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Fingerprint Recognition Using Minutiae Based and Discrete Wavelet Transform

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Abstract: ***Fingerprint recognition is one of the methods used in biometric system. Most of the biometric systems which are used for human identification or person's identification. In this paper we are discussing minutiae matching and discrete wavelet transform and comparison of these two in fingerprint recognition. In this paper, firstly it uses fingerprint identification and performance in terms of equal error rate and then by calculating using discrete wavelet transform. The main aim of this paper is to create performing and accurate program for fingerprint identification.***

Keywords: minutiae based, DWT

I. INTRODUCTION

Fingerprint identification is an authenticated method used for verifying a match between two persons fingerprint. Fingerprints are one form of biometric systems which can used to verify their identity and individual person identification. Biometric systems verity's a person using behavioral and physiological biometric data. The behavioral biometrics is: signature, gait, speech and keystroke, which change with age and environment. Physiological characteristics do not change the lifetime of a person. Such characteristics which include face, fingerprint, palm print and iris. The biometric systems verify and identify a person using his biometric data. Most biometric systems are *unimodal* - rely on a single source of information for authentication (e.g., single fingerprint, face or signature) . Due to a large number of users, these systems experience problems, such as: noise in sensed data (e.g.: a fingerprint image with a scar, dirty sensor, etc.); intra-class variations (e.g., incorrect facial pose); inter-class similarities (e.g.: there may be inter-class similarities in the feature space of many users); non-universality (e.g.: incorrect minutiae features caused by low quality of ridges). A biometric system can be an identification or verification system, in which identification means determine a person's identity even without his or her knowledge, for example identifying a person in huge crowd. Verification means confirming a person's identity, for example verifying a person in which he or she belongs to company or not.

In fingerprint recognition technique the patterns of friction ridges, edges and valleys of a separate fingerprint are unique to the individual persons. Fingerprints are same for each finger of a person including for identical twins. The most commonly used fingerprint recognition methods are based on the minutiae points, because extraction of the points does not require a high-resolution image, and the minutiae points can be extracted from a not-aligned and dissorted fingerprint image. Thus, the method can be alignment invariant. In this paper we are going to calculating the equal error rate for fingerprint recognition based on minutiae extraction and for discrete wavelet transform (DWT). Fingerprint is a pattern of ridges and valleys. The basic fingerprint image which consists of features is shown in figure (1).

Fig 1. Fingerprint features

METHODOLOGY

Minutiae based fingerprint recognition include some following process which are binarization, thinning process, minutiae extraction, minutiae matching and minutiae score. In binarization step the fingerprint image is converted into grayscale image and then it is converted into binary format. This includes image enhancement where which the image is normalized and gabor filters are applied to recover the ridge structure and to remove the noise.

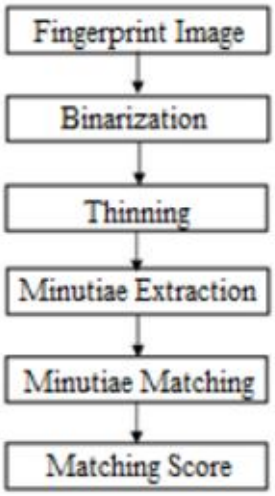
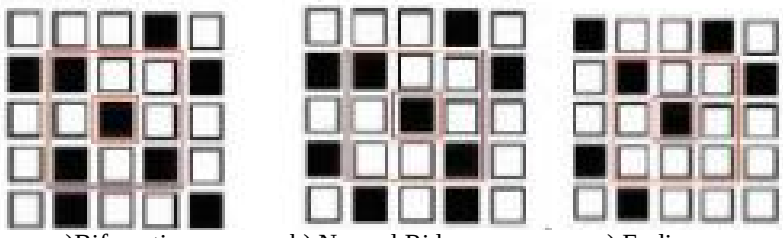


Fig 2. Minutiae based fingerprint recognition method.

