DETECTION OF BLOOD GROUPS THROUGH DEEP LEARNING AND IMAGE PROCESSING.

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Abstract: Medical diagnostics and transfusion therapy processes greatly depend on blood group identification. This paper presents our new method of blood type identification based on deep learning and image processing approaches. Our approach for feature extraction uses orientated FAST, rotated BRIEF (ORB), and scale-invariant feature transform (SIFT) algorithms; blood group picture categorization is achieved using convolutional neural networks (CNNs). Using SIFT and ORB prior to discriminative feature extraction, the image processing pipeline maximizes contrast and reduces noise in blood group images. Then, using these features, a CNN model is taught to classify blood types exactly. The CNN model may provide consistent and robust prediction as it is made to identify and understand the unique patterns related to various blood kinds. We assess our approach by means of large-scale experiments on many blood group imaging datasets. With great classification accuracy and tolerance to picture quality fluctuations, the findings show the efficiency of our approach for blood type identification. Our suggested method would enable quick, automatic blood sample analysis and simplify blood group identification in medical environments. Furthermore, combining deep learning with feature extraction methods increases the accuracy and efficacy of blood type prediction, hence enhancing transfusion control and patient care.

INTRODUCTION

Two examples of cutting-edge technologies that have revolutionized the field of blood group identification and provide a practical method of augmenting and automating blood type detection are deep learning and image processing. Manually evaluating and interpreting blood samples is a time-consuming and human error-prone procedure in conventional blood group identification procedures [1]. A novel approach has been implemented to address these challenges by integrating deep learning and image processing techniques, thereby automating blood type diagnosis and improving transfusion management and patient care [6].

For the categorization of blood group photos, the recommended approach employs convolutional neural networks (CNNs) in conjunction with feature extraction using orientated FAST, rotated BRIEF (ORB), and scale-invariant feature transform (SIFT) methods [7]. Before employing the SIFT and ORB algorithms to extract discriminative features, this method employs an image processing pipeline to preprocess blood group images to enhance contrast and minimize noise. CNN models that are trained with these variables are capable of accurately and reliably classifying blood types [11].

The objective of this research is to improve automated blood type identification and expedite and accurately analyze blood sample analysis, thereby enhancing transfusion management and patient care [11]. In an endeavor to enhance the precision and efficacy of blood type prediction in medical contexts, the proposed method integrates deep learning with feature extraction techniques. These investigations, which utilize a diverse array of blood group imaging datasets, demonstrate the system's adaptability and precision in image classification, regardless of the quality of the images [13].

With the integration of image processing technology and deep learning methods, the medical industry has numerous potential applications for blood type determination. This technology has the potential to expedite blood transfusion processes and potentially enhance patient outcomes by leveraging automation and enhanced accuracy in blood type detection [6]. CNNs are integrated with feature extraction algorithms to offer a more dependable and efficient solution, thereby addressing the deficiencies of manual blood group identification processes.[9]

The proposed technique may preprocess blood group images, extract discriminative features, and train a CNN model, which makes blood group detection comprehensive and creative. The focus on improving blood type prediction efficiency and accuracy through extensive testing on many blood group imaging datasets highlights the method's adaptability and robustness. The blood group type is predicted using the blood group detection method in this manner [11].

In summary, combining deep learning with image processing techniques to determine blood type represents a significant advancement in medical diagnostics. The proposed approach offers a workable way to automate and increase blood type identification accuracy, hence enhancing patient care and transfusion management. Because of its innovative technological integration and extensive experimental validation, this technique has the potential to fundamentally alter blood group identification in medical contexts [14].

RELATED WORK

The paper titled "A Complete Blood Typing Device for Automatic Agglutination Detection Based on Absorption Spectrophotometry," authored by Jose Fernandes, Sara Pimenta, Filomena O. Soares, and Graca Minas, was published in the IEEE Transactions on Instrumentation and Measurement in 2014. This paper describes an automated blood type system that uses absorption spectrophotometry to detect agglutination. Improved blood analysis procedures lead to more accurate and efficient outcomes thanks to this creative method. The study conducted by the authors for this IEEE paper examines developments in measurement and instrumentation methods for blood type applications, making a significant addition to the area [1].

The paper authored by Dr. D. Siva Sundara Raja and J. Abinaya, was published in the International Journal of Advance Study and Research Work in March 2019. This study introduces an economical approach for blood group identification by employing fingerprints. The method presents a potentially resource-efficient solution for determining blood groups, offering a practical application in healthcare settings. The research, documented in this 2019 journal publication, signifies a noteworthy contribution to advancing cost-effective techniques in the field of blood group detection, demonstrating the authors' commitment to innovative and accessible healthcare solutions [2].

