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Non-Invasive Blood Group Detection Using CNN

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Abstract: Before administering a blood transfusion in critical situations or determining a person's eligibility for blood donation, it is crucial to accurately identify their blood group. Currently, the manual tests conducted by lab personnel in laboratories can be time-consuming and prone to human error, which can have severe consequences, particularly in urgent situations or blood donations. To address these challenges, we propose a non- invasive method which uses conventional neural network. The CNN model used is Inception-V3, which is a pre-trained model. What sets our method apart is that it eliminates the need for mixing antigens (A, B, and O) with blood samples, avoids the use of any actual blood samples, and eliminates the requirement for chemicals. By doing so, we significantly reduce the potential for human error and ensure a non-invasive and efficient blood group detection process.

Keywords *– Blood group detection, Image Processing, Conventional Neural Network.*

I. INTRODUCTION

Blood, a vital component for sustaining life, circulates throughout the human body, delivering oxygen and nutrients to all its intricate parts, ensuring their optimal functionality. The elucidation of blood types can be credited to the pioneering work of Karl Landsteiner, an esteemed Austrian physician. Blood group detection is an essential process in medical diagnostics, transfusion medicine, and various healthcare scenarios. Traditionally, blood group detection has relied on invasive procedures, such as blood sampling and laboratory tests, which can be time- consuming and require skilled personnel. However, recent advancements in machine learning and computer vision techniques have paved the way for non-invasive blood group detection methods.

One such promising approach is the use of Convolutional Neural Networks (CNNs), which are a class of deep learning algorithms known for their ability to extract meaningful features from visual data. CNNs have shown remarkable success in image analysis and pattern recognition tasks, making them suitable for blood group detection based on non-invasive imaging.

In non-invasive blood group detection using CNNs, the process typically involves capturing images of specific body parts, such as fingertips or palms, using imaging devices like cameras or specialized sensors. These images contain valuable information related to the individual's blood group, such as distinct patterns and characteristics associated with different blood types.

The advantages of non-invasive blood group detection using CNNs include the elimination of invasive procedures, reduced testing time, and potentially broader accessibility in various healthcare settings. The blood group detection system holds immense significance across various aspects of the medical field, primarily due to the crucial need for accurate blood typing. This necessity arises in numerous situations, such as during blood donation drives, where it is essential to determine the precise blood group of potential donors.

Additionally, in rural regions lacking accessible laboratories for blood typing, this system serves as a valuable resource, enabling individuals to identify their own blood groups conveniently.

II. LITERATURE SURVEY

In their paper, Nuha Odeh and colleagues [1] introduced various image-matching techniques, namely SURF, ORB, and SIFT, for the purpose of analyzing blood samples. The blood samples were divided into three patches, each containing a different combination of antibodies (A, B, and D). Using an 8MP camera on a phone, grayscale images of these patches were captured after converting them from the RGB color model. Multiple image techniques were employed to detect the agglutination of blood cells by comparing them with relevant reference images. A major challenge in this process was finding an appropriate source image that encompassed a wide range of possible blood agglutination variations. This was crucial to ensure the system's effectiveness in identifying and analyzing different agglutination patterns. Notably, the proposed system offered the advantage of not requiring expensive hardware, making it a cost-effective solution.

In the paper by Mansi K., Hitashree M., and Chandana Lakshman Hegde [2], a blood group detection system is proposed. This system utilizes an image processing technique that can be employed by both laboratory technicians and users with no prior knowledge of blood group detection. The process is straightforward, requiring the user to take blood samples and add three antigens (A, B, and D) to each sample. The images of these samples are then captured and fed into the system for analysis, which provides a conclusive outcome. The proposed method involves several key steps. First, the image undergoes segmentation to separate relevant regions. Pre-processing techniques are then applied to enhance the quality of the image. Thresholding is employed to distinguish important features. Morphology operations are utilized to refine the image and improve the accuracy of subsequent analysis. The system also employs histogram analysis to further extract meaningful information from the image. Finally, quantification techniques are employed to process the image and derive the desired blood group information.

