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A Literature Review on Blood Group Detection Techniques

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Abstract: Ensuring accurate blood classification is imperative prior to administering a transfer of blood from one individual to another during emergency scenarios. Currently,performing these assessments conducted conducting this task laboratory specialists, and when handling a large volume of tests, it becomes tedious and mayresult in errors attributable to humans. This paper proposes the replacement of manual labor in clinical laboratories for the identification of blood groups . The proposed system aims to develop an embedded system utilizing image processing algorithms to conduct blood tests based on blood typing systems. Through a review of various existing methods and their performance evaluation, this paper aims to assist researchers in their endeavors

Keywords: Antigen, Blood Samples, GPU, Histogram, LBP (nearby paired example),Nearest Neighbor Classifier, Image Processing, Pattern Matching.

I. INTRODUCTION

Before administering blood from one individual to another, it conducts specific tests to confirm blood grouping. This test is crucial to ensure a safe blood transfusion by matching the recipient's blood type with compatible donor blood. In particular critical scenarios where time is limited, immediate blood administration may be necessary. Currently available tests require sending samples to a laboratory, which may not be feasible in urgent cases. In such situations, O negative blood is often used as a universal option with lower risk of compatibility issues. However, even with reduced risk, transfusion reactions can still occur, emphasizing the need to match the patient's blood type and use appropriate blood units whenever possible. Manual testing by experts can occasionally lead to human errors in the process, analysis, and interpretation of results. Given the potential fatal consequences of these errors, it is crucial to automate these tests and the reading of results. Blood grouping determines specific blood groups and plays a vital role in emergencies and transfusions, as it identifies antigens that can trigger immune responses if they are unfamiliar to the body.

Blood types are determined by the presence of antigens and antibodies. Antigens are small particles found on RBCs, including proteins, nucleic acids, polysaccharides, glycolipids, and sugars. These antigens, known as agglutinogens, elicit a response from specific antibodies called agglutinins. Antibodies are found in the plasma of the blood.A blood type, also known as a blood group, its classification is based on the presence or absence of inherited antigenic substances found on the surface of red blood cells. These substances can vary, including proteins, sugars, glycoproteins, or glycolipids, depending on the specific blood group system. Blood groups are distinguished by the presence of distinct antigens and antibodies.

In the bloodstream, antigens function as triggers for the immune system, prompting the production of antibodies. These antigens can encompass a range of agents like bacteria, viruses, or parasites, which are responsible for causing infections and diseases. Antibodies, also termed immunoglobulins, are proteins manufactured by the body to combat foreign substances known as antigens. Upon encountering antigens, the immune system is activated to generate antibodies.

Antibodies attach they attach themselves to antigens and render them inactive, enabling other bodily processes to eliminate and eradicate foreign substances. Multiple blood group systems exist, but the two primary ones are the ABO blood system and the Rhesus blood system. Among these, the ABO blood system holds the greatest significance in human blood transfusions, as it is determined by the presence of A and B antigens on the surface of red blood cells. The corresponding anti-A and anti-B antibodies are of the immunoglobulin class. Blood is categorized into four major groups under the ABO system: A, B, AB, and O. Group A contains only the A antigen, Group B solely presents the B antigen, Group AB exhibits both A and B antigens, while Group O lacks both A and B antigens. Individuals with AB blood type lack A or B antibodies, making them universal recipients capable of receiving any blood type. Conversely, those with O blood type lack A or B antigens, rendering their blood resistant to agglutination by

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recipient antibodies, thus qualifying them as universal donors. There maining sections of the paper are structured as follows: Chapter 2 provides a review of recent methods utilized for detecting glaucoma disease, while Chapter 3 examines various methods employed for blood group detection. In Chapter 4, the results obtained by different researchers are analyzed, and the final chapter concludes the findings and highlights any gaps identified in the entire survey.

II. LITERATURE SURVEY

T.M. Selvakumari[2] explores blood group identification using fiber optics. The transmitter emits pulses at a frequency of 10 kHz, which are then amplified and directed to an LED. Optical variations are obtained by converting electrical signals, which are then transmitted through a blood sample via fiber optics and received by a collector. The received optical signals are converted back into electrical signals, which are subsequently amplified, filtered, corrected, and fed into a capacitor filter. The output voltage varies for different blood groups. However, the Rh blood group has not been studied yet. Considering other optical properties such as scattering and reflection could potentially enable the measurement of the Rh factor.

Priyadharshini. R, Ramya. S, Kalaiyarasi[1] present a novel approach to identifying blood groups using laser technology. This method relies on laser-induced changes in blood sample density due to clotting. The laser beam passes through blood specimen onto a photocell, stimulating it and resulting in a voltage measurement of 2.5 volts. When an antigen is added to the blood sample, clotting occurs, leading to increased sample density and a decrease in photocell voltage. This change is compared with a reference voltage using a comparator, determiningblood specimen compatibility. Rapid and accurate blood group specimen identification is crucial, especially during urgent circumstances where traditional methods may be slow.