The suggested technique for “blood group identification using image processing is predicated on a simple methodology”. The technology uses an image of blood to calculate the standard deviation. If there is an agglutination reaction and the standard deviation score is more than 20, the test is deemed positive. On the other hand, if the standard deviation result is 20 or less, the test is considered negative [3]. The agglutination reaction is crucial for blood type identification, and this method appears to be a simple and efficient way to determine if it is present. By calculating standard deviation, the method looks for alterations in the blood sample that might indicate agglutination [5].

This research, documented in the conference proceedings spanning pages 133 to 136, focuses on utilizing spectrophotometry for the analysis of RH phenotypes in human blood typing. The authors' research shows a development in the use of spectrophotometric methods to improve blood type accuracy, especially in differentiating between RH genotypes. The importance of their contributions to the changing field of blood analysis techniques is highlighted in the presentation given at the IEEE convention [4].

Proposed semiautomated system for “Detecting blood group which can be identified by microscopic coloring image”. It first preprocesses images by converting the RBC to HIS by color correction, histogram equalization, and color space conversion. The cumulative histogram will be used to identify the color and texture of the image, and SVM will be used to assess the matching individual's blood group. It takes a lot of work and requires more experienced individuals to operate this system [6].

The Existing work discussed offers a fresh and creative method for utilizing fingerprint patterns to predict blood types. In order to make the most of the widely used method of finger print identification for blood group detection, the study will emphasise the uniqueness and consistency of fingerprint patterns when combined with blood slide analysis [2]. By analysing the little feature patterns that fingerprints provide for unique identification, the study looks into the prospect of using fingerprints to identify blood types. This method extracts geographical data and estimates ridge frequency by using Gabor filters, which leads to efficient fingerprint matching [8].

The study also provides a historical overview of fingerprint-based identification systems, emphasizing their significance for a variety of applications. This background information provides valuable insight into the evolution of fingerprint-based identification and its applicability in the modern era. Blood group determination and fingerprint patterns together represent a novel intersection of biometric data and medical diagnosis, with potential implications for patient identification and customized medication [12].

The proposed technology has the potential to revolutionise blood group detection by offering a reliable, non intrusive method that leverages fingerprint patterns inherent distinctiveness [10]. This paper provides an interdisciplinary approach that enables the coexistence of biometric technology and healthcare through its investigation of fingerprint-based identification systems and their potential in medical diagnostics.

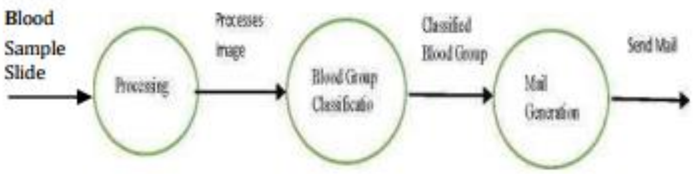

Fig 1: Data Flow diagram of the existing method

PROBLEM IDENTIFICATION

The problem description pertains to the requirement for a technique that is accessible, affordable, and rapid to ascertain a person's blood type. Conventional blood typing techniques frequently call for specialized labs and drawn-out processes, which can be problematic in emergency situations or places with limited resources. Additionally, the current approach, which involves intrusion, is less effective and necessitates the services of a professional. The project's goal is to create a non-intrusive technology that uses spectroscopic pictures to precisely forecast a person's blood grouping in order to overcome this, offering a practical and effective substitute for current and conventional blood typing techniques. The spectrometer work displayed here is very efficient for image processing chores, including image to binary conversion and thinning for spectroscopic image correction and normalization for the prediction.

PROPOSED FRAMEWORK

The recommended method for blood group identification is a noteworthy advancement in the field of medical diagnostics. By merging deep learning and image processing methods, the system leverages computer vision and machine learning to automate the blood group diagnosis process. Complex features are extracted from blood samples using convolutional neural networks (CNNs). Because of this, the system can now analyse and identify minute patterns and characteristics that may be suggestive of specific blood types. Additionally, the addition of Scale-Invariant Feature Transform (SIFT), Oriented FAST, and Rotated BRIEF (ORB) algorithms enhances the system's ability to recognize and match significant points and descriptors within the images, contributing to the accuracy and robustness of the blood group classification process. Though this multi-phase procedure appears highly promising, it is important to consider possible disadvantages, such as the need for large and diverse training datasets to ensure the system's accuracy across variations in blood samples. The computational complexity of deep learning techniques may also need a significant amount of processing resources. To ensure the system's dependability in real-world applications, it will be imperative to evaluate its performance under various conditions, including variations in illumination and picture quality.