Gayathri T. and colleagues presented a system in their paper for detecting blood types by passing varying voltages of light through the finger, where light serves as the optical signal source [3]. Each blood group exhibits distinct optical properties, resulting in varying voltages at the detector. By analyzing these properties, the system can determine the blood types A, B, AB, and O. In the experimental setup, participants were instructed to place their middle finger on the device. Two samples were collected from each individual, with both the left

and right middle fingers tested to obtain different output voltages corresponding to the ABO blood group. The paper also explains the utilization of bio-optics methods for blood typing. To evaluate the accuracy of the experiment, 100 samples were taken and analysed. The findings of the study indicate that blood detection using optics is a feasible approach.

In their paper, Chethan G. and Nithin S. proposed a concept for determining a patient's blood type by analyzing the reflected light from their red blood cells [4]. The paper outlines the steps involved in this determination process. The first step entails constructing a box equipped with a laser and a camera. This box features a hole on its top surface through which laser light is directed towards the patient's skin. The patient places their thumb on the hole of the box. In the second step, the light emitted by the laser is absorbed by the haemoglobin in the red blood cells. When the light hits the edges of specific antigenic determinants with distinct shapes or structures at certain frequencies, it gets scattered. The third step involves activating the device for a specific duration, during which a particular pattern is identified. Images are captured by the camera inside the box to track the scattered light. This pattern serves as the basis for detecting the blood type of the corresponding patient. The advantages of the experimental setup proposed in this paper include its low cost and compact size.

In their paper, L Suganthi and colleagues proposed a system that utilizes an absorbance spectrophotometer to calculate the amount of light absorbed by a blood sample [5].The experimental setup involved taking 3 ml of blood from each individual and adding saline in a 10:1 ratio. This mixture was then divided into three equal parts of 4 ml each in separate tubes, while the remaining portion was preserved for future use. Distilled water was added to some of the tubes to adjust the absorbance value to zero and minimize potential errors. Next, antibodies A, B, and D were introduced into the three tubes containing the blood samples.

The spectrophotometer was set to wavelengths ranging from 400nm to 700nm, with increments of 25nm, to measure the absorbance values. The results obtained from the experiment showed that positive samples had absorbance values ranging from 0.8 to 0.9, while negative samples had values ranging from 0.50 to 0.55.It was determined that the most suitable visible spectrum wavelength range for detecting blood types fell between 425nm and 475nm.

In their study titled "Blood Group Detection Using Deep Learning" [6], Dikshita Agarwal, A. N. Kalyani, and their colleagues proposed a method that utilizes deep learning for blood group detection. The approach involves capturing a series of high-resolution images of a person's fingertip positioned on a light source. Approximately a hundred to two hundred pictures are taken, with predetermined proportions for each image. Thresholding is applied to each captured image, followed by grayscale conversion, contrast enhancement, and denoising to transform the images into binary representations. The focused area of the fingertip is identified by locating the pixels with the highest intensity. The model used in this experiment is trained on predetermined values collected from various medical institutions, allowing it to learn and recognize specific patterns associated with different blood types. To extract relevant features, a grayscale co-occurrence matrix is employed. These features can be indicative of the morphological characteristics necessary for blood type detection. It is important to note that the precise accuracy of this method has not been thoroughly validated due to the limited scope of the study. Only a single investigation was conducted on this particular approach. Moreover, the obtained images may suffer from morphological dissimilarities, which can potentially affect the quality of the results. Additionally, the sample size and specific outcomes of the experiment are not clearly presented in the study.

