B and anti-D separately. The agglutination or blood clumping pattern can be visually observed from which the ABO and rhesus D (Rh D) type of blood can be determined. The test completes in 5–10 min and is inexpensive, which requires only a small volume of blood typing reagents. However, it is an insensitive method and only useful in preliminary BG matching for getting an early result. The test cannot be conducted for weakly or rarely reactive antigens from which the results are difficult to interpret, and additionally, a low titer of anti-A or anti-B could lead to false positive or false negative results. Although the slide test is useful for outdoor blood typing, it is not reliable enough for completely safe transfusion.

Figure 1: Blood Grouping–Slide Method

The aim of this paper is to develop an embedded system which uses Image processing algorithm to perform blood tests based on blood typing systems. 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.

This paper helps in reducing human intervention and perform complete test autonomously from adding antigens to final generation of the result and provides the results in shortest possible duration with precision and accuracy along with storage of result for further references. Implementing a quality system in the laboratory minimizes errors and ensures that the right test is performed on the right sample, the right results obtained and the right blood product provided to the right patient at the right time.

The proposed system presents the design and implementation of intelligent portable device which provides the proper information that we need for the analysis with reduced cost and the highly trained operators are not required.This system uses a machine learning algorithm like neural network which supports MATLAB software for blood group identification and detection of blood count analysis.This system also finds out a solution using different algorithms and techniques which gives us maximum accuracy in blood group identification and counting.

3.1 BLOCK DIAGRAM

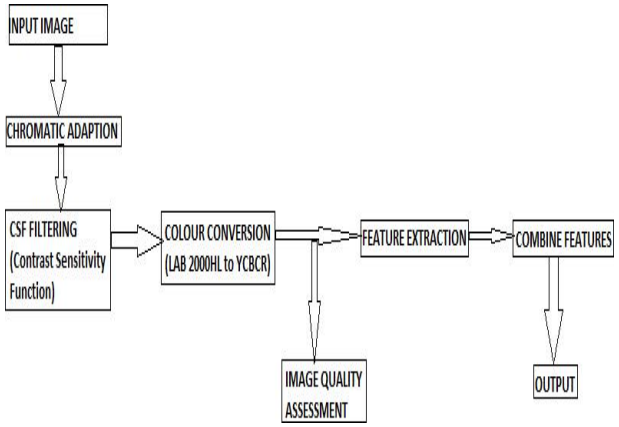

Figure 3.1: Block Diagram of Proposed System

In an input image, the natural scene image for text detection we give as input image. The input image is a photograph or video frame. Chromatic adaptation is one aspect of vision that may fool someone into observing a color-based optical illusion, such as the same color illusion. An object may be viewed under various conditions. For example, it may be illuminated by sunlight, the light of a fire, or a harsh electric light. Contrast sensitivity function (CSF) is a type of filter which is a subjective measurement of a person's ability to detect a low contrast pattern stimuli, usually vertical stripes of decreasing shades of black to grey. The resulting measurement is said to give a more accurate representation of the eyes' visual performance. Colour conversion converts the RGB values in map to the YCbCr color space. Map must be an M-by-3 array. YCbCr map is an M-by-3 matrix that contains the YCbCr luminance (Y) and chrominance (Cb and Cr) color values as columns. Each row in YCbCf map represents the equivalent color to the corresponding row in the RGB color map, map. Pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative, non-redundant, facilitating the subsequent learning and generalization steps, in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be redundant, then it can be transformed into a reduced set of features (also named features vector). This process is called feature extraction. The extracted features from input image using color conversion methods, the most relevant features under color bands are combinedto get new image.

IV. ALGORITHMS

- Color conversions
- Thresholding technique by Image Segmentation
- Morphological Process by using Segmented Image
- Dilate image
- Erode image
- Open filter
- Close filter

4.1 COLOR CONVERSIONS

The RGB color input image is converted into Grey scale image, iycbcr image and then it is converted into binary image with the threshold value of 0.5. Map must be anM-by-3array.

4.2 THRESHOLDING TECHNIQUE BY IMAGE SEGMENTATION

Segmentation decomposes the image into parts for further analysis. Partitioning an image into regions corresponding to objects. All pixels in a region share a common property. The simplest property that the pixels can share is intensity. Thresholding is used for the separation of lights and dark regions.

Image thresholding classifies pixels into two categories:

- Those to which some property measured from the image and falls below a threshold and those at which the property equals or exceeds a threshold.
- Thresholding creates a binary image called binarization. For example: perform cell counts in histological images.

4.3 MORPHOLOGICAL PROCESS BY USING SEGMENTED IMAGE

It deals with tools for extracting image components. It is used for processing pixels at image borders i.e. Padding behaviour. Morphological functions position the origin of the structuring element, its center element, over the pixel of interest in the input image. For pixels at the edge of an image, parts of the neighborhood defined by the structuring element can extend past the border of the image.

To process border pixels, the morphological functions assign a value to these undefined pixels, as if the functions had padded the image with additional rows and columns. The value of these padding pixels varies for dilation and erosion operations.

4.4 DILATIE IMAGE

The value of output pixel is maximum. Pixels beyond the image border are assigned the minimum value afforded by the data type. For binary images, these pixels are assumed to be set to 0. For grayscale images, the minimum value for uint8 images is 0.

4.5 ERODE IMAGE

The value of output pixel is minimum. Pixels beyond the image border are assigned the maximum value afforded by the data type. For binary images, these pixels are assumed to be set to 1. For grayscale images, the maximum value for uint8 images is 255.

