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Artificial Intelligence and Image Processing Techniques for Blood Group Prediction

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Abstract—The classification and prediction of blood group is most important aspect for the transfusion of blood. In present situations, they are done in laboratory using manual process. This is a time-consuming process and hence need manual energy. To overcome the constraints in the prediction of conventional methods in blood group, the artificial intelligence is implemented. This includes the image processing techniques with segmentation process to detect the classification of blood group. They are done through MATLAB simulations to detect the blood components. Through collecting the blood samples and processing and classified the images with feature extraction leads to govern the variety of blood based on ABO and Rh group systems. To overcome the drawbacks in the conventional process, the developed methodology is implemented. This reduces various manual errors. Thus, the image processing technique with artificial intelligence helps to determine the classification of blood rapidly without any errors.

Keywords—Transfusion, blood group prediction, artificial intelligence, image processing, segmentation, feature extraction, pattern recognition

I. INTRODUCTION

In medical field, the determination of blood group is the fundamental tool for diagnosis and operations. The combination of liquids and solids are termed as the blood. The constituents of blood include water and plasma. The blood is the circulatory part in human body [1].

It is source for transporting the necessary substances such as nutrients, proteins, lipids and immunity. They help to fight against various diseases. Nearly 80% of population in the world donate their blood which saves millions of lives. They are estimated and detected through the innovative techniques. To overcome the conventional methods in testing the blood samples, the AI is introduced. There are numerous categories of blood assemblage. The most complicated blood transfusion is the ABO blood organization. The blood groups are eight kings based upon the ABO and Rh blood schemes [2], [3]. These blood group vary for every individual. The blood is combination of red blood cells, white blood cell and plasma. The blood hold a pH level. There are various disease occur through the blood transfusion. This includes anemia, HIV and certain diseases. They are transmitted through the components in the blood. Before the transfusion of blood to the patients, the exact information regarding the blood group is essential to analyze and detect [4].

This helps to save the patients from various complications. The red blood cells are denoted as the oxygen carrier whereas the white blood cells are used to enhance immunity process that is used to fight against the infection. The important composition of the blood includes platelets [5]. The process of clot is attained through the platelets. This helps in freeze of blood within a specific period of time at the time of any external injury. Delay in the clotting time leads to severe complexity that leads to threat for life. Thus the clotting time must be in range to avoid various consequences [6]. The reduction in the count of platelets in the blood composition leads to the lack of coagulation. Hence the platelets count must be maintained accordingly [7], [8]. This leads to blood transfusion. In case of any emergency or any accidents, the blood transfusion is necessary to save lives. To donate or acquire blood, one must know the blood group.

The analysis of blood group must be done in a careful manner to avoid various consequences. Any deviation or careless in the detection of blood group leads to complete loss of consciousness and leads to fatal. Thus the determination of blood group is the important part for both the donors and patients [9].

In some situations and circumstances, the saline solution is used as a replacement for blood. They forms an important role in supply of oxygen to whole body. Hence the analysis of blood group is done in laboratory and it consumes time. This is the conventional process for the identification of blood group [10], [11]The manual detection of blood sample leads to time consuming with various careless due to overload of work. This is also leads to inaccurate reports. These includes the collection of blood samples and then placing in a glass slide. Then it is mixed with anti-serum and need to observe change occurs in the blood sample. Based upon the observations performed, the blood samples are denoted and classified accordingly. The laboratory process of checking and analyzing the blood group is done through the glass slide verification process [12]–[14].

They are done through antigens mixed with the blood samples. These antigens are may combine or may not combine with the blood samples. The next stage includes the detection of blood clumps. If the antigen A and D is found in the blood sample then it is termed as A positive blood group . If the

clumps are detected in the antigen D then it is denoted as the A negative blood group. The knowing of blood group is most important part which is used for numerous prominent task. This helps in versatile ways. They are used for the detection of various diseases in human body. The initial stage for the observation of the infections and diseases are analyzed through the blood sample and based on its group [15].