Dikshitha Agarwal, A. N. Kalyani [6] et al. proposed Blood Group Detection using Deep Learning. In this paper, a camera of high resolution is used to capture hundred to two hundred pictures of fingertip of person positioned on a light source. The proportion of each captured picture is predetermined and thresholding of each image is performed. The images is processed by grey scaling, enriching the constant and denoising were transformed into binary figures. For the focused area pixel location is obtained. The model which is used in this experiment is well trained by the input of pre-determined values collected from hospitals. Using Grey scale co- concurrence matrix, is used to extract this features. The output will vary, depending on the morphological feature which can be used to determine the blood group. The precise value of this method is not verified because only sole study was carried out on this topic. The morphological dissimilarity can affect the picture obtained. The sample size and outcome obtain are not clearly expressed in this experiment.

Tanvi Patel, Gautam Joshi, Dimpal Khambhati, and their colleagues conducted a study on various clinical examination methods for blood group detection [7]. These methods include the Slide test, Tube test, Microplate technology, and Gel centrifugation. In the Slide test, separate mixtures of blood sample antibodies A, B, and D are prepared on a slide. The clumping pattern observed helps determine the individual's Rh type and ABO blood group. This method is considered less sensitive and can provide results within 0-15 minutes, but its reliability is questionable.

The Tube test, on the other hand, is more sensitive compared to the Slide test. It requires a longer duration of 10-30 minutes to detect the blood group. However, this method requires a smaller number of reagents. The Microplate method allows for the extraction of antibodies from plasma and blood, as well as antigens from red blood cells. This technique is known for its speed and high sensitivity in determining blood groups. In the Gel centrifugation method, blood is mixed with antibodies A, B, and D in microtubes. The mixture is then subjected to controlled incubation and centrifugation. This method is relatively simple and quick to handle, making it suitable for use by less skilled laboratory personnel. To summarize, Patel, Joshi, Khambhati, et al. explored different clinical examination methods for blood group detection, including the Slide test, Tube test, Microplate technology, and Gel centrifugation.

Jaya Rubi, G. Srividhya, R.J Hemalatha, A. Keerthana, and their colleagues presented a novel system in their study [8], where a light-emitting diode (LED) serves as a semiconductor light source. This LED exploits the phenomenon of electro-luminescence, which generates photons when electrons and holes recombine. To convert the emitted light into a voltage signal, an OPT101 optical detector is employed, which is then amplified by an operational amplifier (OP-AMP). The detection range of this setup spans from 300nm to 1100nm.This proposed system differentiates itself from existing non- invasive techniques by leveraging LED technology instead of relying solely on photoplethysmographic principles. By utilizing LEDs and avoiding light scattering, the system offers enhanced accuracy compared to other methods. In summary, Rubi, Srividhya, Hemalatha, Keerthana, et al. put

forth a system that utilizes an LED as a semiconductor light source, harnessing the electro- luminescence effect. The system employs an optical detector and an OP-AMP to convert the emitted light into a voltage signal, providing a wider detection range and improved accuracy compared to conventional techniques.

The optical behaviour based on near- infrared (NIR) light is commonly employed in biological media to assess the absorption and scattering properties of various components such as H20, oxygenated, and deoxygenated haemoglobin at different wavelengths. Each blood group and type is characterized by unique protein structures and accumulations in the blood, which exhibit distinct interactions with photons. These interactions result in varying degrees of scattering and absorption. Sultan E. and their colleagues conducted an experiment focusing on this principle, where they placed an 850nm transmitter as a cuff around the lower arm of the patient and calculated the levels of RF absorption at the receiver [9]. Modulation and demodulation were performed using a network analyzer. Additionally, the Rh factor was also considered for each blood type, similar to the optical method. The study compared in vivo values obtained from the experiment with in vitro values, revealing a correlation greater than 0.95. This high correlation indicated that the method exhibited high accuracy, minimal complications, and a short detection time. However, it is worth noting that the sample size in this experiment was relatively small, consisting of only around 70 individuals.

