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Finger Knuckle Based Biometric Identification of person

Ms. Arti B Waghode[1], Prof. C A Manjare[2],

[1] Ms. Arti B Waghode, M.E. (Digital System), JSPM's JSCOE Pune, Maharashtra, India
[2] Assistant Professor. C A Manjare, Dept. of E&TC Engineering, JSPM's, JSCOE, Pune, Maharashtra, India

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Abstract - *Finger knuckle print can be incredibly beneficial for person identity. FKP as a new biometric modality supplying huge scope for researchers in few years.*
In this system we present a finger knuckle identification method that uses subspace techniques. In proposed system we use the three subspace techniques, first we use Gabor filter in preprocessing for removing the noise from acquired image and we get the noise free image. Secondly we use PCA for feature extraction and then last we use the LDA as well as Knn classifier for matching purpose. Result obtained from knn classifier and LDA algorithm gives the approximately 98% recognition rate. Also gives the high efficiency as compare to other methods.

***Key Words*: Finger Knuckle, LDA, PCA, Gabor filter, Image Processing, Feature Extraction, Identification**

1. INTRODUCTION

In ancient days, traditional modes consisting of password gadget, PIN range system and identification playing cards device are used for the authentication cause. Biometric device is notably utilized in man or woman authentication gadget than traditional methods. The genetic developments like fingerprint, face, iris, palm print, hand geometry, finger vein and hand vein are used as biometric systems. Biometric behaviors like palm print, fingerprint, hand vein and hand geometry are extensively used because of excessive person acceptance. The image sample of membrane wrinkles and creases, the outside finger knuckle region is greatly distinctive. Consequently this biometric characteristic is used as a distinctive biometric device [4]. The inner surface of the finger knuckle print is extensively used in conserving of objects. Consequently, it isn't always effortlessly damaged by intruder. The criminal sports are not associated with finger knuckle print and as a result it has higher consumer recognition [13]. The strains of the knuckle surface aren't seemed on the sensor tool and hence it cannot be cast without difficulty. It's far prosperous in texture and used as great biometric gadget. On this paintings, a nearby–worldwide feature fusion approach is proposed for finger knuckle-print biometric scheme.

Later, Kumar and Ravikanth [4] proposed some other approach to personal authentication via the usage of 2-D finger-returned floor imaging. They evolved a tool to seize hand-back pictures after which extracted the finger knuckle regions with the aid of some preprocessing steps. The sub-area evaluation strategies together with PCA, LDA and ICA were blended to do feature extraction and matching. With Kumar et al.'s design, the purchase tool is doomed to have a big length because almost the whole hand returned area needs to be captured, notwithstanding the fact that the finger knuckle area handiest occupies a small part of the received photo. Furthermore, subspace evaluation strategies may additionally be effective for face reputation however they will not be capable of effectively extract the exclusive line features from the finger knuckle.

2. PROPOSED METHODOLOGY

Figure 1. Represents work flow diagram for proposed Knuckle Surface Identification.