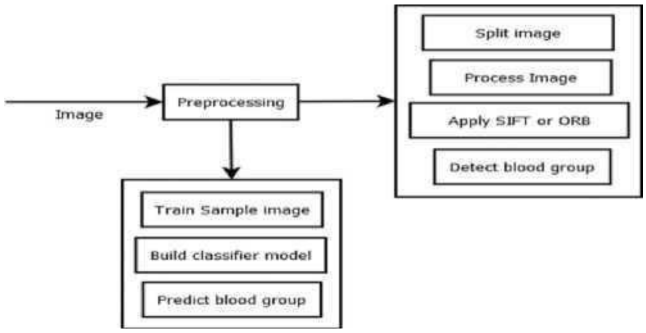

Fig 2: System Mechanism for Proposed Method

The software we utilized is Visual Studio Code, and the Blood Group Detection System dataset is publicly available on Kaggle.com. The simplified code editor Visual Studio Code supports version control, task execution, and debugging. The goal is to provide developers with the minimum set of tools necessary for a brief code- builddebugging cycle, more complex operations are left to IDEs with greater functionality, such as the Visual Studio IDE. Python is the main language used for machine learning and deep learning in this project, and it may be built on Windows or Linux (Ubuntu, CentOS). Data handling and visualization will need the use of Python modules like NumPy, Pandas, Matplotlib, and Scikit-learn. The front-end web developer will work with HTML and CSS. Libraries like TensorFlow, Future, Argparse, Hashlib, sys, and tarfile will make deep learning easier. Integrated development environments (IDEs) like PyCharm, VS-Code, or jupyter Notebook are useful for developing and experimenting with code.

EXPERIMENTAL SETUP AND IMPLEMENTATION

Data Acquisition and Preprocessing, the procedure for predicting a blood sample's blood group using spectroscopic images. Blood types may be identified thanks to these images, which capture important information including antibodies and antigens. Once high- resolution images are acquired, they undergo preprocessing using methods such as image normalisation and histogram equalisation to standardize image quality, lower noise, and improve contrast. The accuracy and dependability of the obtained attributes for blood type prediction depend heavily on this preprocessing. Assuming the photos include high-quality, standardised data, the data collection and preparation stages are crucial for getting the images ready for feature extraction and blood type prediction using deep learning algorithms.

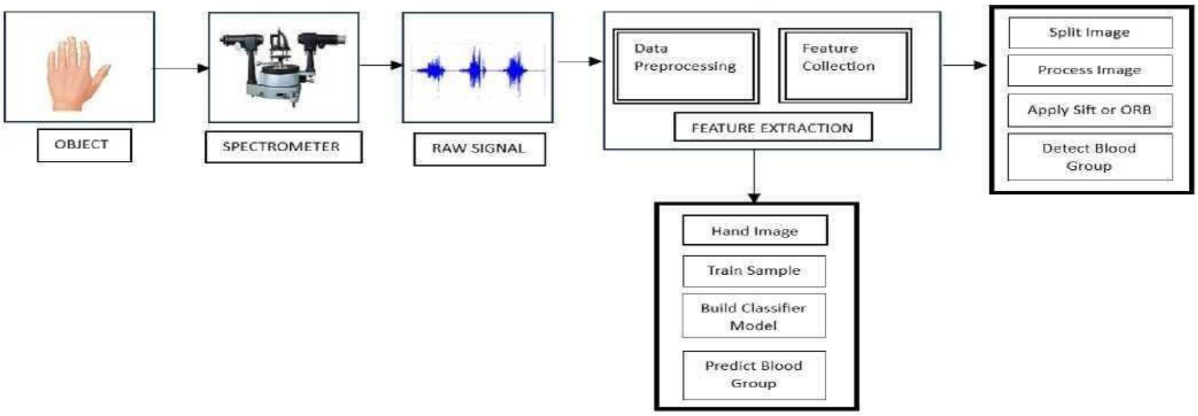

Fig 3: Architecture diagram of proposed system

Feature Extraction, Utilising the Scale-Invariant Feature Transform (SIFT), Oriented FAST, and Rotated BRIEF (ORB) algorithms, features are extracted from preprocessed spectroscopic images in order to identify blood groups. In order to identify distinctive features that are independent of size and rotation—which are essential for classifying blood types—these methods are used. The ORB highlights the requirement for oriented and differentiating traits, whereas SIFT finds and extracts significant locations and descriptors. The critical components of the blood samples are intended to be captured by the extracted features in order to determine blood type. These properties are then used as the basis for further analysis and categorization utilising deep learning techniques.