The principle of spectrophotometry is based on the qualitative analysis of an object's reflection or transmission characteristics as a function of wavelength. This research paper focuses on utilizing spectrophotometry to analyse the blood group type of a patient [10]. The methodology involves mixing the patient's blood sample with antisera, which are antibodies specific to particular blood groups. To ensure comparable illumination of two adjacent surfaces, two light sources are positioned accordingly. The Beer- Lambert law is employed in this study, which states that the absorbance of a solution is directly proportional to the concentration of the absorbing species and the path length. A blood sample mixed with three different antisera is placed in a cuvette, which is then inserted into a spectrometer. The spectrometer emits light in the range of 380nm to 420nm and 460nm to 610nm. The resulting absorbance values, representing absorbance units, are recorded. The recorded data is analysed to detect any agglutination reactions. A Voting Algorithm is employed, and the results are subsequently displayed. In summary, this research paper focuses on using spectrophotometry to determine the blood group type of a patient. The methodology involves mixing the patient's blood sample with specific antisera, recording absorbance values at different wavelengths using a spectrometer, and analyzing the data to detect agglutination reactions.

III. METHODOLOGY

Non-invasive blood group detection using the Inception V3 model offers a promising and convenient alternative to traditional invasive methods. The proposed system takes the images of hands of the person as input to detect the blood group of respective person. A web application is developed to load the image and display the detected blood group of a person.

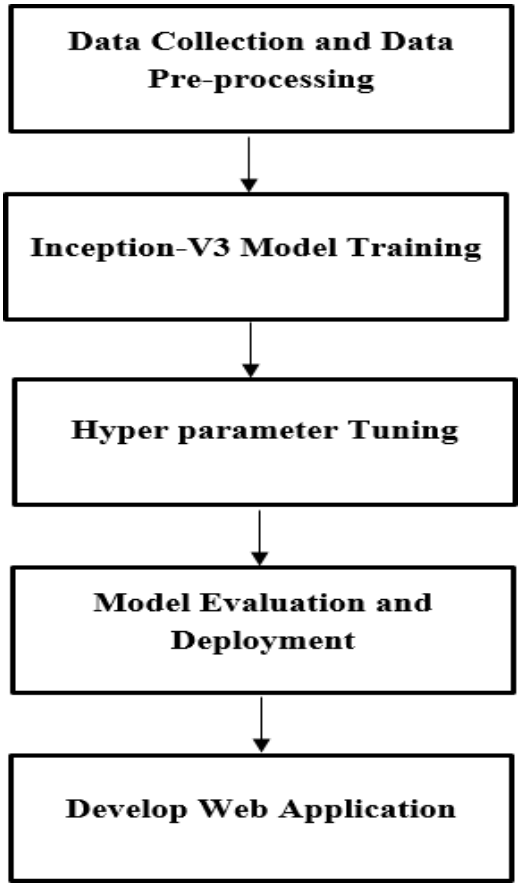

Figure 1. Proposed Methodology

A. Data Collection and Data Pre- Processing

A dataset of hand images along with corresponding blood group labels is gathered. The dataset should be diverse, including individuals from different ethnicities, ages, and genders, and cover all major blood groups (A, B, AB, and O). Pre- processed the collected hand images to ensure uniformity and enhance the quality of the dataset. This involved resizing the images, normalizing pixel values, and applying techniques like image rotation, cropping, or filtering to improve image quality. The pre-processed dataset is divided into training, validation, and testing sets. The training set is used to train the Inception-V3 model, the validation set is used for hyper parameter tuning, and the testing set is used to evaluate the final model's performance.

B. Model Training:

An Inception V3 model is initialized, which is a pre-trained convolutional neural network architecture with excellent image recognition capabilities. This model has been trained on a large-scale dataset (e.g., ImageNet) and can be fine-tuned for the blood group detection task. The model is trained using the training set, optimizing the model's weights through back propagation and gradient descent.

C. Hyper parameter Tuning:

Performed hyper parameter tuning using the validation set. This involves adjusting parameters such as learning rate, batch size, optimizer, and regularization techniques (e.g., dropout) to optimize the model's performance. This step helps to find the best configuration for the Inception V3 model.

