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Identification of Human Blood Group Using Convolutional Neural Network

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Abstract: The blood type of a person will always be an important consideration in medical studies. Blood group identification is critical while obtaining emergency blood transfusions. It was found by dilating the blood sample with a certain mix and placing the blood samples on a glass plate, so you could examine the pattern under a microscope. But, a skilled expert was also necessary to detect it correctly. It is important to correctly and quickly determine blood types without human mistakes. The technique based on current image processing technology is incredibly fast and has numerous applications in the biotechnological field. In this study, we are proposing a convolutional neural network (CNN) to accurately and fastly identify a blood type. The human eye sometimes produces inaccurate results, but when we use image processing with CNN to determine the blood group, the little mistakes are removed. On the basis of the analysis of the images taken during the slide test, we can easily and precisely classify the blood group using deep learning technology. Image processing techniques including thresholding and morphological operations are used. Hence, the developed automated technique is used to identify the blood type using CNN. When the proposed algorithm's performance is compared to existing methods approach, it performs extremely well, with **99%** classification accuracy.

Software_Required: - The proposed system developed on a **MATLAB 2013a** version.

***Key_Words*: -** Antigen, Blood Samples, Image Processing, Histogram, LBP (Local Binary Pattern), Nearest Neighbour Classifier, Feature Extraction, CNN (Convolutional Neural Network) and IOT (Internet of Things).

I. INTRODUCTION

Blood typing is a technique for identifying the exact type of blood that an individual has. Everyone is required to be aware of their blood type. It's highly necessary before blood Donations, accidents, transfusions, and other emergency scenarios. Blood group research tests are now manually performed in laboratories by technicians. The testing process requires a lot of samples, which really is tedious. This approach has some drawbacks, including slowness, non-standard precision, and inability to function in emergency situations. As tests are carried out manually; if appropriate blood group is not determined then it may result in death of an individual. Although several systems have been created to automate these checks, they cannot complete the analysis in time for critical circumstances.

The suggested system's goal is to create a way for easily and precisely analysing the various blood groups and this technique also helps in lowering the need for human intervention, the hazards and risks associated with transfusion reactions. The system employs MATLAB-based image processing algorithms. Pictures that have been processed after slide testing are used to find occurrences of agglutination. For the slide test, a sample of blood is mixed with a drop of each reagent—antigen A, antigen B, and antigen D.

Reaction occurred between antigen and antibody indicates the presence of antigen appropriate called agglutination reaction. Presence and absence of agglutination in blood samples, determines the blood type of human.

In this approach, CNN is utilized as a classifier to classify the proper type of blood sample. Databases are employed for storing all the data. Consequently, the suggested technique is useful for quick, accurate, and precise blood type diagnosis without human error, which makes a significant contribution in emergency situations.

The research work for this study is divided into many sections by its management structure.

Section **II** contains the Literature Review.

Further, in section **III** Proposed methodology is discussed with Concept of CNN.

In section **IV** Simulation Results work is shown with the performance comparison of Proposed system with existing system and

the Conclusion and future work are presented by next sections.

II. LITERATURE SURVEY

The techniques mentioned below have been developed for blood group diagnosis.

S. Pimenta, F. Soares, and G. Minas presented an article describing how a specific light source system based on LEDs (three discrete values of O.D.) can help categories agglutinated blood samples and non-agglutinated blood samples to determine specific blood group. Three LEDs with peak emission of 406nm, 566nm, 956nm were chosen; The photodiode produces output current directly proportional to light intensity received. The microcontroller collects the voltage value, computes the OD value, and analyses the outcome by displaying the blood group type.

[1] Ana Ferraz, Filomena Soares, and Vitor Carvalho used a new blood phenotypic methodology based on plate tests and image processing techniques. They developed a portable gadget with a quick response time for determining proper blood group. The created system has a 10.5cm diameter and a height of 30cm. AC motor used for mixing and centrifugation. When the test finishes, the motor is turned off. LEDs were turned on, and photos were collected, analysed, and created before being turned off. The algorithm was developed using IMAQ vision software from National Instruments. Because this technology is portable, it can be utilized in ambulances and other emergency vehicles.