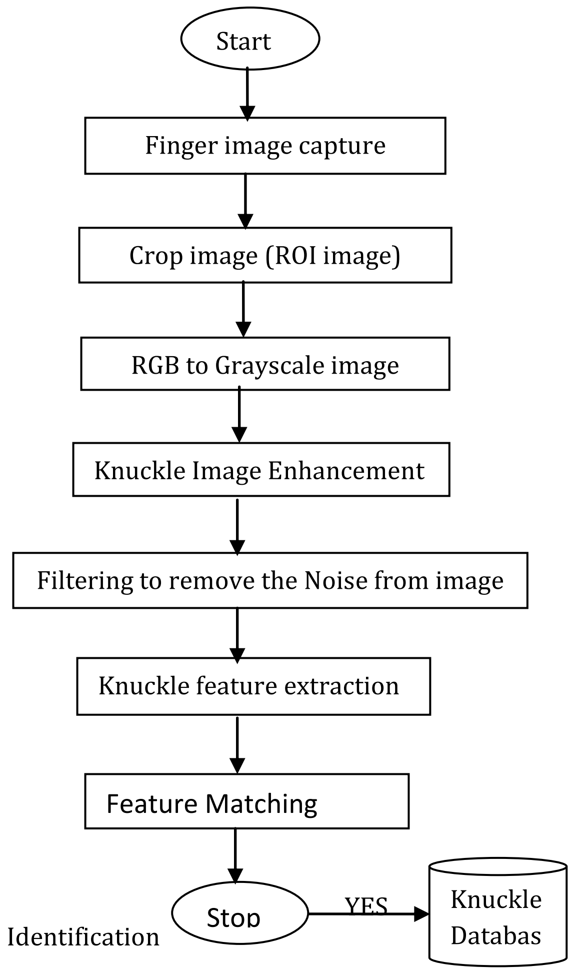

Fig -1: Flow diagram for proposed Knuckle Surface Identification

3. BLOCK DIAGRAM

The proposed authentication system deals with the database of ‘n’ number of images i.e. a system is designed for one-to-many identification. A system uses just a webcam or smart phone as a part of hardware [2]. The system is divided into two main modules, namely: Registration and Identification.

The system can be precisely understood by looking at the system block diagram shown in Fig. 2. Proposed work is concentrating on the advancement of a mechanized strategy for removing finger knuckle print and knuckle highlights from the finger back surface and utilizing it for individual recognizable proof reason.

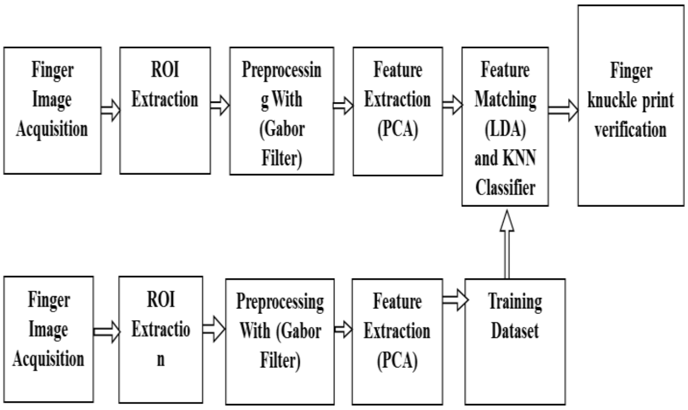

Fig -2: Block Diagram of Proposed System

4. PROPOSED TECHNIQUES

4.1. Subspace Technique:

1. Gabor filter
2. PCA
3. LDA

4.1.1. Gabor Filter:

Gabor Filter Implements one or multiple convolutions of an input image with a two dimensional Gabor function:

Real

$$g(x,y;\lambda,\theta,\varphi,\sigma,\gamma) = \exp\left(-\frac{x'^2+\gamma^2 y'^2}{2\sigma^2}\right) cos\left(2\pi\ \frac{x'}{\lambda}+\varphi\right) \quad (1)$$

Where,

And

To visualize a Gabor feature choose the option "Gabor function" under "Output picture". The Gabor function for the specified values of the parameters "wavelength", "orientation", "segment offset", "aspect ratio", and "bandwidth" might be calculated and displayed as an intensity map image in the output window. (Mild and darkish gray colorings correspond to advantageous and terrible feature values, respectively.) The picture in the output widow has the equal size because the enter photograph: choose, for instance, enter image octagon.jpg to get an output picture of length a hundred with the aid of 100. If lists of values are exact under "orientation(s)" and "segment offset(s)", simplest the primary values in these lists can be used.

4.1.2. PCA:

The principal component analysis (PCA) determines the basis vectors spanning an optimal subspace such that the mean square error between the projection of the training images onto this subspace and the original images is minimized. We call this set of optimal basis vectors as eigen knuckles since these are simply the eigenvectors of the covariance matrix computed from the vectored images in the training set. The feature extraction steps begins with firstly representing each of the N × M pixel knuckle image by a vector and then computing its covariance matrix of these normalized vectors ϴj
Algorithm for finding Eigen knuckles for M knuckle images having similar dimensions is explained as below.
1. Collect a bunch of sample knuckle images (say three knuckle images for each person). Dimensions of all images should be same say NX×NY. An image can be stored in an array of (NX×NY) ×1 dimension [T] which can be considered as an image vector. Therefore training set of image vectors of size (NX×NY) ×M is,

$$\{\Gamma i|\ i= 1, 2 .... M\} \quad (2)$$

Where, M is the average number of images. To find the average image of bunch of images,

$$\psi = \frac{1}{M}\sum_{i=1}^{M}\Gamma_i \quad (3)$$

2. To find the deviated [Img1-Avg, Img2- Avg, Imgn- Avg] images,

$$\phi_i = \Gamma_i - \psi \mid i = 1,2,\ldots\ldots,M \quad (4)$$

3. Calculate the covariance matrix.

$$C=AAT \quad (5)$$

$$C = \begin{bmatrix} c(1,1) & \cdots & c(1,d) \\ \vdots & \ddots & \vdots \\ c(d,1) & \cdots & c(d,d) \end{bmatrix} \quad (6)$$