This is a manual technique for identification. The estimation of detecting the blood group must be done with higher precision and accuracy. Thus to obtain exact results, the image processing techniques are obtained. These rapid detection of blood group helps to obtain faster results . The field of image processing plays an important role in the field of medicine [16].

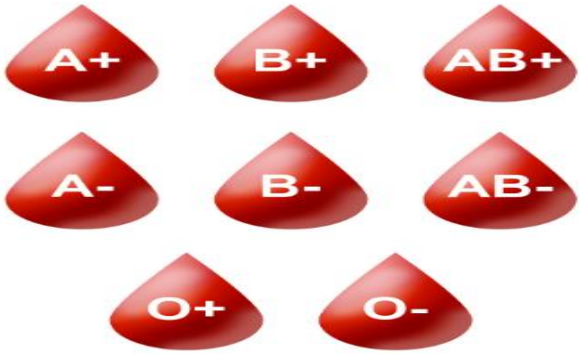

Fig. 1. Classification of blood group

The figure 1 represents the classification of blood group. Due to various emergency situations, the manual determination of evaluation of blood group is highly difficult. Thus the automation in the detection of blood group is employed [4], [6], [9].

In those emergency condition, prior detection of blood group must be an efficient way. In order to avoid severe conditions, the transfusion of blood must be done in a proper way with higher care. Since transfusion of different blood samples leads to fatal. Hence accuracy in the prediction of blood samples is the essential way. This helps to identify various diseases automatically without the human interference. This is followed through the artificial intelligence techniques. These innovative technology helps in the detection of diseases to aid the doctors and medical practitioners to save time and obtain results accurately. The detection of blood group includes several stages. The advanced technology helps to detect the blood sample as soon as possible. This in turn saves time. Various complicated disease are identified and diagnosed through the image processing and recognition techniques [17]–[19].

TABLE I. CRITERIA OF BLOOD GROUP

Blood type	Anti A	Anti B	Anti C
AB –ive	1	1	0
O +ive	0	0	1
O –ive	0	0	0
AB +ive	1	1	1
B +ive	0	1	1
A +ive	1	0	1
A -ive	1	0	0
AB –ive	1	1	0

The table I shows the criterion that are needed to satisfy the identification of blood group. These are necessary and basic level for detecting the blood group.

The image processing includes face recognition and fingerprint recognition techniques. This helps in the faster recovery process. Various diseases such as diabetic retinopathy and brain tumor are detected through image processing techniques. They helps to detect the disease accurately based upon the images obtained and comparison done. These advanced technologies helps the medical practitioners to provide treatment rapidly based upon the accurate predictions of disease. Thus the image processing plays a substantial part in the advancement and modernism occurred in diverse fields [6], [20], [21].

II. PROPOSED SYSTEM

The classification and detection of the blood group are done accurately through the image processing techniques with deep learning. These includes the classification and differentiating the various components in the blood samples. It includes the collection of raw blood images and process them in MATLAB to obtain the images similar to the predefined images. This helps in the classification of blood samples. This process includes the blood sample images and process them. The blood sample is collected in a transparent glass and allowed to combine with anti-serum and then it is captured in pixels. These images are then processed through the image processing techniques. This helps to save time through automatic detection of blood group in simulation platform. They are obtained through the deep learning techniques. This includes the collection of numerous data and process them to obtain the optimum results. These numerous amount of information are processed in the hidden layer with activation function. The image processing techniques involves the calculation of numerous iterations. This includes the data to be processed to obtain the similar image compared with the predefined images in dataset.

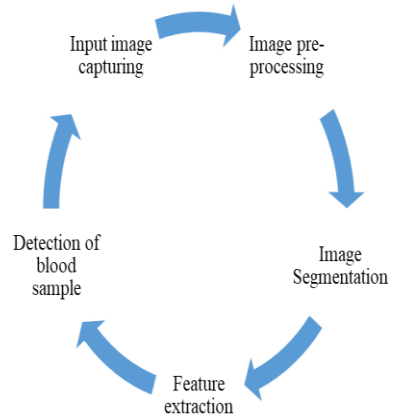

Fig. 2. Stages in blood group detection

The figure 2 demonstrates the various stages in the blood group detection techniques.

