Saranathan College of Engineering

Title : Finger Vein Recognition Based on Deep Learning

Domain : Deep Learning

Mentor :

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Problem Statement :

- Finger vein biometrics offer a secure and reliable method for personal identification, but existing detection methods often suffer from low accuracy and robustness.
- This project aims to address these limitations by employing deep learning models to accurately identify and extract vein patterns from finger images.
- The proposed system goal is to create a robust finger vein detection system capable of achieving high accuracy

Abstract:

- In this project propose a novel approach for finger vein detection leveraging deep learning techniques along with advanced image processing methodologies.
- Our method begins with preprocessing steps to enhance the quality of finger vein images. Subsequently, a deep learning architecture is employed to automatically extract discrminative features from the preprocessed images.
- The extracted features are then utilized in conjunction with Complete Direction Representation (CDR) to effectively capture the directional information present in finger vein patterns.
- Additionally, Band-Limited Phase-Only Correlation (BLPOC) is employed for precise matching of vein patterns, exploiting the phase information while suppressing irrelevant frequency components

Objective:

- To develop a robust finger vein detection system utilizing deep learning techniques, specifically focusing on image processing methods.
- Implement preprocessing techniques to enhance finger vein images, including noise reduction, contrast enhancement, and normalization.
- The proposed algorithms to extract directional features from finger vein images using CDR, capturing both local and global information.
- The pattern matching algorithm improved matching accuracy and computational efficiency.

Literature Survey

S.NO	Author & Year	Title of the Paper	Methodology	Findings
1	Chong Han; Zilong Chen & 2022	A Robust Edge Detection Algorithm for Finger Vein Recognition	Robust edge detection algorithm. Back propagation neural network	Results show that the proposed algorithm can robustly detect the finger edge of low quality finger vein images
2	T. Sathish Kumar; Pachaivanna n Partheeban & 2022	Finger Vein based Human Identification and Recognition using Gabor Filter	Gabor Filter, SURF Technique	Extracts vein patterns with nearperfect accuracy and recognizes them with high accuracy.

Literature Survey

S.No	Author & Year	Title of the Paper	Methodology	Findings
3	Hang Yang; Lei Shen & 2020	Finger Vein Image Inpainting With Gabor Texture Constraints	Gabor texture constraints	Improves the recognition performance of the finger vein identification system with the acquired damaged images.
4	Amira Oueslati; Nadia Feddaoui & 2020	An Efficient palm vein Region of Interest extraction method	Region of interest extraction (ROI)	Proposed method is performed at high accuracy of correct segmentation rate.

Existing system:

- Existing system implements a convolutional neural network (CNN)-based approach for finger vein detection.
- Finger vein biometrics offer a secure and convenient means of identification.
- Leveraging CNNs, our method extracts discriminative features from finger vein images to accurately detect and localize veins.
- Through extensive experimentation on benchmark datasets, this model demonstrate the effectiveness of our CNN.
- However, the CNN-based approach may suffer from computational complexity, requiring substantial resources for training and inference.

Disadvantages

- Computationally intensive and time-consuming.
- Irrelevant features and patterns are analyzed.
- Provide Low accuracy.

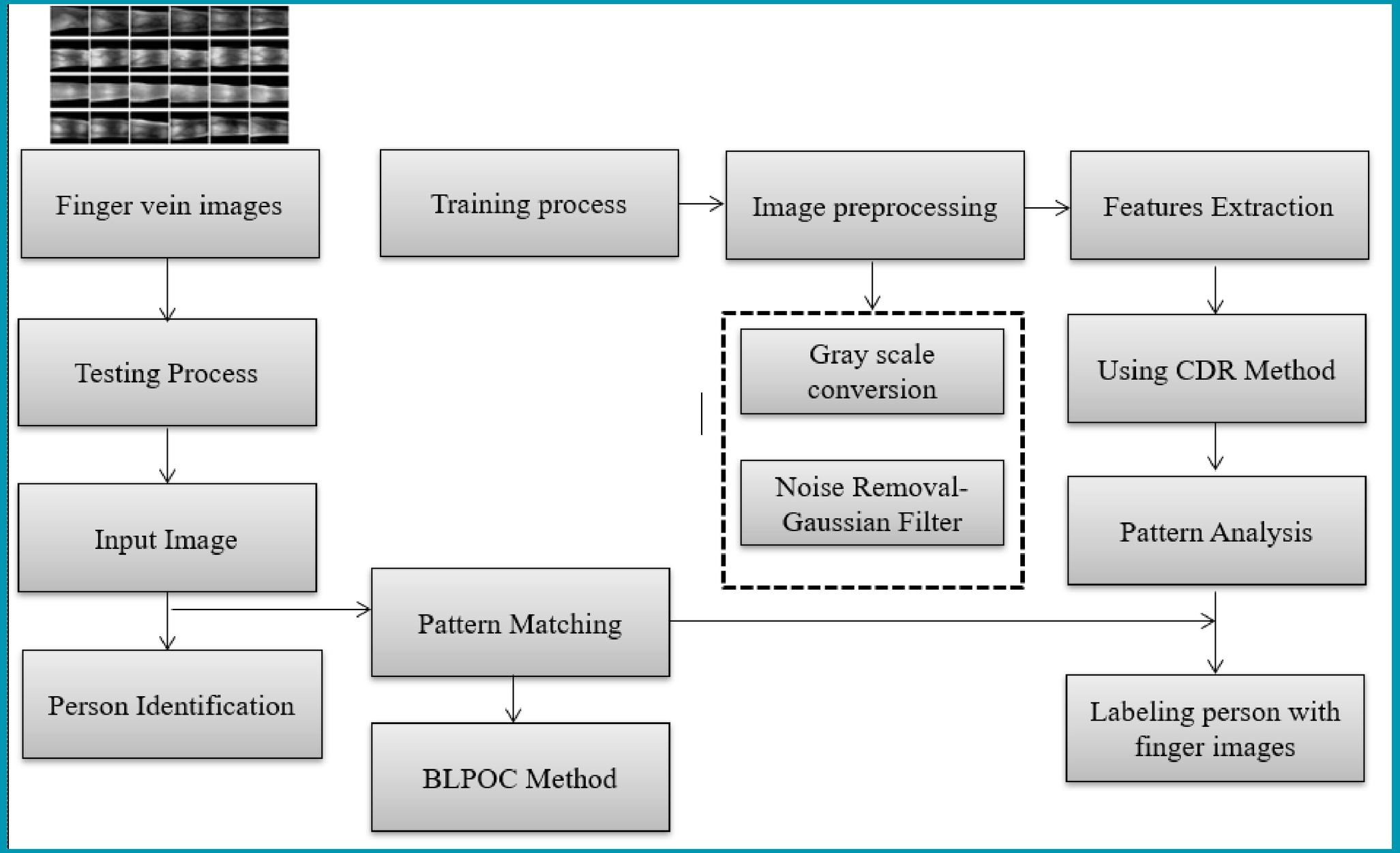
Proposed Solution:

