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DORSAL FINGERPRINT PATTERNS USING LBP AND GABOR FOR IDENTIFYING HUMAN IDENTITIES

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Abstract: - Dorsal fingerprint patterns are used to provide new biometric based authentication system for human identification. In existing system, the minor knuckle is used for authentication and Distance Measurement is used for recognition and matching. In Existing system hairs in the major knuckle has not be determined and minor knuckle are not well shown in surface. In proposed system we combine the minor and major knuckle for the finger authentication and use Local Binary pattern, 1D-Gabor filter for the matching process. That features will help to extract the image pixel information about intensity and textures. The Local Binary pattern, 1D-gabour filter is combined with classification process. The K-nearest neighbour classifier (KNN) is a robust classifier used to classify the feature for authentication process. Finally KNN Classifier help to improve accuracy of authentication process with 91%.

Keywords*:* Major Finger Knuckle, Minor Finger Knuckle, Local binary pattern. Gabor filter, K-Nearest Neighbour classifier.

1. Introduction

The Biometric authentication is one of the recent research areas for improvement in the security systems. In Biometric authentication research, the knuckle based authentication is used for recognition. Accurate identification of finger knuckle patterns can be beneficial for several applications involving forensic and covert identification of suspects [1]. It is different from other biometrics and it is not easy to fake because structure of the bone is unique.

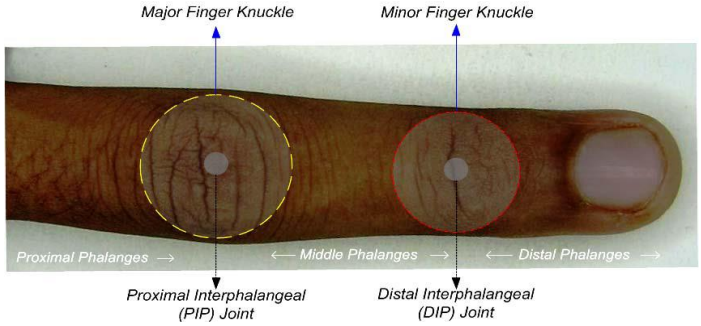

Figure.1 A finger dorsal surface for identifying the major and minor knuckle pattern regions with respect to the PIP/DIP joints.

A normal human hand has four fingers each of which has 3 bone segments and three joints These segments are known as phalanges (plural of phalanx) .The knuckle is divided into major knuckle and minor knuckle [2]. The major knuckle are present between proximal and middle phalanx bones while minor knuckle are present between distal and middle phalanx bones.

2. Limitations for Biometric Process

In existing system, the minor knuckle [3] is used for authentication and Distance Measurement is used for recognition and matching. In Existing system hairs in the major knuckle has not be determined and minor knuckle are not well shown in surface. In the biometric process, we have got some draw backs in security and cost level is high. In existing system, the fingerprint and face authentication of the hackers easily attacks the biometric details.

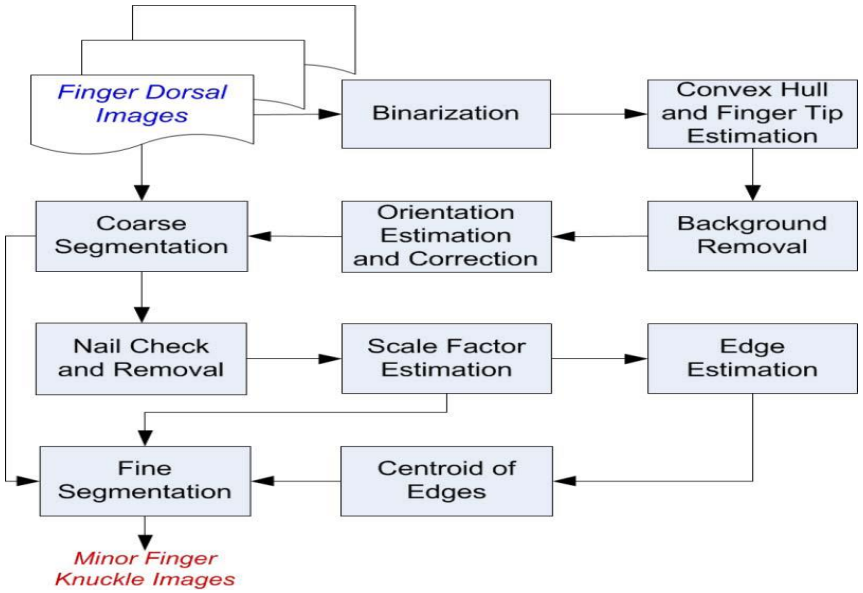

Figure.2. Block diagram of minor finger knuckle images from the finger dorsal images