III. Prediction of Blood Group Using Image Processing Techniques

The image processing techniques involves various stages to calculate and predict the blood group. This helps to detect the classification of blood group without any manual errors. The image processing technique automatically process the data and provides the exact output. They are optimized through the logical regression algorithm. This includes the following stages [9], [22], [23].

A. Pre-processing step and collection of blood samples

The pre-processing stage includes the collection of blood samples in a transparent glass slide. The transparent glass must be clean and free from microorganisms. They are allowed to mix with anti-serums such as antigen A, antigen B and antigen D. Then they are allowed to keep for seconds. This leads to obtain small clumps on the glass slide. Then the formed clumps are taken as images through camera in pixels. The numerous blood samples are collected and done in the same process.

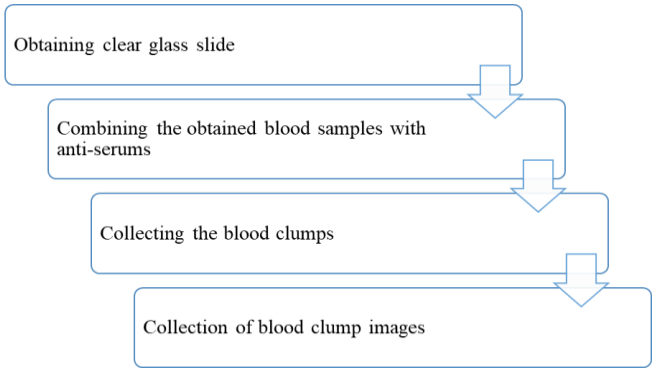

Fig. 3. Pre-processing

The figure 3 represents the pre-processing stage. This is proceeded with feature extraction and segmentation.

(ii) Classification of blood through feature extraction techniques

The collected blood samples are then processed through the process of segmentation. This is done through the splitting the obtained blood clumps images. This helps to obtain the clear images to extract the accurate information.

The obtained data are processed and calculated and saved in the original dataset for further reference. This helps to reduce the unwanted data and save the important data in the dataset. It also helps to reduce the terminated data. The collected data are stored in the dataset and compared with the original data to obtain the results. Thus the components in the blood are compared with the components that helps to obtain the blood group detection.

```
# Print the Confusion Matrix and slice it into four pieces

from sklearn.metrics import confusion_matrix

cm = confusion_matrix(y_test, y_pred_test)

print('Confusion matrix\n\n', cm)

print('\nTrue Positives(TP) = ', cm[0,0])

print('\nTrue Negatives(TN) = ', cm[1,1])

print('\nFalse Positives(FP) = ', cm[0,1])

print('\nFalse Negatives(FN) = ', cm[1,0])
```

Fig. 4. Segmentation through code

The figure 4 represents the segmentation code. Then the image is reduced dimensionally and forwarded with feature extraction. The feature extraction is the technique of obtaining the exact information from the raw data.

