Finger Vein Biometric Approach for Personal Identification Using IRT Feature and Gabor Filter Implementation

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ABSTRACT: *The paper proposes a unique technique to find the local and the global features using Integrated Responses of Texture (IRT) features from finger veins which improves the overall accuracy of the system and is invariant to rotations. The segmentation of region of interest at different resolution levels makes the system highly efficient. The lower resolution data gives the overall global features and the higher resolution data gives the distinct local features. The complete feature set is descriptive in nature and reduces the Equal Error Rate. We develop and investigate the finger-vein images of different persons and the features are extracted using Gabor filter, which improves the overall accuracy of the system. The minute internal features of the finger vein are extracted for all the images present in the database and finally the matching was done based on extracted features to ascertain their effectiveness in the proposed system The Multi-Support Vector Machine (Multi-SVM) is used to classify and match the obtained results. The experimental results indicate that the system is highly accurate.*

KEYWORDS: Gabor filter, CLAHE (Contrast Limited Adaptive Histogram Equalization), ROI (Region Of Interest), Feature Extraction, Multi-support vector machine (Multi-SVM).

1. INTRODUCTION

Vein pattern is the network of blood vessels beneath a person's skin. This vein pattern can be used to authenticate the identity of an individual. In the ubiquitous network society, where individuals can easily access their information anytime and anywhere, people are also faced with the risk that others can easily access the same information anytime and anywhere. The development of new approaches for both the finger-vein identification, which achieves significantly improved performance over previously proposed approaches the unconstrained finger texture imaging with a low-resolution webcam presents high rotational and translational variations. The input images are enhanced using Contrast limited adaptive histogram equalization (CLAHE). A robust image normalization scheme is developed, and the ROI part is extracted. The rotational and translational variations are also accommodated in our matching strategy, which results in significantly improved performance.

Thus, an effective feature extraction technique termed as Integrated Responses of Texture using Local Binary Pattern is proposed in which different resolution levels of Texture using LBP is concatenated to form a complete set of features which describes the local and the global features more prominently. In the proposed method, when finger of a human being is inserted, it is being illuminated by the near-infrared Light Emitting Diode (LED) and the images of the veins are captured through a charge- coupled camera. When the near IR (infrared) radiations falls on the finger, the hemoglobin present in the blood of the vein absorbs the radiation and gives a dark pattern due to absorption. These digital images are recorded and form the database for the system. The blood vessels can only be seen in living human beings therefore can't be forged when a person is dead. The structure of vessel is unique to everyone and can't be copied easily. In the proposed system, the Local Binary Pattern Operator in texture at various resolution levels is analyzed to improve the accuracy of the system. Integrated Responses of Texture (IRT) using Local Binary Pattern proves that IRT is a better substitute with a more descriptive feature vector with a smaller vector size.

2. OBJECTIVE & TOOLS USED

Project Objective

The objective of the paper is to propose a finger vein recognition system which can be used for human identification. The main contribution of the paper is to extract an effective feature extraction technique which strategically improves the accuracy of the system.

Tools Used

Simulation Software: MATLAB 7.14 Version R2012a 4 is used for design and implementation for the simulation.