Figure 2 shows that a dorsal finger image is fed into binarization to convert the pixels into binarized values of 0's and 1's.Then the binarized image is enhanced by converting rough texture(coarse segmentation) segments into fine segments(fine segmentation) [4]. The edge is detected by subtracting the background and the enhanced image is viewed. The match score strategy is used to select the score level for matching the finger knuckle images respectively [5].

3. Related Techniques

The Related work for the proposed paper comprises of the works that uses various Local binary pattern(LBP) and Gabor filter to verify the human identities using K-nearest neighbour classifier(KNN classifier). They have used Accurate personal identification using minor finger knuckle patterns will require accurate segmentation of region of interest images [6]. It is used to establish similarity between two texture based images. It also used phase components in 2D (two-dimensional) discrete Fourier transforms of iris images for iris recognition and Phase-Only Correlation (POC) function used for Phase-Based Image Matching [7]. Thus by acquiring simultaneously the finger-vein and low-resolution fingerprint images and combines these two evidences using a novel score-level combination strategy.
In proposed system we combine the minor and major knuckle for the finger authentication and use Local Binary pattern, 1D-Gabor filter for the matching process [8]. That features will help to extract the image pixel information about intensity and textures. The Local Binary pattern, 1D-gabour filter is combined with

classification process. The K-nearest neighbour classifier (KNN) is a robust classifier used to classify the feature for authentication process [9].

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3.1) System Model

Dorsal finger knuckle pattern are pre-processed using binarization [10]. The binarized image is segmented into fine segment and the edge is detected by subtracting the background. The feature of the knuckle image is extracted by Local binary pattern (LBP) and Gabor filter and the feature is combined. Then the K-nearest neighbour classifier is used for matching the patterns and the result is analyzed by computing whether the user is authenticated or not.

3.2) Pre-processing

In pre-processing, binarization is a process where each pixel in an image is converted into one bit and assign the value as '1' or '0' depending upon the mean value of all the pixels [11].

$$R = \frac{1}{k}\sum_{i=0}^{k} x \qquad \text{- - - -(1)}$$

Here, x is the sum of elements in the matrix?
k is the number of elements ranges from i=0 to k.

$$H(g) = \begin{cases} 1 & if\ g > Mean \\ 0 & otherwise \end{cases} \qquad \text{- - - -(2)}$$

Here H (g) is the binarization function.

3.3) Image segmentation

Image segmentation is the process of partitioning a digital image into multiple segments [12]. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.

3.4) Edge Detection

Edge detection is defined as a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply. Sobel filter is used for edge detection. In the sobel operator, image processing is used and computer vision is used creates an image which emphasizes edges and transition.

3.5) Coarse segmentation

Coarse segmentation is the process of segmenting the rough in texture or structured images into fine segments. Median filter is used for segmenting the images [13]. A *region of interest* (ROI) is a portion of an image that you want to filter. Threshold is a non-linear operation that converts a gray-scale image into a binary image where the two levels are assigned to pixels that are below or above the specified threshold value. A fudge factor is an *ad hoc* quantity introduced into calculation, formula or model in order to make it fit observations or expectations.
Figure.3 describes how the image is segmented and extracted using Local binary pattern and Gabor filter and Classification is done by KNN classifier for matching and authentication.

3.6 Image Filtering and Enhancement

The process of image filtering is done by which we can enhance images. The process of improving the quality of a digitally stored image by manipulating the image with software is called enhancement. Median filter is used for enhancement. A median filter is more effective than convolution where the goal is to simultaneously reduce noise and preserve edges. The following are the steps for median filter,

Step 1: The 3*3 matrix A is taken as,

$$A = \begin{pmatrix} 10 & 30 & 40 \\ 20 & 50 & 12 \\ 24 & 60 & 58 \end{pmatrix}$$

Step 2: Arrange in ascending order.