Brinkhaus O, Giers G, Hanfland introduce electronic data processing to streamline blood group serology. They propose using centrifugal racks with transparent bases for efficient processing and reading of up to 32 blood samples in one batch. This semi- automated method reduces manual labor by approximately 50%. Blood plays a crucial role in the human body, transporting oxygen, nutrients, regulating pH, and performing various immunological functions. Any blood type comprises red blood cells (RBCs) for oxygen transport, white blood cells WBCs for immune response, and platelets for clotting. In emergencies where significant blood loss occurs, transfusions are necessary. While saline solution can sometimes be used as a blood substitute, transfusions with red blood cells may be required. The discovery of over 30 blood groups, with ABO being the most significant, has led to various classification systems of specific antigens. Ensuring accurate blood matching between donor and recipient is crucial to prevent adverse reactions such as agglutination, and fatal. Automating blood specimen identification processes is essential for obtaining precise results, especially in critical situations. Despite the development of several automated systems, none provide immediate results. Hence, there is a need for a system capable of rapid and accurate blood group identification, particularly during emergencies. Traditional lab methods involve time-consuming steps such as placing blood samples on white plates, mixing with anti- serums, waiting for reactions, and analyzing the results. However, in disaster scenarios where specialists are scarce, an image processing-based application could provide invaluable assistance, delivering accurate results swiftly.

III. METHODLOGLY

a. Blood specimen detection

In our proposed approach, reagents are combined with three blood specimens. Subsequently, agglutination might ensue. Once agglutination is observed, the slide is photographed and subjected to processing via the MATLAB image processing toolbox. This framework offers a substantial reduction in the likelihood of human errors. The image processing methods utilized for blood group identification encompass

Pre-processing techniques Thresholding Morphological operations

For this envisioned approach, Several preprocessing methods were employed, such as color plane extraction and gamma correction. The preprocessing of images can greatly enhance the reliability of optical analysis. Different filtering operations, aimed at enhancing or reducing specific image details, facilitate easier and quicker evaluation. Users can improve the quality of a camera image with just a few clicks. Filtering involves a variety of image filters for enhancement, including edge enhancement, noise suppression, and character adjustment. Image processing encompasses a range of functions for manipulating images, such as contrast enhancement through static or dynamic binarization, lookup tables, or image plane segmentation. Furthermore, resolution reduction is achieved through binning and image rotation.

An image $f(x,y)$ typically comprises light objects against a dark background, which allows for the separation of light objects from the dark background using an edge value T. Any image point (x, y) where $f(x,y)>T$ is considered an object or foreground point, while the rest are categorized as background points.

b. The Fabric Strip Based Diagnostic Tester

It employs it containing biochemical agents to identify particular biomarkers. Upon sample application, interactions with these agents produce observable color or pattern changes, indicating biomarker presence or absence. This diagnostic tool offers a straightforward, swift, and economical means for point-of-care testing across diverse healthcare environments.

c. Image Processing

Image processing entails the manipulation of digital images to improve or extract information for analysis or visualization purposes. It encompasses a spectrum of methods, including filtering, enhancement, segmentation, and feature extraction. These techniques are applicable to various image types, ranging from photographs to medical and satellite images. Image processing holds significance across diverse domains such as medical diagnostics, remote sensing, surveillance, and digital imaging. Ongoing advancements in image processing algorithms and technologies fuel progress in fields like computer vision, artificial intelligence, and image recognition.

d. Image Pre-processing

Preparing digital images for subsequent analysis or processing involves image pre-processing, which employs various techniques to enhance quality or extract pertinent information. Typical pre-processing steps include reducing noise, enhancing contrast, normalizing, and resizing. These steps are geared towards optimizing the accuracy and efficiency of subsequent image processing tasks, like object detection, classification, or segmentation. Image pre-processing is indispensable in domains such as computer vision, medical imaging, remote sensing, and machine learning, where precise data is critical for reliable analysis and decision-making.

IV. RESULT

The findings from various researchers, employing diverse methods for blood specimen detection, reveal a range of accuracies spanning from 93% to 99.0%. This indicates an opportunity for new researchers to enhance the classification accuracy by up to 1% or explore on these methods on alternative datasets. Additionally, it's noteworthy that certain experimental outcomes demonstrate high accuracy even without the utilization of any soft computing techniques. Hence, in the foreseeable future, there is potential for the integration of soft computing techniques to further enhance accuracy levels.

V. CONCLUSION

This review paper introduces several frameworks designed to identify blood group types using MATLAB algorithms. Initially, a colored image captured by a digital camera is imported into the MATLAB application and converted into the HSV color model. Subsequently, an edge detection method is applied, followed by the extraction of derivatives and focusing on the region of the blood image. Then, utilizing this processed image, the blood group is classified.

The Image Processing technique exhibits the highest accuracy, reaching 99.00%, compared to other techniques. In the future, the utilization of different datasets and the application of soft computing techniques may be explored to further enhance accuracy.

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