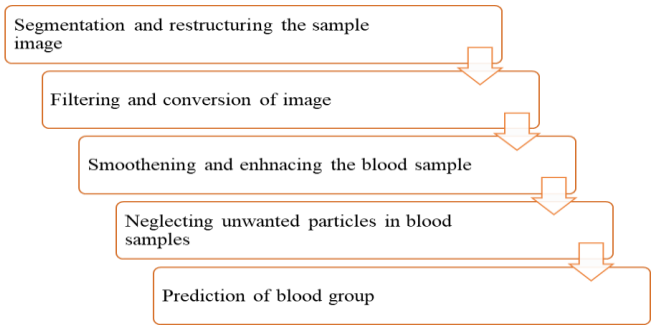

Fig. 5. Feature extraction techniques

The figure 5 represents the feature extraction techniques. This helps to compare with original image to the obtained images in the dataset.

```
#Visualizing the training set result
from matplotlib.colors import ListedColormap
x_set, y_set = x_train, y_train
x1, x2 = nm.meshgrid(nm.arange(start = x_set[:, 0].min() - 1, stop = x_set[:, 0].max() + 1, s
nm.arange(start = x_set[:, 1].min() - 1, stop = x_set[:, 1].max() + 1, step = 0.01))
mtp.contourf(x1, x2, classifier.predict(nm.array([x1.ravel(), x2.ravel()]).T).reshape(x1.shape)
alpha = 0.75, cmap = ListedColormap(('purple','green' )))
mtp.xlim(x1.min(), x1.max())
mtp.ylim(x2.min(), x2.max())
for i, j in enumerate(nm.unique(y_set)):
    mtp.scatter(x_set[y_set == j, 0], x_set[y_set == j, 1],
        c = ListedColormap(('purple', 'green'))(i), label = j)
mtp.title('Logistic Regression (Training set)')
mtp.xlabel('Age')
mtp.ylabel('Estimated Salary')
mtp.legend()
mtp.show()
```

Fig. 6. Visualization of the samples

The figure 6 represents the testing and training the samples through logic regression algorithm.

IV. DEEP LEARNING WITH IMAGE PROCESSING TECHNIQUES

The deep learning is the process of artificial intelligence that functions as similar to that of human intelligence. This contains many layers in which the information are processed. They are an attempt to replicate the functioning of human brain. This includes the input layers, hidden layers and the output layers.

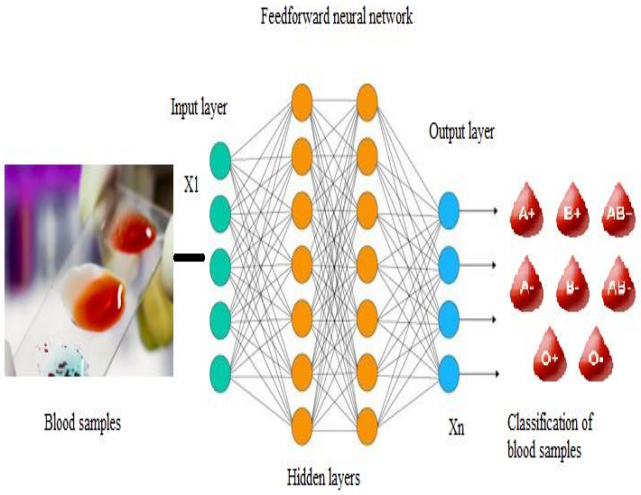

Fig. 7. Identification of blood samples

The figure 7 represents the identification of blood samples through deep learning with feedforward neural network. This is done through the logistic regression optimization techniques. There are two assumptions done in the logistic regression algorithm. The first one involves the dependent variables that must lie in the categorical form. The another one includes the absence of non-linerality in the variable functions.

TABLE II. BLOOD GROUP

Test sample	Blood group	White pixel density in 1st region	White pixel density in 2nd region
Test sample 1	B –ive	4532	7623
Test sample 2	AB –ive	6579	6235
Test sample 3	O +ive	5631	4097
Test sample 4	O –ive	9823	5629
Test sample 5	AB +ive	7149	9131
Test sample 6	B +ive	5498	4190
Test sample 7	A +ive	5438	6254
Test sample 8	A -ive	6724	9134

The table II represents the detection of blood group classification through involving 6 test samples.

The logistic regression is used to detect the probability of determining the output based upon the dependent classes. This helps to obtain the combination of input variables and calculates the logistic to determine the output. They are formulated through the dependent variables forms under the supervised learning techniques. The output are obtained in the form of discrete functions.