D. Model Evaluation and Deployment:

The trained Inception V3 model is evaluated using the testing set. Measured the model's performance metrics such as accuracy assess how well it can predict the blood groups based

on hand images. This evaluation provides insights into the model's effectiveness and generalization capabilities. Once the model has been trained and evaluated, it can be deployed for non-invasive blood group detection. Given a new hand image, the trained model takes the image as input, processes it through the neural network, and generates predictions for the blood group of the individual.

E. Develop Web Application:

The final step was to create a user interface for the deployed models. To achieve this, we designed a web application using, Flask which is a web framework for building web applications in Python. It also utilizes HTML and CSS for the front-end and Python for the back-end. The web application consists of input field where users can upload an image of their hands. The image of hand is displayed with their results.

IV. RESULTS

We have created a web application that simplifies the prediction of blood group detection by displaying the individual's blood type.

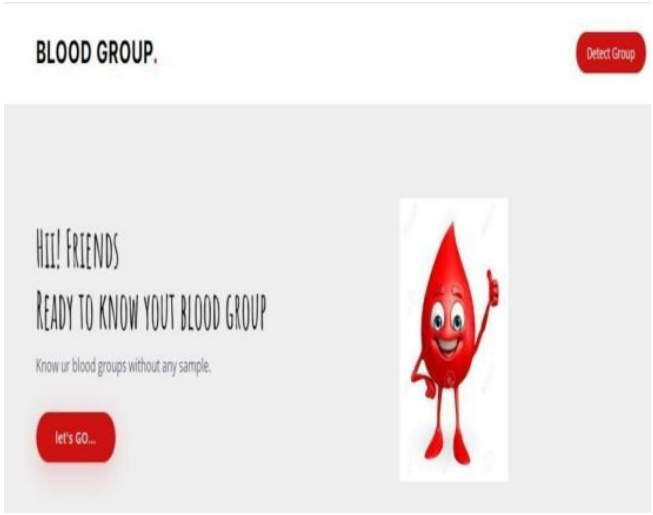

Figure 2. Overview of Webpage

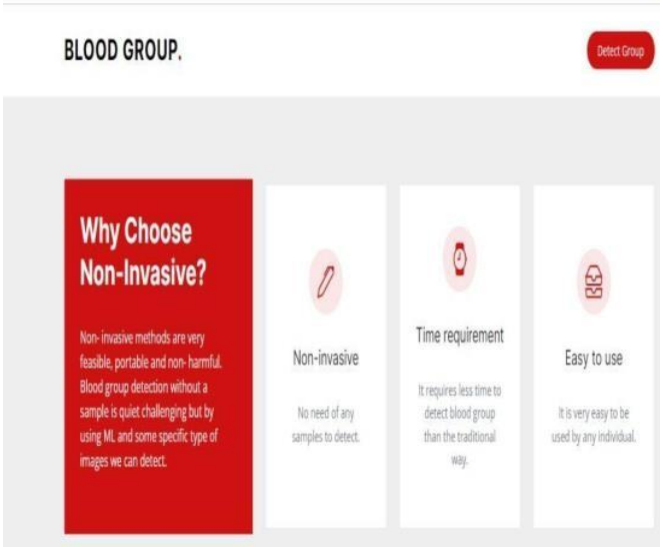

Figure 3. About blood group detection

Figure 4. Image of hand

Figure 5. Detection blood group

CONCLUSION

Detection of blood type of a person is very essential in urgent situation or during blood transfer. Non-invasive blood group detection using the Inception V3 model offers a promising and convenient alternative to traditional invasive methods. One of the key benefits of using Inception V3 for non-invasive blood group detection is its ability to learn and extract features from images. With its deep neural network structure, Inception V3 can learn to recognize complex patterns and features associated with different blood groups, enabling accurate and efficient blood typing without the need for invasive procedures. . One of the challenges is the need for a large and diverse annotated dataset to train the model accurately. Additionally, variations in lighting, and other factors can affect the accuracy of the model, and ongoing research is needed to improve the model's robustness. With further advancements in training techniques, dataset availability, and optimization of the Inception V3 model, this approach has the potential to revolutionize blood typing procedures, improve healthcare accessibility, and enhance patient care outcomes.