[2] J.M. Fernandes, F.O. Soares, and G.Minas concluded that the Rho phenotype can be identified using a spectrometric technique based on a plate test protocol. Both samples with and without agglutination displays a different OD spectrum.

[3] S.M.Nazia Fathima discussed about implementing an SVM classifier to categorize blood types. Pre-processing of microscopic pictures includes histogram equalization and color correction. Here, color - shape feature extraction takes place using cumulative histogram and the Haralick algorithm.

[4] Walter Hong-Shong Chung, Yaw-Jen Chang Yuan Christian and Yu-Te Lin proposed a unique approach for classifying blood types that uses integrated Light RBC agglutination and a lowered power of beam to determine proper blood type.

[5] Tejswini H. V. and M. S. Mallikarjuna Swami proposed a system for blood group detection. This process utilizes pre- and post-processing techniques for images, such as thresholding and morphological functions. The blood group is determined by the system following the quantification and HSL luminance plane methods.

[6] A research article was given by Priyadharshini R, Ramya S, Kalaiyarasi S, Kalpana Devi S, and Suthathira Vanitha N.As the blood sample reacts with the antigen, the LASER beam is utilized to spot any clumping. Agglutination leads to an increase in the LASER beam's intensity, which is recognized by a photocell. The output from the detector is sent into a comparator, and the proper blood group is detected using an embedded controller.

[7] Jose Fernandes, Sara Pimenta, Filomena O,Soares and Graca Minas performed blood type test with 50 samples. To distinguish between agglutinated and non-agglutinated samples, the OD variance value is important. Hence, different thresholds are appropriate to identify blood type. The low-cost device prototype was put into use. Using cross matching and IPST.

[8] Mrs. K. Cibimuthu, Dr. T. Gunasekar, and Mrs. P. Kokila presented a paper in which an Artificial Neural Network is utilized to classify blood groups. In order to categorize blood type, image processing techniques like color plan segmentation, thresholding, and morphological operations are utilized, Features are then extracted and back propagation algorithm is then applied in a neural network.

[9] Mehedi Hasan Talukder, Md. Mahfuz Reza, Mahbuba Begum, Md. Rabiul Islam, and Md. Mahmudul Hasan presented a paper that had used image processing methods and MATLAB to determine the blood type of a subject. The Standard Deviation parameter is used to distinguish between agglutinated and non-agglutinated samples.

[10] Prof. Yogita Hande, Shradha Abhang, Suriya Bhosale, and Rahul Deshpande suggested an embedded system to examine blood groups in which blood pictures are analysed using image processing techniques and an SVM classifier is utilized to classify samples. In this system, a pattern recognition algorithm is employed. GPU (Graphical processing unit) is used, which does parallel computation, for quick computation.

[11] An study describing a MEMS-based cantilever structure to detect blood groups was presented by Sushmita Katti, Pooja Naragund, Vaibhavi Saradesai, Pyati Vidhyashree, Kaushik M, Anilkumar V Nandi, and Vaishali B Mungurwadi. COMSOL multiphysics 4.2 software is used to design and simulate the sensor's structure. Surface tension develops during coagulation as a result of the chemical and biological interaction between the antigen and the antibody. This causes the cantilever beam to deflect. This distortion was used to identify blood types.

[12] Sara Pimenta, Graca Minas, and Filomena Soares revealed how a spectrometric approach makes blood typing possible. For non-agglutinated samples, the OD spectrum resembles the OD spectrum of suspended red blood cells and contains peaks related to haemoglobin absorption. Flattened OD was observed for samples that had agglutination. The OD spectra for agglutinated samples was flattened, with no haemoglobin peaks. As a consequence, they developed the system to identify blood types.