3. PROPOSED MODEL

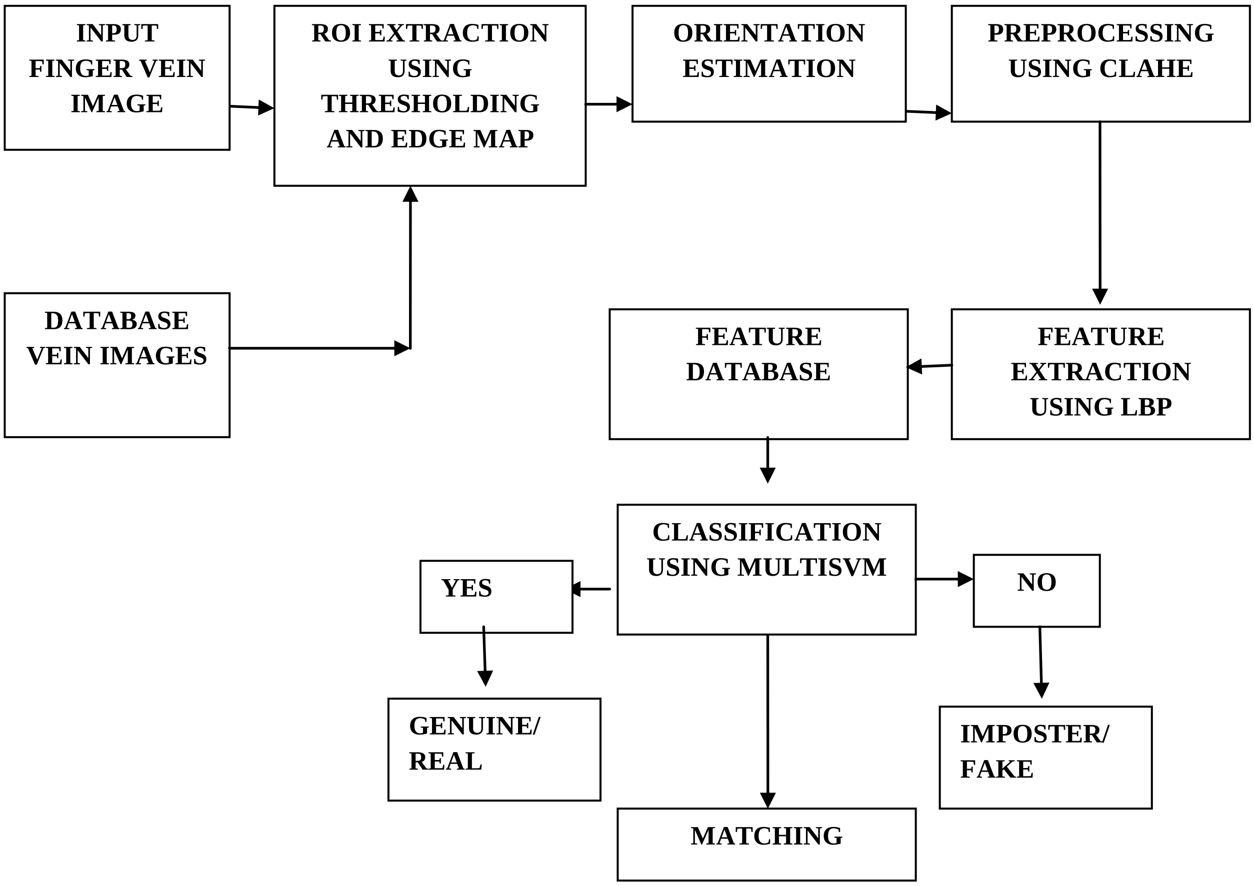


Fig 1: Block diagram of the proposed model

In this paper is on the development of new approaches for both the finger-vein identification, which achieves significantly improved performance over previously proposed approaches the unconstrained finger texture imaging with a low-resolution webcam presents high rotational and translational variations. The input images are enhanced using Contrast limited adaptive histogram equalization (CLAHE). A robust image normalization scheme is developed, and the ROI part is extracted. The rotational and translational variations are also accommodated in our matching strategy, which results in significantly improved performance. The Uniform Local Binary Operator is highly efficient in comparing all the neighborhood values which contains the local details of the vein pattern that significantly reduces the Equal Error Rate. The Local Binary Pattern Operator in texture at various resolution levels is analyzed to improve the accuracy of the system.

The finger vein recognition system is a secure and a reliable system with the advantage of robustness against malicious attacks. It is more convenient to operate this biometric feature than other biometric features such as facial and iris recognition system**.** The finger veins are hidden structures; it is extremely difficult to steal the finger-vein patterns of an individual without their knowledge, therefore offering a high degree of privacy. Second, the use of finger-vein biometrics offers strong ant spoofing capabilities as it can also ensure liveness in the presented fingers during the imaging.