4.6 OPEN FILTER

Opening an image starts with an erosion operation, light regions that are smaller than the structuring element are removed. The dilation operation that follows ensures that light regions that are larger than the structuring element retain their original size.

4.7 CLOSE FILTER

Closing an image starts with a dilation operation, dark regions that are smaller than the structuring element are removed. The dilation operation that follows ensures that dark regions that are larger than the structuring element retain their original size.

V. RESULTS AND SIMULATION

When entering the statements in command window, MATLAB immediately adds a variable to the workspace and displays the result in the command window. When an output variable is not specified, MATLAB uses the variable answer, short for answer, to store the results of any type of calculations.

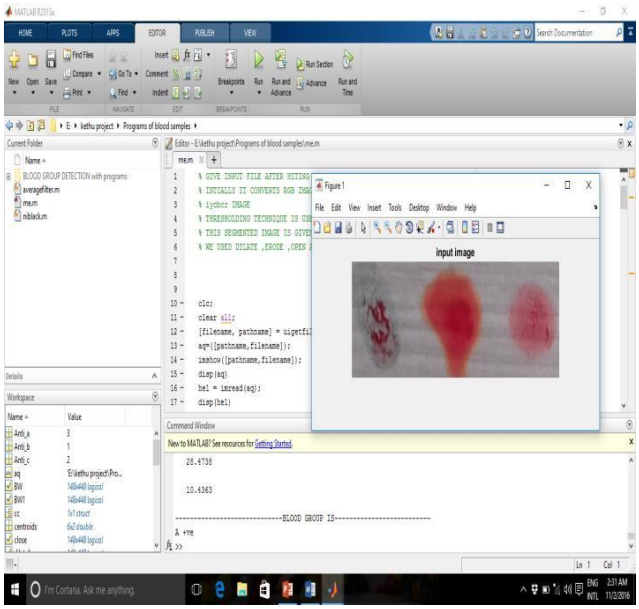

Figure 5.1: Simulation of Input Blood Sample

Command window displays the resulting values of every command which is given in the program that is written in Editor window. From this project, the pixel values of the input image can be viewed easily through the command window and the corresponding input image can be viewed in figure 5.1

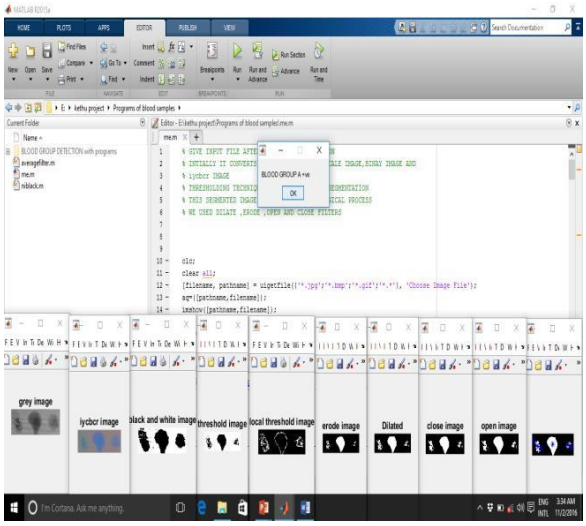

Figure 5.2: Simulation of Output Blood Sample

The images of the blood samples to be identified are given as input. The images can be viewed multi dimensionally in 3ways i.e.(HSV) H-Hue, S-Saturation, V-Vector by segmenting the image and by extracting the features called as thresholding. The images of those features are obtained in the form of different dialog boxes with different algorithms that has been coded. After extracting the features, the minor and the major axis that are present in the blood sample are identified by reducing the liquid blood spills in between i . e. noise. After the i dentification of blobs, the blood group of the blood sample isrecognized with the help of awarningdialogue box.

VI. CONCLUSION

Blood Group Typing is analyzed by using the different algorithms and methodologies that are needed in extracting the features. It is used to avoid the manual analysis of blood grouping and the occurrence of the manipulation errors in laboratories. The coding is done in MATLAB software. Hence, the result of blood group identification is obtained which makes the operation rapid and accurate with better efficiency. The components selected and its test results analyzed in Simulation will be implemented in real time environment. Thus, the test result can be verified in hardware part.

REFERENCES

a) *Richard R. Jahan-Tigh, Caitriona Ryan, GerlindeObermoser and Kathryn Schwarzenberger,* ***"Flow Cytometry"****, Journal of Investigative Dermatology (2012)*

b) *Thejashwini M & M C Padma* ***"Counting of RBC's and WBC's using Image Processing Technique"****, International Journal on Recent and Innovation Trends in Computing and Communication (2015), Volume:3, Issue:5*

c) *YogitaNamdeo Pore, Yoginath R. Kalshetty****"Review on Blood Cell Image Segmentation and Counting"****, International Journal of Application or Innovation in Engineering & Management(IJAIEM), Volume:3, Issue:11*

d) *Min Zhang, XuanqinMou, and Lei Zhang, "Non-Shift Edge Based Ratio (NSER): An Image Quality Assessment Metric Based on Early Vision Features", IEEE Trans. Image Process vol. 18, NO. 5, MAY 2011*

e) *Lehmann T.M., Wein B., Dahmen J., Bredno J., Vogelsang F. &Kohnen M.: "Content based image retrieval in Medical applications: a novel multi step approach" International Society for Optical Engineering (SPIE), 3972, pp.312-320 (2000).*