[13] Using Lab view from National Instruments, Ana Ferraz built an automatic method for examining blood type. Following slide tests, IMAQ vision is used to analyse blood image information. Identify the occurrence of agglutination, classify the blood type using a classification algorithm, and then archive the data in a database.

[14] Dipali B. Birnale and S. N. Patil released an article that describes an algorithm that combines FCM with SVM to detect brain tumours. Fuzzy c-means clustering is used to segment the brain MRI picture in order to identify problematic areas. Then feature extraction carried out and SVM is used to classify Brain MRI images. MRI images that are normal are classified as non-tumour images and abnormal views as tumour images. When detecting brain tumours, the combination of FCM and SVM produces accurate results.

For the previously mentioned blood type diagnosis purpose, various techniques were described. Nonetheless, the proposed system performs more effectively than these methods.

The methodology that uses laser beam or light eye technology has some shortcomings with the red laser beam. Some of the system's components utilize expensive National Instruments methods. Due to the algorithms' reliance on a small number of features, the results are not always accurate. Among these is the use of the Gray Level Co-occurrence Matrix (GLCM) in the suggested system, which improves feature extraction operations. When compared to other classifiers like neural

networks and Bayesian classifiers, the system uses the powerful classifier known as the Support Vector Machine. It requires substantially less calculation. Lack of training data is not a major issue for CNN, and it performs well with noisy input. As a result, the system can deliver greater efficiency. The most significant benefit is that it offers proper results quickly, which is helpful in an emergency.

III. PROPOSED SYSTEM

The objective of this effort is to automatically categorize blood groups using CNN and deliver results as efficiently and precisely as possible. The steps of the proposed algorithm are listed below and are depicted in figure 1.

Step [1]: Get raw microscopic images of blood samples from the laboratory or from the internet.
Step [2]: Transform the color image to a grayscale image.
Step [3]: Apply the Local Binary Pattern (LBP) to the image.
Step [4]: Perform histogram comparison.
Step [5]: Perform the feature extraction operation.
Step [6]: Use a Convolutional Neural Network to classify data (CNN).
Step [7]: Display the outcome.

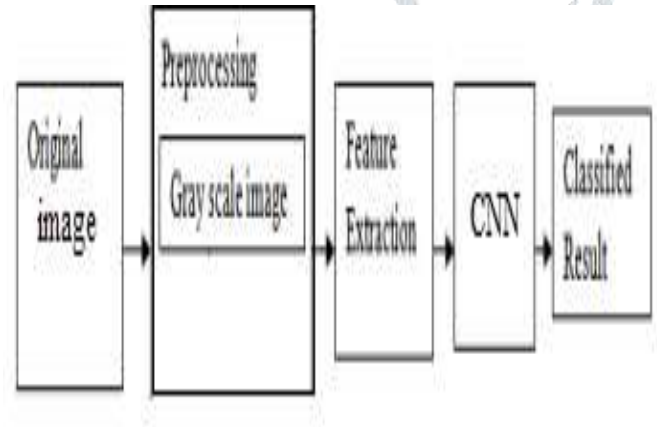

Figure. 1: Block Diagram of Proposed algorithm.

A. Data collection:
There are eight different blood groups for humans, including A +ve, A -ve, B +ve, B -ve, AB +ve, AB -ve, and O +ve, O -ve. The first stage is to get samples of data from the lab as well as an internet.

B. Pre-processing:
The system utilizes a Local Binary Pattern, which is one of the visual identifiers. The most important step after histogram comparison is feature extraction.

C. Feature Extraction:
A variety of characteristics, including mean, standard deviation, texture histogram, R value, G value, B value, and color information, can be obtained for the purpose of classifying images. Here are some feature extraction parameters. Using the grey level co-occurrence matrix (GLCM), second order statistical information can be extracted.