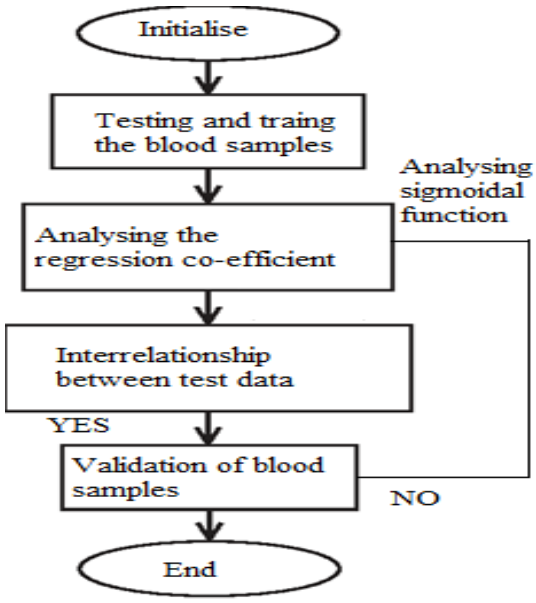

Fig. 8. Linear regression algorithm

The figure 8 represents the linear regression algorithm flowchart. The probability of the function is dependent between the variables from 0 and 1. This determines the category of the blood samples based prior predefined dataset. Thus the logistic regression algorithm is used to evaluate the classification of complex parameters . This includes the predictive modelling for anlaysis and determination of the blood samples. This is determined through the threshold values in the system. The functioning of the logistic regression includes the sigmoidal function. It is used in the prediction of the probabilities. This solution cannot go beyong the limits. The threshold value defines the probability functions. The logistic regression outcome is obtained through the linear regression equation. The overall result of binary digits such as 0 and 1 must satisfy the criterion for blood group detection as shown in above table 1. This help in the detection of blood group.

TABLE III. CLASSIFICATION OF BLOOD

Blood group	Doners	Receivers
B –ive	B+, B−, AB+ and AB−	B- and O−
AB –ive	AB+, AB−	AB−, A−, B−, O−
O +ive	A+, B+, O+, AB+	O+ , O−
O –ive	AB+, AB−, A+, A−, B+, B−, O+ O	O-
AB +ive	AB+	AB+, AB−, A+, A−, B+, B−, O+ O−
B +ive	AB+ ,B+	B+, B−, O+ , O−
A +ive	AB+ , A+	AB+ , A+
A -ive	A+, A−, AB+, AB−	A- , O−

The table III determines the classification of blood group with doners and receivers. Any deviations in the doners and

receivers blood group leads to severe constraints. Thus they must be taken care. The blood group determines the paternity test. This includes the evaluation of classifiers in the dataset through the confusion matrix. This includes true positive and negative and false positive and negative respectively.

V. Simulation Results

The identification of the blood group is performed through MATLAB Simulink. This helps to analyse and classify the category of blood group through image processing techniques.

The training and testing phase determines the exact output through optimization techniques. The proposed system involves the Graphical User Interface. In MATLAB, the image process is done through collecting the sample images that are needed to be stored. They are proceeded through deep learning techniques. They are performed through the information processing techniques. It uses the feedforward neural network. They are efficient in modelling and data processing for non-linear interrelationships. This is done through the samples collected from the laboratory. These samples are tested to classify the blood group.

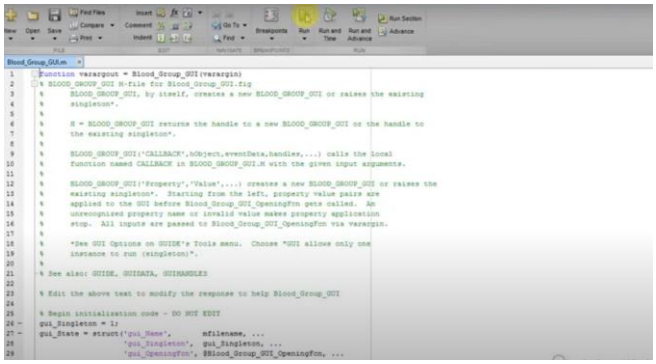

Fig. 9. Implementation of blood group detection in MATLAB

The figure 9 determines the implementation of blood group detection.