3.1 Database Collection:

Data acquisition involves collection of images to form a database from the human beings. The images are used from the database of 6 finger vein images of 106 individuals with a total of 3,816 images of 320 x 240 pixel and stored in 'bmp' format . However, the proposed method is only tested on selected 17 individuals in which 6 samples from each of index, middle and ring finger per hand (6 x 6 x 17 =612 images) is taken which constitutes a database of 612 images in total for ease of processing. A sample is shown below

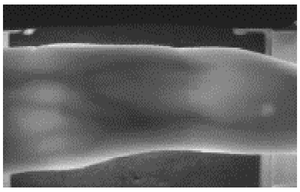
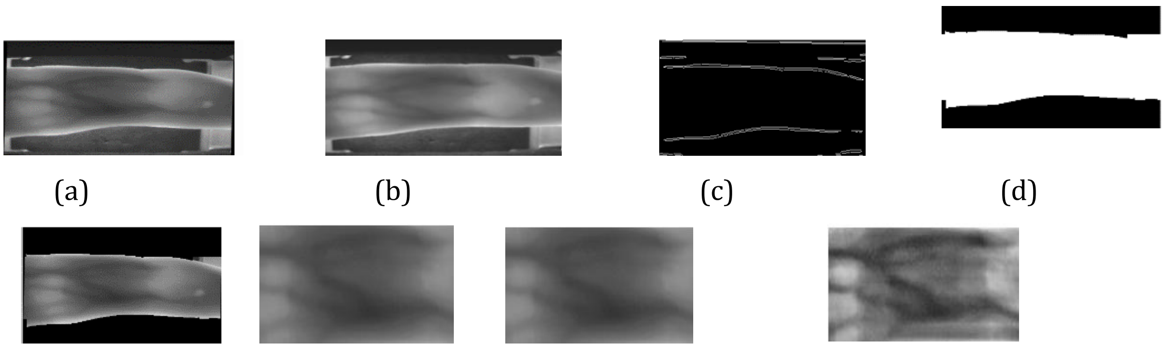


Fig 2 : Acquired Image from the Database

3.2 Preprocessing using CLAHE & ROI Extraction:

To create images of finger vein invariant to rotations, the rotation correction is used. The boundaries of the images are highlighted and edge points are found out. The finger vein image is processed by using CLAHE (Contrast-limited Adaptive Histogram Equalization) technique and the image is normalized and the required ROI is extracted.

This technique works on good as well as poor samples and extracts the region of interest for rotated images as well. The illustrates the extraction of Region of Interest and the processed ROI with normalization.



(a) (b) (c) (d)

(e) (f) (g) (h)

Fig 3 : (a) Image from Database, (b) Rotation corrected original image with theta (in degree) = -1.12, (c) Edged Image, (d) Finger Vein Region, (e) Masked ROI, (f) Region Of Interest, (g) Extracted ROI with CLAHE, (h) Normalized Image.

3.3 Localizing the Finger Vein Recognition:

The captured images included shaded regions at both ends in the horizontal direction. Because this caused degraded recognition, and because we were able to align the finger veins horizontally by using the guiding bar, we were easily able to cut off the shaded regions with predetermined pixel sizes at both ends. The shapes of each person's fingers were different. so we localized the finger region in order to normalize the finger vein image and extract the texture from the normalized image. The finger region is brighter than the background region, as shown in Figure 9, because infrared light shone through the skin. Therefore, in order to localize the finger region from captured images, we used the masks shown in Figures 5 a) and b). The masking value was calculated in the Y direction for each X position and the position at which the masking value became maximal was determined as the boundary position between the finger and the background in the Y direction. Figure shows the result of localizing the finger regions with mask.

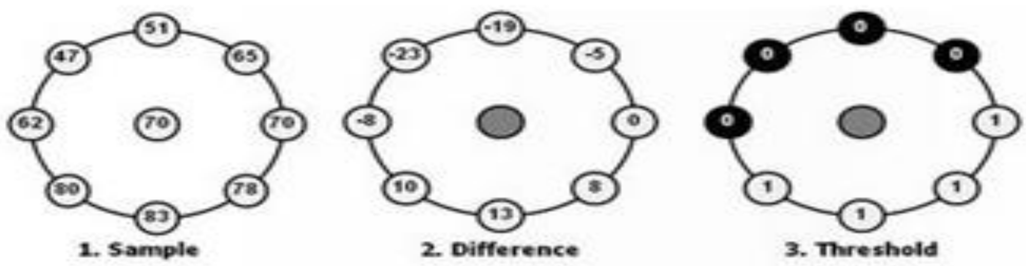


Fig 4: Local Binary Operator

A Local Binary Pattern (LBP) is uniform if the binary pattern contains at most two bitwise transitions from 0 to 1 or vice versa when the bit pattern is traversed circularly.