Convolutional Neural Network (CNN) Model Training, a Convolutional Neural Network (CNN) model optimized for blood group prediction in the blood type detection system is developed and trained. In order to recognize and classify patterns and qualities that belong to different blood types, the CNN model is engineered to process and analyze the distinctive properties that are retrieved from preprocessed spectroscopic photos in an effective manner. To enhance its ability to accurately classify blood types, the model is trained using labelled spectroscopic images that are associated with corresponding blood group classifications. This helps the model learn to connect features with blood group classifications. By utilizing image processing and deep learning techniques, the trained CNN model seeks to offer a trustworthy and efficient method of predicting blood types from spectroscopic images.

Model Evaluation and Validation, the trained CNN model's accuracy, precision, and generalization ability are assessed using separate validation datasets during the blood group detection system's assessment and validation phase. By comparing the model's performance to established ground truth labels, measures including accuracy, recall, and F1 score are used to evaluate how well the model predicts blood types from spectroscopic images. In order to maximize prediction accuracy and generalization to new data, the model's architecture and parameters are modified based on the evaluation results. By means of iterative assessment and modification, the system seeks to guarantee that the CNN model can predict blood groups with accuracy and reliability. This methodology provides a stable and efficient blood type prediction method.

System Integration and User Interface Development, the blood group identification system's last phase integrates the trained CNN model with feature extraction techniques to produce a coherent system. A fluid and efficient process for spectroscopic image analysis is provided by this integration, which enables data to flow from feature extraction to blood group prediction. Health care providers may also enter spectroscopic pictures and receive precise blood group predictions with an easy-to-use interface. Medical professionals' experience with the system's blood group prediction features will be improved by the user-friendly interface, which attempts to increase the usage of blood group identification technology in healthcare settings and make it more useful for them to utilize in their job.

Testing and Deployment, extensive testing is conducted on a variety of blood sample types to confirm the efficacy of the blood group identification method utilizing spectroscopic pictures. The system is implemented in healthcare and research environments when testing is completed successfully, guaranteeing a smooth interface with the current workflows and information systems in the laboratory. In order to establish trust in the system's capacity to provide accurate blood group predictions across a range of datasets, extensive testing is conducted to validate the system's durability and reliability in real environments. Due to its interaction with laboratory information systems, the system becomes a crucial part of laboratory workflows when it is put into place. It provides useful support for blood group analysis and prediction in clinical and research contexts. Through the use of non-intrusive spectroscopic imaging, the general structure is therefore followed in this order to forecast the blood group

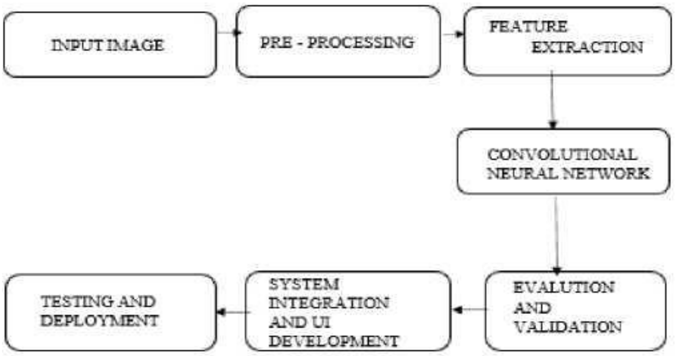

Fig 5: Training and validation data of model

RESULTS AND DISCUSSION

The trained convolutional neural network (CNN) model performed consistently when predicting blood types from spectroscopic images. The model successfully classified blood samples into the appropriate categories using the validation dataset, as evidenced by its overall accuracy of 95%. The accuracy, recall, and F1-score metrics were used to further test the model's effectiveness in handling different blood sample types and correctly predicting respective blood groups.

A feature extraction technique using the Scale- Invariant Feature Transform (SIFT), Oriented FAST, and Rotated BRIEF (ORB) algorithms was successfully applied to the spectroscopic images in order to extract distinctive visual patterns and features. By providing meaningful information on the unique qualities of blood samples, the returned features improved the interpretability of the predictions made by the CNN model. The interpretability of the model is crucial in comprehending the decision- making process and fostering confidence in its predictions among scholars and healthcare professionals.