Where, A= [øi, ...,øm]

But the issue with this approach is that we unable to complete this operation for a bunch of images because covariance matrix will be extremely huge.

For example matrix of covariance for a knuckle image of size NX×NY pixels is of size (P× P), P being (NX×XNY). This covariance matrix is very hard to work with due to its huge dimension causing computational complexity. It is very hard or may be practically impossible to store that matrix. Also finding that matrix will require considerable computational requirements. So for solving this problem we first compute the matrix L.

$$L=ATA \tag{7}$$

And then find the Eigen Vectors [V] related to it

$$VX(X = 1\ldots\ldots, M) \tag{8}$$

Eigen Vectors for covariance matrix C can be found by

$$U= [u1\ldots\ldots, um] \tag{9}$$
$$= [\emptyset 1 \ldots \emptyset m][v1,\ldots\ldots,vm] \tag{10}$$
$$= A \cdot V \tag{11}$$

Where UX(X= 1…….. , M) are Eigen Vectors for C. Using these Eigen vectors, we can construct Eigen Knuckles. Eigen knuckle will have numerical value which will be classified and identified using LDA.

4.1.3. LDA:

Linear Discriminant analysis has been successfully used as a classification technique for a number of problems, such as speech recognition; face recognition. While PCA takes the complete training data as one entity, LDA's main aim is to find an efficient way to represent the vector space by using class information (class is defined as a collection of data belonging to a particular entity, for example a collection of images belonging to a person.) [7-9]. The FK images in the training set are divided into the corresponding classes. LDA then compute a set of vectors W as follows:

$$W = \max\left|\frac{W^T S_b W}{W^T S_w W}\right| = \max\left|\frac{S_b}{S_w}\right| \tag{12}$$

5. CLASSIFICATION AND IDENTIFICATION USING KNN CLASSIFICATION

5.1. K-nn Classifier

Classification is the process of detecting a pattern and comparing it with the predefined pattern in the database and identifies the matching features. Training has to be done to the predefined features and the trained and test features are compared. The test feature is our input image. When the features match, and then it is recognized. Here, the k-nn classifier is used. K-nearest neighbor classifier is a robust method used for matching. The k nearest neighbor (k-nn) pattern classifier is an effective learner for general pattern recognition domains.

6. RESULT

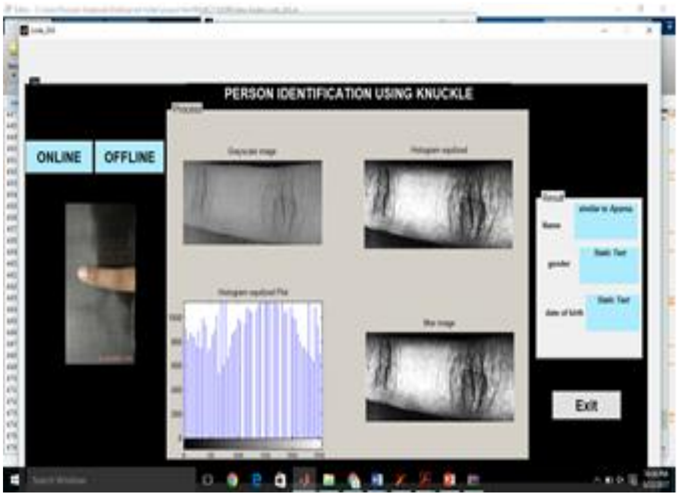

Fig -3: Final GUI

7. CONCLUSION

This paper has presented a new approach of subspace technique for personal authentication using finger knuckle back surface. This system compares the user knuckle with the database knuckle from the captured knuckle by using web camera, the contour part of two images. It has shown the matching percentage as 96.7%, if both are perfectly matched.
The proposed idea assures security and improved efficiency in comparison traditionally used biometric identification.

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