Then in the next step image is applied to the thinning process in order to reduce the thickness of the ridge lines. This step will help in order to extract the minutiae points. The minutiae extraction step derives the minutiae locations and angles. The terminations caused by the outer boundary are not considered as minutiae points. Crossing number (Cn) is used for finding the minutiae points, which is defined by half of the sum of differences between the intensity values of two adjacent pixels. If crossing points is 3, 2,1 then the minutiae points are considered as bifurcation, normal ridge, and ending respectively.



a)Bifurcation b) Normal Ridge c) Ending

Fig 3. Minutiae extraction

To compare the input fingerprint data with the template data Minutiae matching is used. For efficient matching process, the extracted data is stored in the matrix format. The data matrix is as follows.
Number of rows: Number of minutiae points.

NUMBER OF COLUMNS: 4

Column 1 is the row index of each minutiae point; column 2 is the column index of each minutiae point; column 3 is the orientation angle of each minutiae point; column 4 is the type of minutiae. During the matching process each minutiae point is compared with the template data. There are several rotation invariant algorithms for comparing minutiae points in two fingerprints. One of them connects each point to its nearest neighbor, and calculated some values of the resulted connected structure (crossing ridge number, point types, distance, and rotation angle).

The matched minutiae points is divided into four different groups: N1 – they belong to a structure that has 3 or more similar local structures; N2 - they belong to a structure that has 2 similar local structures; N3 - they belong to a structure that has 1 similar local structure; N4 - they are matching, but the local structures are not. The grouping is used to give a weight to each point and make the matching score more accurate. The final matching score is calculated, based on the following equation:

$$score = 100 * \frac{2 * (3\tilde{N}_1 + 2N_2 + 1.5N_3 + N_4)}{7.5}$$

The higher the score more the matching fingerprints. This score is based on number of matching minutiae points.

DWT

A wavelet is a wave like oscillation. The wavelet decomposes the signal into a set of basic functions called wavelets. The discrete wavelet transforms transform the signal from time domain to a discrete wavelet representation. Discrete wavelet transform is a matrix which is used to identify low quality images on a low quality fingerprint from a inked printed images on the paper. The fingerprint images which are taken from the paper which they of poor quality and sometimes it is very difficult with fabric background. For that reason firstly we take a center point area of fingerprint is detected and keep that core point as center point, the image size w x w is cropped. Then applying gabor filter for enhancement compared to the original image. Then features are extracted by analyzing the fingerprint with discrete wavelet transform.

ALGORITHM:

The fingerprints are segmented by using the DWT. Then these fingerprints are decomposed into four sub bands for verification purpose which results in LL sub band, HH sub band, LH sub band, HL sub band. Most of the fingerprint original information is stored in LL sub band, the horizontal information of the fingerprint image id concentrated in HL sub band, the vertical information is stored in LH sub band, and finally the diagonal information of the fingerprint image is obtained on HH sub band. Finally, in this paper we are going to extract the features by using the method minutiae based and by using DWT.

FUSION SCHEME

Take the fingerprint image as a input then applying minutiae based and DWT in order to extract the features, then for each fingerprint we are going to apply minutiae based algorithm and DWT algorithm to get the features. Then the extracted features are fused to get increase the number of features in fingerprint recognition.

RESULTS

In this paper we propose a fusion method by using minutiae based and DWT. The proposed method which gives more accuracy when compared to other fusion method. The accuracy will improve in terms of equal error rate (EER) and total success rate (TSR).

TECHNIQUE	EER	TSR
Minutiae based	0.4	59.26
DWT	0.75	55.55
Fusion	0.45	103.69

CONCLUSION

Biometrics plays an important role in now days. In this paper we propose a method of fingerprint recognition based on minutiae based method and DWT algorithm. This fusion method which give the performance and efficiency of biometrics in terms of Equal error rate(EER) and total success rate(TSR).

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