References

[1] N Odeh, et al. (2021). An efficient system for automatic blood type determination based on image matching techniques, Applied Sciences, 11(11), Available at: https://doi.org/10.3390/app11115225.

[2] K Mansi, et al. (2021). Blood group determination through medical image processing, International Journal for Research in Applied Science & Engineering Technology, 9(V), 203- 210, Available at: https://www.ijraset.com/fileserve.php? FID= 34023.

[3] T Gayathri, et al. (2018). Non-invasive blood group detection using light emitting diode, International Journal of Pure and AppliedMathematics, 119(15), 565-574, Available at: https://www.researchgate.net/ publication/326252790_Non_invasive_blood_group_detection_using_light_e mitting_diode.

[4] G S. Mehare, et al. (2018). A non- invasive way to determine blood type based on image processing, International Research Journal of Engineering and Technology, 5(4), 2040- 2043, Available at: https://www.irjet.net/arc hives/V5/i4/IRJET-V5I4456.pdf

[5] L Suganthi, et al. (2019). Estimation of ideal visible spectrum wavelength for optimal ABO blood grouping using spectrophotometry, 8(2), 1-5, Available at: https://1library.net/document/yee27884-estimation-ideal-visible-spectrumwavelength-optimal-groupin gspectro photometry.html.

[6] D Agarwal and A. N. Kalyani (2020). Blood group detection using deep learning, International Journal of Advanced Science and Technology, 29(9), 499-507, Available at: http://sersc.org/journals/index.php/IJA S T/article/view/13126.

[7] T Patel, G Joshi and D Khambhati (2019). Identification of voltage level present in blood during mistransfusion of blood, International Journal of Engineering Trends and Technology, 67(3), 96-99, Available at: https://ijettjournal.org/assets/Volume67/Issue-3/IJETT-V67I3P218.pdf

[8] J Rubi, A. Keerthana, G. Srividhya and R.J. Hemalatha (2019). Blood group measurement using light emitting diode, International Journal of Recent Technology and Engineering, 8(4), 11339-11342, Available at: https://www.ijrte.org/wpcontent/uploa ds/papers/v8i4/D5408118419. pdf.

[9] E Sultan, et al. (2018). Novel optical biosensor method to identify human blood types using free-space frequency- modulated wave of NIR photon technology, Medical Devices, 12, 9-20, Available at: https://doi.org/10.2147/mder.s181796

[10] J C. Dela Cruz, et al. (2020). Blood type identification through spectrophotometry and optical density analysis. 2020 IEEE8th R10 Humanitarian Technology Conference (R10-HTC).IEEE, Available at:https://doi.org/10.1109/R10-HTC49770.2020. 9357052.

[11] B Panjavarnam, et al. (2019). Non- invasive blood group detection, International Journal of Emerging Technologies and Innovative Research, 6(5), 139-143, Available at: https://www.jetir.org/papers/JETIRCU 0602 9.pdf

[12] S D. Sahane and U M. Chaskar (2017). To provide an easy and fast means of identification of blood group using IR sensors. 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT). IEEE, Available at: https://doi.org/10.1109/RTEICT.2017. 8256 666

[13] S Neve, et al. (2021). Blood group identification using machine learning- A review of literature, International Journal of Advance Research and Innovative Ideas in Education, 7(2), 1325-1327, Available at: https://ijariie.com/AdminUploadPdf/Blood_Group_Identification_Using_Mac hine_Learning_ijariie14035.pdf

[14] A Yamin, et al. (2017). Image processing based detection & classification of blood group using color images. 2017 International Conference on Communication, Computing and Digital Systems (C-CODE). IEEE, Available at: https://doi.org/10.1109/CCODE.2017. 7918945.