D. CNN:
The proposed method utilizes the Convolutional Neural Network (CNN) which is a powerful classifier. The examples of the various classes are clearly separated by a gap in the CNN model, which represents examples as a point in space. New examples are mapped in the same location and are predicted to belong to a category. As a result, it splits the collection of training images into various classes. CNN determines the ideal dividing line, having a good ability to generalize. Even with huge quantities of information, it learns quickly. Hence, the presented system can quickly classify the proper blood group.
A convolutional neural network (CNN) is a neural network with one or more convolutional layers that is used mostly for image processing, classification, segmentation, and other auto correlated data.

IV. SIMULATION RESULTS

A. DATA SET COLLECTION: -
The image for analysis is gathered from the laboratory and digital images are saved in png format. Colour plane extraction is used as part of the pre-processing of these pictures.
The figure in this section displays the original slide test image.

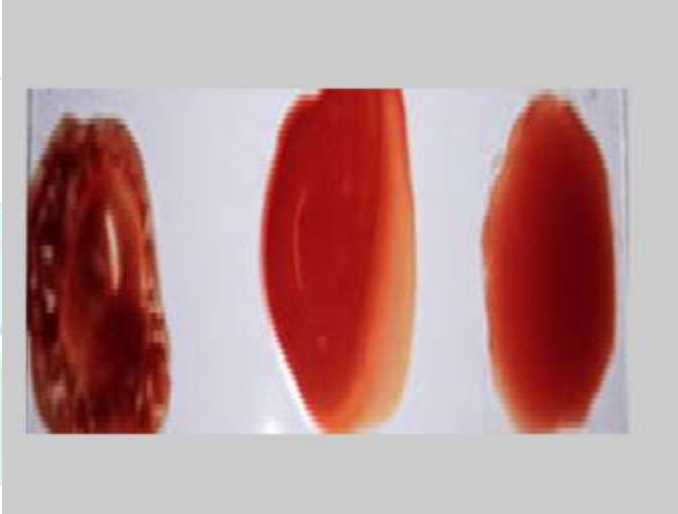

Fig.(A). Blood samples

B. COLOUR PLANE EXTRACTION: -
Images' color information can be found in the color plane. Every picture has a separate value for the background and foreground colours.
Colour display mapping does not alter the colours in the color plane. Just the green color component is retrieved in this work because it has the highest value in the RGB color plane.

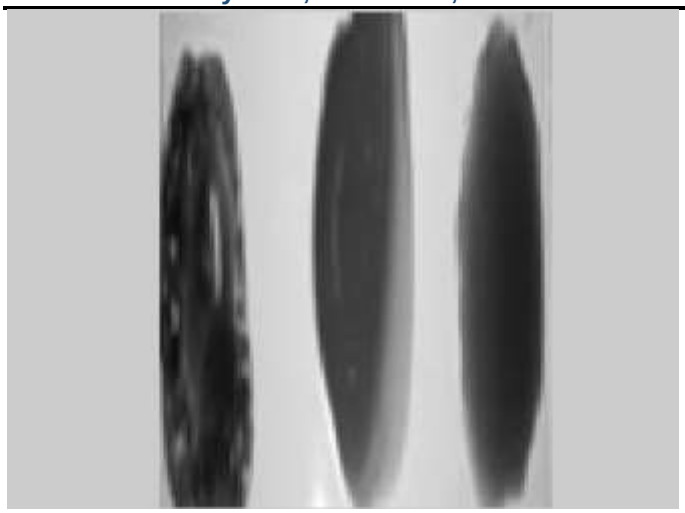

Fig.(B). Colour Plane Extraction

C. PREPROCESSING OF IMAGES: -

Pre-processing includes converting a color image to a grayscale image. Thresholding, Clustering, HSV luminance, as well as other image processing techniques are utilized to process these images.

The filtered image of the blood samples is shown in the below diagram.

