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A NOVEL APPROACH TO PREDICT BLOOD GROUP USING FINGERPRINT MAP READING

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ABSTRACT

Blood group identification is an essential process in medical diagnostics, typically performed using invasive methods that require blood samples. This project proposes a novel, non-invasive approach to predict blood groups using fingerprint map reading obtained from Thermal Spectroscopic Photoplethysmographic (PPG) sensors. The system captures fingerprint images and extracts unique patterns using Gabor filter-based feature extraction techniques. These extracted features are then used to train a machine learning model for classification. A Convolutional Neural Network (CNN) is employed to learn complex patterns from the fingerprint signals and accurately classify blood groups into categories such as A, B, AB, and O with positive and negative types. The system is implemented using Python and deployed through a web-based interface, allowing users to upload fingerprint images and receive predictions in real time. Experimental results demonstrate that the proposed model achieves high accuracy, with performance evaluated using metrics such as precision, recall, and F1-score. This approach provides a fast, cost-effective, and non-invasive alternative for blood group detection, making it suitable for healthcare and emergency applications.

Keywords : Blood Group Prediction, Fingerprint Analysis, CNN, Gabor Filter, PPG Sensor, Machine Learning, Biomedical Imaging, Non-Invasive Diagnosis

I.INTRODUCTION

Blood group detection is a critical procedure in medical applications such as blood transfusion, organ transplantation, and emergency care. Traditional methods require blood samples and laboratory testing, which can be time-consuming, costly, and invasive. These limitations highlight the need for alternative techniques that can provide faster and non-invasive solutions. Recent advancements in biomedical imaging and machine learning have opened new possibilities for predicting physiological attributes using external features such as fingerprints.

Fingerprint patterns are unique to each individual and contain rich information that can be analyzed using image processing techniques. Thermal Spectroscopic Photoplethysmographic (PPG) sensors capture fingerprint images with detailed structural patterns. By applying feature extraction methods such as Gabor filters, it is possible to extract meaningful signals from these images. Machine learning algorithms, particularly Convolutional Neural Networks (CNN), can then be used to learn complex patterns and classify them into different blood group categories. These models are capable of achieving high accuracy by analyzing spatial and texture features in fingerprint images.

This project presents a system that integrates image processing and deep learning techniques to predict blood groups from fingerprint images. The system includes modules for data preprocessing, feature extraction, model training, and prediction through a web interface. The trained CNN model achieves high accuracy and provides reliable predictions. This approach offers a non-invasive, efficient, and scalable solution for blood group detection, with potential applications in healthcare and emergency services.

II SURVEY OF RESEARCH

[1] The study by Dennis Gabor (1946) introduced Gabor filters, which are widely used for texture analysis and feature extraction in image processing. The methodology involves applying frequency and orientation-based filters to extract meaningful patterns from images. Results showed that Gabor filters are highly effective in capturing local features such as edges and ridges, making them suitable for fingerprint analysis. However, they may require high computational resources. In the proposed system, Gabor filters are used to extract fingerprint signals from PPG sensor images for blood group prediction.

[2] The research by Yann LeCun et al. (1998) introduced Convolutional Neural Networks (CNNs), which are widely used for image classification tasks. The methodology involves convolutional layers, pooling, and fully connected layers to extract and learn spatial features. Results demonstrated that CNNs outperform traditional machine learning methods in image-based classification problems. However, they require large datasets and computational power. In the proposed

system, CNN is used as the primary model to classify fingerprint images into different blood groups.

[3] The study by Allen J. Hahn (2010) explored the use of biometric features such as fingerprints for identifying physiological characteristics. The methodology focuses on extracting unique patterns from fingerprint images and analyzing them for classification tasks. Results showed that biometric data can be used for various predictive applications. However, accuracy depends on feature extraction techniques. This research supports the use of fingerprint patterns in predicting biological attributes such as blood groups.

[4] The research by Sepp Hochreiter and Jürgen Schmidhuber (1997) introduced deep learning models capable of handling complex data patterns. Although primarily used for sequence data, deep learning approaches have shown effectiveness in image-based prediction tasks. Results demonstrated improved accuracy in pattern recognition problems. However, deep learning models require careful tuning. This research highlights the importance of advanced neural networks in predictive systems. In the proposed work, CNN is used as a deep learning model for classification.

[5] The study by Geoffrey Hinton et al. (2006) introduced deep belief networks and multi-layer neural networks. The methodology focuses on learning hierarchical features from data. Results showed significant improvements in classification accuracy. However, these models require large datasets and computational resources. In biomedical imaging, such techniques help in extracting complex features. In the proposed system, similar deep learning concepts are applied to improve blood group prediction accuracy.

[6] The research by Yoshua Bengio et al. (2015) emphasized the importance of deep learning in handling large-scale data and complex relationships. The methodology involves training neural networks to learn high-level representations of data. Results demonstrated improved performance in classification and prediction tasks. However, training requires large datasets. This study supports the use of deep learning in biomedical applications. In the proposed system, CNN leverages these concepts to achieve high prediction accuracy.

III. WORKING METHODOLOGY

The proposed system for blood group prediction using fingerprint map reading follows a structured pipeline that includes image acquisition, feature extraction, model training, and prediction. Initially, fingerprint images are collected using Thermal Spectroscopic Photoplethysmographic (PPG) sensors. These images contain detailed ridge and texture patterns that are essential for analysis. The collected images are preprocessed to improve quality by removing noise and normalizing pixel values. Preprocessing ensures consistency in the dataset and enhances the performance of the machine learning model. The dataset is then organized into different classes representing blood groups such as A, B, AB, and O with positive and negative types.