- The proposed solution for finger vein detection using deep learning integrates advanced image processing techniques like Complete Direction Representation (CDR) and Band-Limited Phase-Only Correlation (BLPOC) for pattern matching.
- Initially, the input finger vein images are preprocessed to enhance contrast and reduce noise.
- Subsequently, CDR is employed to capture directional information effectively, enabling robust feature extraction from the vein patterns.
- The model is trained on a large dataset of annotated finger vein images to accurately identify vein patterns.
- Finally, BLPOC is utilized for precise vein pattern matching, aligning the input images with the learned representations for accurate detection.

Advantages

- The proposed models can effectively extract relevant features and perform precise pattern matching, leading to highly accurate vein detection results.
- Helps in capturing robust representations of finger vein patterns, making the detection system less sensitive to environmental factors.

Block Diagram :



Module Description

Image Acquistion

- The finger vein images are collected from Kaggle source.
- These images encompass diverse hand poses and lighting conditions, offering a comprehensive dataset for training and evaluation.
- Each image is annotated with corresponding person labels, ensuring supervised learning for accurate model development.
- The dataset contains sufficient variations in finger vein patterns and backgrounds, enabling robust model generalization.

Module Description

Training

- Deep learning models are trained using the Kaggle dataset for finger vein detection.
- The dataset is split into training and validation sets to assess model performance.
- Hyperparameters are fine-tuned through validation performance.
- The model learns to extract discriminative features from finger vein images to distinguish individuals accurately.

Module Description

Preprocessing

- Preprocessing steps include image resizing, normalization, and noise reduction.
- Images are resized to a standard dimension to ensure uniformity across the dataset.
- Normalization techniques such as mean subtraction and standard deviation scaling enhance model convergence and stability during training.
- Noise reduction using Gaussian blurring and median filtering eliminate artifacts and enhance vein visibility.
- Preprocessed images are then fed into the deep learning model for subsequent feature extraction and classification.

Module Description

Feature Extraction

- Feature extraction using Complete Direction Representation (CDR) for robust finger vein characterization.
- CDR captures directional information of vein patterns, enhancing discriminative capabilities.
- Convolutional layers extract hierarchical features, while pooling layers aggregate information to reduce dimensionality and increase translational invariance.
- The network's architecture enables effective representation learning, capturing intricate vein patterns crucial for identification.
- Feature maps are generated at different network depths, allowing the model to learn increasingly abstract representations of finger vein patterns.

Module Description

Person Identification

- Person identification involves matching extracted finger vein features against stored templates or reference patterns.
- BLPOC enables efficient correlation between query and reference features, facilitating accurate identification.
- Finger vein images are compared based on their phase information, enabling robust matching even under varying lighting conditions.
- Matching scores are computed to quantify similarity between query and reference patterns, enabling threshold-based decision-making for identification.
- The system outputs the identity of the matched individual, enabling secure access control and biometric authentication.

Reference:

- Han, Chong, Zilong Chen, Jian Guo, and Lijuan Sun. "A Robust Edge Detection Algorithm for Finger Vein Recognition." In 2022 41st Chinese Control Conference (CCC), IEEE, 2022.
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- Assim, Ola Marwan, and Ahmed M. Alkababji. "CNN and Genetic Algorithm for Finger Vein Recognition." In 2021 14th International Conference on Developments in eSystems Engineering (DeSE), IEEE, 2021.
- Yang, Hang, Lei Shen, Yu-Dong Yao, Huaxia Wang, and Guodong Zhao. "Finger vein image inpainting with gabor texture constraints." IEEE Access 8, 2020.
- Oueslati, Amira, Nadia Feddaoui,"An Efficient palm vein Region of Interest extraction method." In 2020 5th International Conference on Advanced Technologies for Signal and Image Processing (ATSIP) IEEE, 2020.