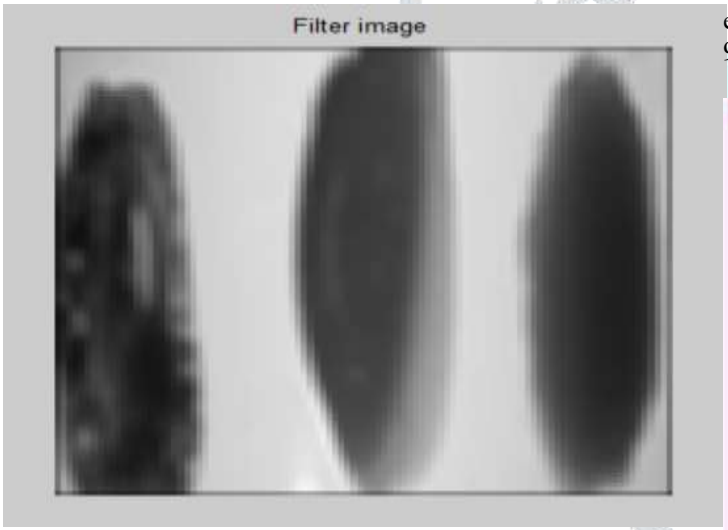

Fig.(C). Sample image for further processing

D. CLASSIFICATION BETWEEN CLUSTER AND PATCH: -

By determining the region of a cluster, we can classify the cluster and patch to determine the blood group in this manner.

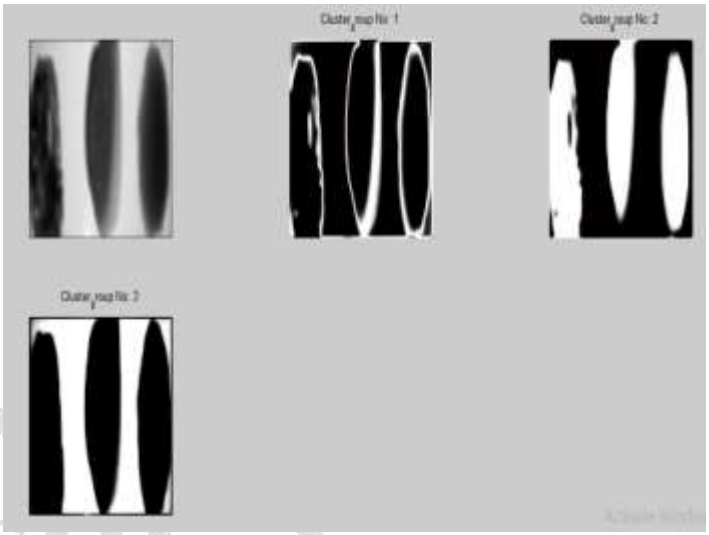

Fig.(D). Cluster images

E. CONVOLUTIONAL NEURAL NETWORK(CNN): -

CNN-based models have been developed to estimate the blood Group levels from the selected features. The method is expected to provide an accuracy of the best-estimate of about 99%.