A= {10, 12, 20, 24, 30, 40, 50, 58, 60}

Step 3: Replace the centered value by the mean value 30.

$$A=\begin{pmatrix}10 & 30 & 40\\ 20 & 30 & 12\\ 24 & 60 & 58\end{pmatrix}$$

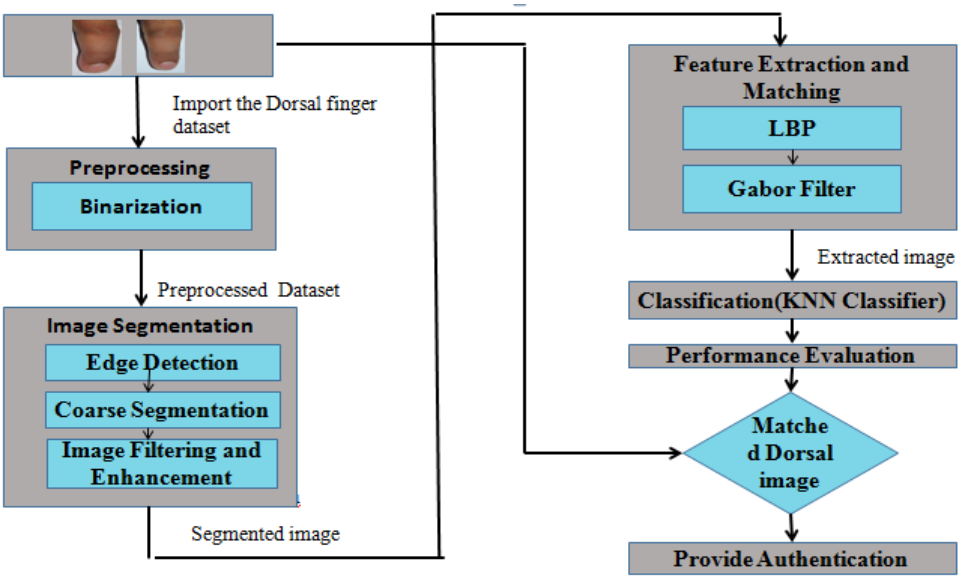

Figure.3. Dorsal finger knuckle pattern

4. Feature Extraction and Matching

When the input data to an algorithm is too large to be processed and it is suspected to be redundant, then it can be transformed into a reduced set of features (also named features vector. This can be named as feature extraction.

4.1) Local Binary Pattern (LBP)

The local binary pattern operator is an image operator which transforms an image into an array or image of integer labels describing small-scale appearance of the image. The original version of the local binary pattern operator works in a 3 × 3 pixel block of an image [14]. The pixels in this block are threshold by its centre pixel value, multiplied by powers of two and then summed to obtain a label for the centre pixel. As the neighbourhood consists of 8 pixels obtained depending on the relative gray values of the centre and the pixels in the neighbourhood.

Consider a monochrome image I (x, y) and let gc denote the gray level of an arbitrary pixel (x, y), i.e. gc = I (x, y). Moreover, let gp denote the gray value of a sampling point in an evenly spaced circular neighbourhood of P sampling points and radius R around point (x, y):

$$g_{p=I(x_p,y_p)}, p = 0 \ldots . p-1 \quad ---(3)$$

$$x_p = x + R\cos\left(\frac{2\pi p}{P}\right). \quad -(4)$$

$$y_p = y - R\sin\left(\frac{2\pi p}{P}\right). \quad -(5)$$

$$s(z) = \begin{cases} 1 & z \geq 0 \\ 0 & z < 0 \end{cases} \quad -(6)$$

Where, s (z) is the threshold function. The generic local binary pattern operator is derived from this joint distribution. As in the case of basic LBP, it is obtained by summing the threshold differences.

4.2) 1D Gabor filter

Gabor feature is a linear filter used for edge detection they have been found to be particularly appropriate for texture representation and discrimination [15]. A filter bank consisting of Gabor filters with various scales and rotations is created. The filter has a real and an imaginary component representing orthogonally.

$$g(x, y; \lambda, \theta, \psi, \sigma, \Upsilon) = \exp\left(-\frac{x^2 + \gamma^2 y^2}{2\sigma^2}\right)\cos\left(2\pi\frac{x'}{\lambda} + \psi\right) - (7)$$

$$g(x, y; \lambda, \theta, \psi, \sigma, \Upsilon) = \exp\left(-\frac{x^2 + \gamma^2 y^2}{2\sigma^2}\right)\sin\left(2\pi\frac{x'}{\lambda} + \psi\right) - (8)$$