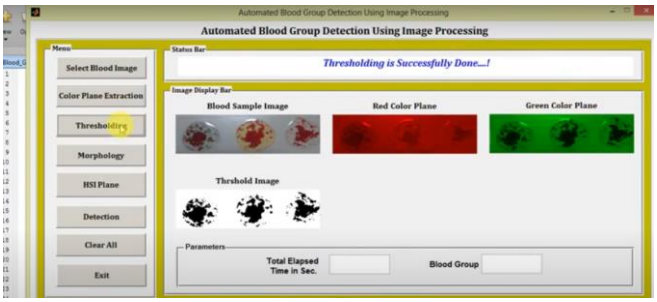

Fig. 10. Pre-processing with feature extraction

The figure 10 represents the pre-processing techniques. This is done through collecting the samples and splitting them. The segmentation process includes three parts. The three parts are denoted as A, B and RH values. They are further proceeded by reducing the dimension in MATLAB. The image of the blood section is differentiated as follows:

A factor : (1:A)

B factor : ((A+1):2A)

RH factor : ((2A+1):N)

Where, N is represented as number of columns

A is obtained through (N/3)

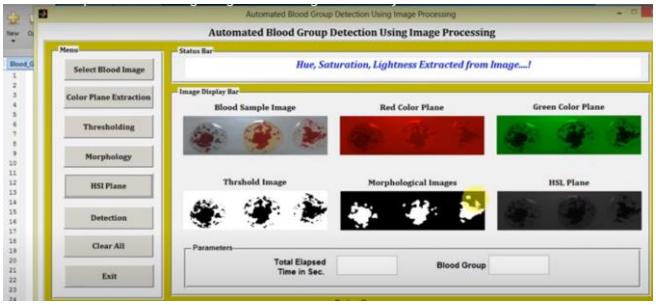

Fig. 11. Detection of blood group

The figure 11 represents the detection of blood group through image recognition. This includes the conversion of images into grey scale and process them to obtain the accurate results. The results are stored in the dataset for further references. [33-35]

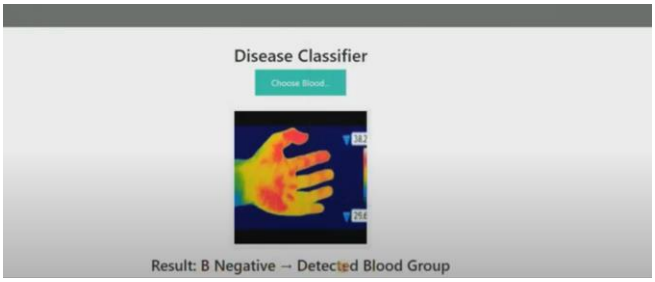

Fig. 12. Infection detected

The figure 12 determines the blood group with any infections [29-32] present in the blood sample. This helps to calculate both the blood group type and any disease. Thus the deep learning techniques with image processing helps to determine both the blood group and infections or diseases present to diagnose rapidly.[24-28]

VI. Conclusion

The introduction of artificial intelligence in the medical field helps in diverse approach. Involving various automations and advanced equipment's helps to detect the presence of disease earlier. This helps to diagnose and provide treatment earlier. The implementation of deep learning with image processing techniques helps to detect and classify the blood group. This is done through the optimization techniques. The projected system is implemented to replace the predictable methodologies in the recognition of blood group type. The conventional method for the exposure of blood group may cause manual errors in the outcome. Thus, the newer technique is introduced. The advanced technique helps to detect the category of blood accurately with enhancing time saving

parameters. This also helps to indicate the presence of bacterial and fungal infected disease that helps to diagnose earlier. Thus, the image processing techniques with deep learning helps to detect and classify the blood group.

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