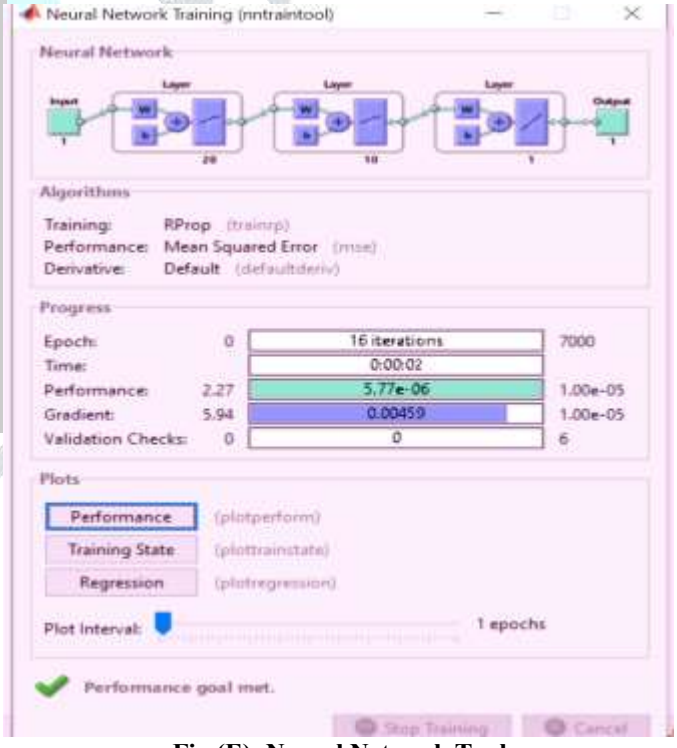

Fig.(E). Neural Network Tool

F. DETECTION OF BLOOD CELL GROUP: -

The figure below shows the Output of Diagnostics of Blood Status.
(Ex: A+ive)

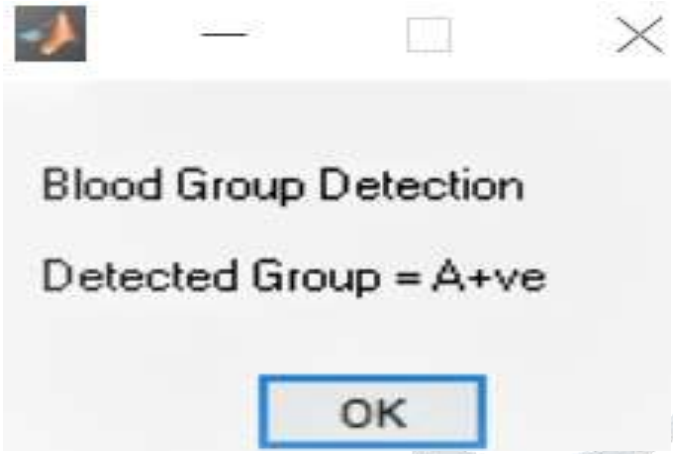

Fig.(F). Blood Sample Status

G. PERFORMANCE COMPARISION; -

The bar graph below compares the performance of the proposed system compared to the existing system for variables including accuracy, sensitivity, and time.

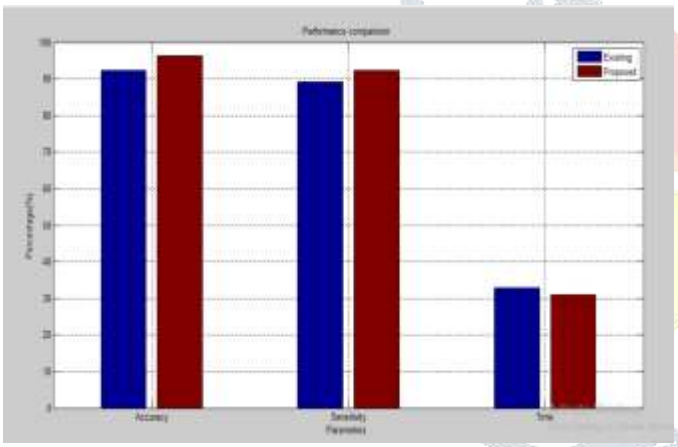

Fig.(G). Performance Comparison

V. CONCLUSION

This research presents Blood Group Classification Using Convolutional Neural Network.
CNN can predict an unknown sample with a high degree of accuracy. It is resistant to noisy data. CNN performs effectively in higher-dimensional spaces.
It has a quick learning rate and is considerably less computationally expensive. This system of classification eliminates human error and minimizes the risk of transfusion reaction. This technology makes possible in urgent situations to quickly and accurately diagnose blood type.

FUTURE SCOPE

The system's future scope is to build a simpler kind of algorithm than CNN that requires only a few number of images to be trained into a dataset.
Facilitating the updating of patient information, like their name, age, gender, and other details, can improve the utilization of IOT.
Deep Convolution Neural Network will be used in the upcoming course of study to improve the flexibility and adaptability of the proposed algorithm.

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