Where $x' = x\cos\theta + y\sin\theta \quad -(9)$

$$y' = -x\sin\theta + y\cos\theta \quad -(10)$$

Deviation of the Gaussian envelope and Υ is the spatial aspect ratio, and specifies the elliptic of the support of the Gabor function. A set of Gabor filters with different frequencies and orientations may be helpful for extracting useful features from an image. Gabor filters is used in pattern analysis applications

4.3) Classification

The classification process is to identify the matching of features in that process the test feature is compare to train feature and which feature is match equal to the train feature it provide the authentication. Train feature is the overall feature of image it contains more image details. The test feature is our input image feature. K-nearest neighbour classifier is a robust method used for matching. The k-nearest neighbour (K-NN) pattern classifier is an effective learner for general pattern recognition domains. This is important because by not leaving the instance out, the k-NN classifier (distance weighted) will always achieve 100% training not possible**.**

Calculations for LBP Dataset

When Calculating the LBP dataset we first present a Data set used then we present the LBP calculation and we present our evaluation results.

5.1) Data set

Dataset is a collection of dorsal finger knuckle pattern. It consists of 106 images. It is called tested set. The workspace consists of the size of the image in bytes. It displays the maximum and minimum pixel values in workspace. The pixel values of the image are represented in a matrix format. Every pixel is a matrix element. The images are read into dataset using im read ().

5.2) Calculation for LBP and Gabor Filter

Local Binary Pattern:

1. Convert bitmap to gray level image.
2. For each pixel we will find LBP.

$$h(x - y) = \begin{cases} 1 & x - y \leq 0 \\ 0 & otherwise \end{cases} \quad -(11)$$

218<157=0
218<178=0

218<220=1
218<255=1

5. Local binary pattern for pixel[1,1] in binary is 00111101 and it is converted to Decimal as 61.
6. Finally we get, 36 unique LBP for image with 256 grey levels

.

A set of Gabor filters with different frequencies and orientations may be helpful for extracting useful features from an image. Therefore, usually, a filter bank consisting of Gabor filters with various scales.

5.3) Evaluation

In the analysis process classifier accuracy was calculated by using the some basic calculation. The accuracy of the classification rate is based on the classifier characteristics. The performance of the system is measured by calculating sensitivity and specificity of the classifier. The accuracy of the classifier represents to which extend the classifier classifies the images based on the given label. The sensitivity of the classifier represents how exactly the classifier correctly classifies the data to each category. The specificity of the classifier represents how exactly the classifier correctly rejects the data to each category.

Sensitivity (also called the true positive rate, or the recall rate in some fields) measures the proportion of actual positives which are correctly identified as such (e.g. the percentage of sick people who are correctly identified as having the condition). Specificity (sometimes called the true negative rate) measures the proportion of negatives which are correctly identified as such (e.g. the percentage of healthy people who are correctly identified as not having the condition).

5.4) Confusion Matrix

If the matrix value is true positive then it is correctly identified else it is false positive then incorrectly identified. If the matrix value is true negative then it is correctly rejected else it is false negative = incorrectly rejected. ROC curve is a graphical plot which illustrates the performance of a binary classifier system as its discriminations. The ROC curve is then the sensitivity as a function of fall-out. In general, if both of the probability distributions for detecting the Cumulative Distribution Function of the detection probability in the y-axis versus the Cumulative Distribution Function of the false alarm probability in x-axis. A classification model is a mapping of instances between groups.

6. CONCLUSION

In this paper, we rectify the existing draw backs to improve the accuracy and efficiency of the process and we design a new method to new biometric authentication technique. It is based on the finger knuckle textures unique like other biometric but it is not easily hack able. The texture pattern produced by the finger knuckle bending is highly unique. Finger-knuckle- prints (FKP), which refers to the inherent skin patterns of the outer surface around the phalangeal joint of if a finger, is a new member of the biometrics family. It has high capability to discriminate different individuals. In this paper, we use median filter to remove the noise or smoothen the image. Then we use histogram equalization technique to improve the image quality for extract the correct feature. Then the LBP and 1-D Gabor filter for extract the knuckle. Then the KNN classifier classifies the features at very accurate level. The Accuracy, sensitivity, specificity, and error will improve compare with existing system. In feature we used robust algorithms are used to find the better accuracy result and get well secure biometric authentication method.

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