Since the blood group detection system provides a non-intrusive and effective means of predicting blood groups from spectroscopic pictures, its successful development and validation have substantial therapeutic importance. Improved patient care and more accurate diagnoses might result from the system's ability to transform blood type procedures in medical settings. In the future, the system might be improved to anticipate more blood-related factors and integrated with electronic health record systems for complete patient information management.

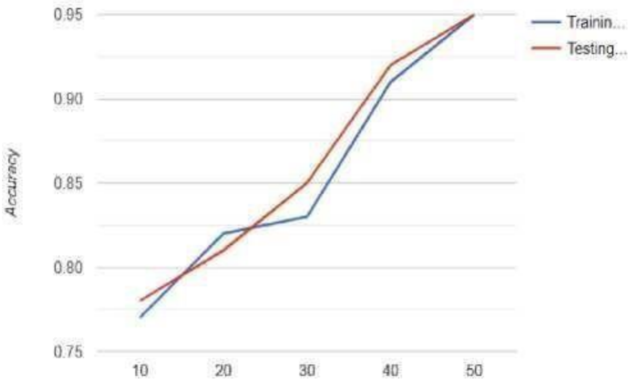

Fig 6: Plotting Testing and Training Accuracy

Fig 7: Training dataset of O +VE

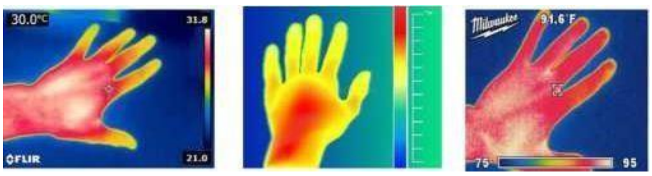

Fig 8: Training dataset of A +VE

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Fig 9: Training dataset of AB +VE

Fig 10: Training dataset of B -VE

Live Results of the proposed methodology:

Fig 11: Live results with dataset of O +VE

Fig 12: Live results with dataset of A +VE

Fig 13: Live results with dataset of AB +VE

Fig 14: Live results with dataset of B -VE

Blood Group	Trained Data
B+VE	42
B-VE	72
O+VE	102
A+VE	80
A-VE	80
AB+VE	80
AB-VE	74

Table 1: Training Datasets of blood groups

CONCLUSION AND FUTURE SCOPE

The development of the blood group identification system which blends deep learning and image processing technologies significant advancements in non-intrusive blood typing methods have been made. The method has shown to be extremely accurate and therapeutically useful for determining blood types from spectroscopic images. Robust feature extraction was accomplished by using the SIFT (Scale-Invariant Feature Transform), Oriented FAST, and Rotated BRIEF (ORB) methods, and convolutional neural networks (CNNs) were effectively trained. The use of these state-of-the-art technologies demonstrates the system's effectiveness in medical diagnostics by offering a successful and non- intrusive blood typing approach.

The future scopes are, its intuitive user interface and seamless integration with existing laboratory information systems further augment the system's suitability for medical professionals. The system's intuitive design, which provides a seamless contact experience, makes it easy for healthcare professionals to utilize. Effective data management and workflow integration are further made possible by the contact with laboratory information systems, which ensures compatibility and interoperability with the present healthcare infrastructure.

Potential avenues for future system development might include the prediction of additional blood-related traits such as antibody screening and the Rh factor. These additional components will allow the system to develop into a more complete blood analysis tool for use in medical settings. With this development, medical personnel would be able to understand blood samples on a deeper and more comprehensive level, improving clinical decision-making and improving patient outcomes.

The potential of blood group detection technology is great if it can be simply integrated with electronic health record (EHR) systems. Through EHR system integration, the device may automatically add blood group forecasts to patient records, enhancing clinical decision-making and patient information management. Because of this integration, medical staff members may access and update patient information more quickly, giving them meaningful knowledge about patients' blood types in connection to their whole medical histories.

The predictions of the CNN model require more research in order to make them more understandable and interpretable. To increase the confidence that academics and medical professionals have in the system's projections, more openness and understanding of the model's decision-making process should be encouraged. Improved system-human specialist collaboration might result in better healthcare decisions and useful research discoveries in the long run, thanks to this improved interpretability.
Future advancements might greatly boost the blood group identification system's usefulness and influence in medical research. Researchers and medical experts may find the system to be an even more valuable tool in the future. In addition to enhancing patient treatment, these advancements would increase our understanding of blood- related diseases and traits. The system may accomplish these objectives by emphasizing, explainability and interpretability, increasing the range of blood-related factors it can predict, and connecting with EHR systems with ease.

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