The ordered set of binary values can be expressed in decimal form as shown by Equation :

$$LBP(xc, yc) = \sum_{n=0}^{7} S\,(in - ic)\, 2^n$$

where ic and in represent the grey value of the center pixel (xc, yc) and the grey values of the 8 surrounding pixels, respectively. The function s(x) is defined as follows

$$S(x) = \begin{cases} 1, & \text{if } x \geq 0 \\ 0, & \text{if } x < 0. \end{cases}$$

3.4 Gabor filters implementation:

Texture features that are based on the local power spectrum obtained by a bank of Gabor filters are compared. The features differ in the type of nonlinear post-processing which is applied to the local power spectrum. The following features are considered: Gabor energy, complex moments, and grating cell operator features. The capability of the corresponding operators to produce distinct feature vector clusters for different textures is compared using two methods: the Fisher criterion and the classification result comparison.

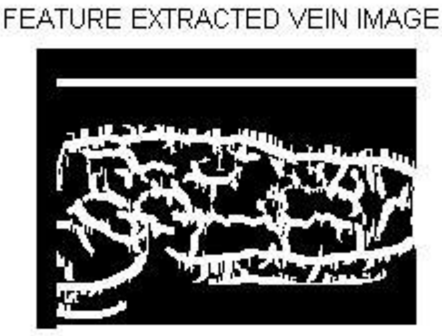
3.5 Matching:

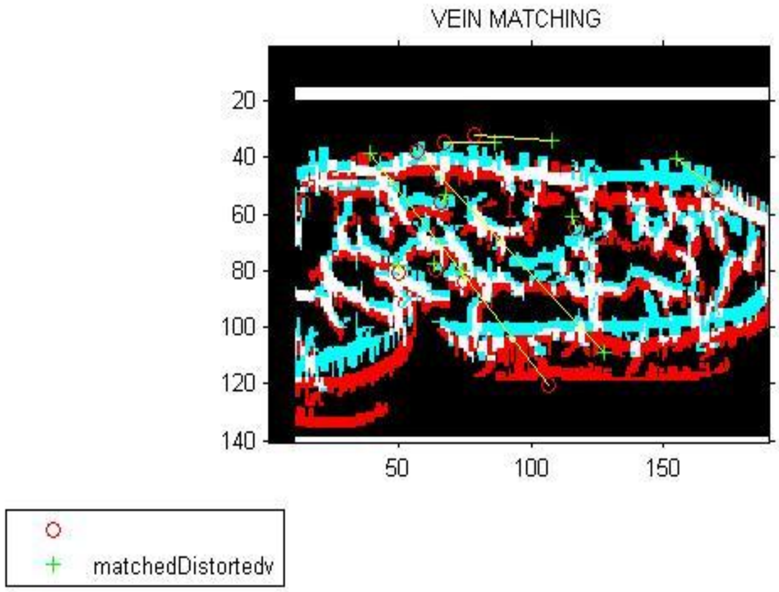
The matching of finger vein images are performed using multi-svm classifier in which the complete database is divided into Training and Testing sets and features are extracted from both the sets along with the Testing and Training Labels as well as their Sample List. The database is divided into 432 images in Training set and 180 images in Testing set with zero overlapping. The classification Accuracy is 94% as shown in Table I.

Table I: Classification Accuracy on Multi-SVM

Classifier	Training Set	Testing Set	Accuracy
Multi-SVM	432 Samples	180 Samples	94%

4. EXPERIMENTAL RESULTS:





5. CONCLUSION:

In this paper, we have proposed a novel finger vein recognition algorithm. We made our proposed algorithm robust against irregular shading and saturation factors by using the local and global features. As a result, the EER was 0.523% and the entire processing time was 98.2ms. The Integrated Responses of Texture (IRT) using Local Binary Pattern is proposed in this paper in order to extract the prominent and descriptive features for improving the accuracy of the system. To make system invariant to rotations, rotation correction techniques have been used along with CLAHE (Contrast-limited Adaptive Histogram Equalization) and normalization. The segmentation of Region of Interest at different resolution levels gives the both global and local features which reduces the Equal Error Rate to 0.523%. The multi-SVM classifies the data and matches the result with an accuracy of 94% when tested on a dataset of 612 finger vein images.

Future work may involve the determination of another promising feature vector and a study on different operators to improve the accuracy of the system.

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