In the next phase, feature extraction is performed using Gabor filters to capture important texture and frequency information from fingerprint images. Gabor filters are effective in highlighting ridge patterns and local structures, which are crucial for classification. The extracted features are then used as input to a Convolutional Neural Network (CNN). The CNN model consists of multiple layers, including convolutional layers for feature extraction, pooling layers for dimensionality reduction, and fully connected layers for classification. The dataset is split into training and testing sets, typically in an 80:20 ratio. The model is trained using the training data, and its performance is evaluated using metrics such as accuracy, precision, recall, and F1-score.

Finally, the trained model is deployed through a web-based application for real-time prediction. Users can log in and upload fingerprint images, which are processed using the same feature extraction techniques. The trained CNN model then predicts the blood group of the uploaded image. The system provides quick and accurate predictions, making it suitable for practical use. Visualization graphs such as training accuracy and loss curves are used to analyze model performance. This methodology ensures an efficient, non-invasive, and reliable solution for blood group prediction using fingerprint analysis.

IV RESULTS EXPLANATIONS

In this paper author using Thermal Spectroscopic Photoplethysmographic (PPG) sensor fingerprint images to predict user Blood Group. Propose application extracting Gabor signals from sensor images and then utilizing Machine Learning algorithm to train all images signals. ML trained model can be employ to

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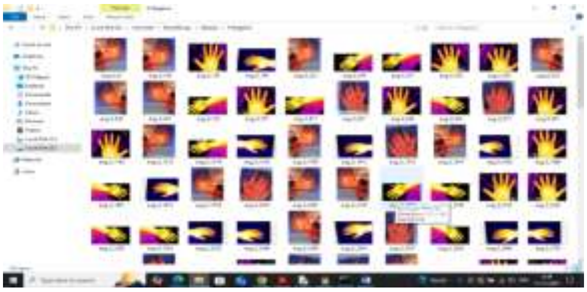
predict Blood Group from any sensor fingerprint images.



So by using above images will extract signals and train with ML model to predict Blood group

To implement this project we have designed following modules

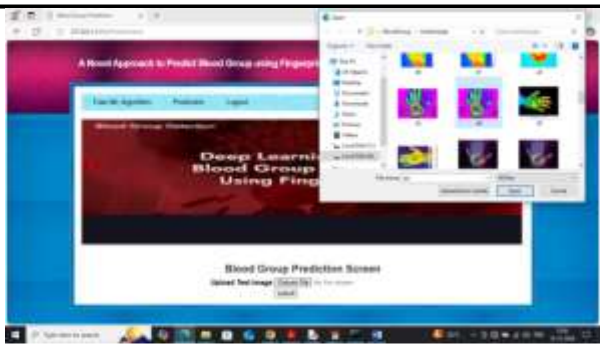
1) User Login: user can login to system using username and password as admin and admin
2) Train ML Algorithm: after login user can use this module to train ML algorithm and can analyse model performance in terms of accuracy and other metrics
3) Prediction: using this module user can upload test image and then application will extract Gabor signals and apply ML model to predict blood group
4) Logout: can exit from the application

In above screen ML CNN model got 97% accuracy on test data prediction and can see other metrics like precision, recall and FSCORE. In above screen visualizing ML CNN training accuracy and loss graph where x-axis represents training EPOCH and y-axis represents accuracy and loss values. In above graph blue and green line represents training and validation accuracy and then red and black line represents training and validation loss. In above graph can see with each increasing epoch accuracy got increased and reached closer to 1 and loss got decreased and reached closer to 0. Now click on 'Prediction' link to get below page

In above screen selecting and uploading test image and then click on "open and submit' button to get below output

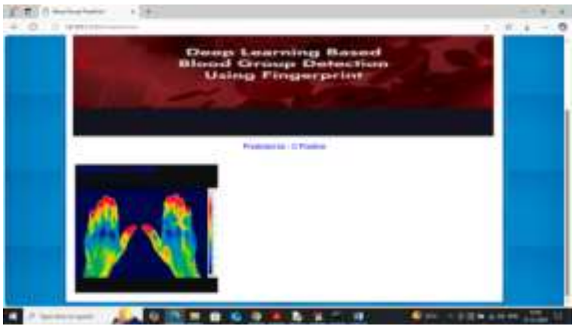
In above screen uploaded image is predicted as 'A Negative' blood group and below is testing another image

Above image predicted as B Negative



In above screen uploading another image and below is the output

Above prediction is B Positive



Above image predicted as 'O Positive'.

V. CONCLUSION

The proposed system for predicting blood groups using fingerprint map reading provides

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an innovative and non-invasive solution for medical diagnostics. By utilizing Thermal Spectroscopic Photoplethysmographic (PPG) sensor images and applying Gabor filter-based feature extraction, the system effectively captures unique fingerprint patterns. The use of Convolutional Neural Networks (CNN) enables accurate classification of blood groups, achieving high performance in terms of accuracy, precision, recall, and F1-score. Unlike traditional methods that require blood samples, this approach is faster, cost-effective, and user-friendly. The web-based implementation allows real-time prediction, making it practical for healthcare and emergency applications. Overall, the system demonstrates that combining image processing and deep learning techniques can provide reliable and efficient blood group prediction, contributing to advancements in biomedical technology.

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