Special Issue on Research and Innovations in Science and Engineering
Volume: 5 Issue: 12s
ISSN: 2454 - 4248
114 – 117

Detection and Rectification of Distorted Fingerprint

Sapna Sunil Chaudhari
Electronics and Telecommunication Engineering
MGICOET, Shegaon
Shegaon, India
chaudharisapna94@gmail.com

Prof. Manjusha M. Patil
Electronics and Telecommunication Engineering
MGICOET, Shegaon
Shegaon, India
mmpatil208@gmail.com

***Abstract*—** Elastic distortion of friction ridge skin or fingerprint is nothing but the major challenges in fingerprint matching process. A critical step is to automatically and reliably extract minutiae from the input fingerprint images. Fingerprints are divided into five classes such as, arch, tented arch, left loop, right loop and whorl. The fingerprint classification provides better way to the database to reduce the searching and mapping process. In this, novel algorithm is proposed to detect and rectify skin distortion based on a single fingerprint image. Distortion detection is considered as a two-class classification problem, where the registered ridge orientation map of fingerprint and period map of a fingerprint are used as the feature vector and a SVM classifier is used to perform the classification task. In this technique the Distortion rectification is considered as a regression problem, where the input is a distorted fingerprint and the output is the distortion field. For solving this problem, various distorted reference fingerprints and corresponding distortion fields are used as a database. When the nearest neighbor of the input fingerprint is found in the database then the corresponding distortion field is used to transform the input fingerprint into a normal fingerprint.

Keywords - svm classifier, Distortion Detection and Rectification.

*****

I. INTRODUCTION

Although automatic fingerprint recognition technologies have rapidly advanced during the last forty years, there still exists several challenging research problems, for example, recognizing low quality fingerprints [1]. The progress of fingerprint recognition systems in identifying individuals has prompted individuals to engage in measures for the purpose of circumventing these systems. The basic truth of identity verification is that each fingerprint is exclusive and a personal may be known by his or her physical or behavioral characteristics [2]. Biometric identification is a very well-known technology that can recognize a person identity based on physical characteristics or behavior characteristics. The characteristic can be fingerprint, face, iris, hand geometry etc. Fingerprint characteristic is the oldest and mostly used for biometric identification. The consequence of low quality fingerprints depends on the type of the fingerprint recognition system [1]. Low quality fingerprints are nothing but the distorted fingerprints, which are usually occurs when users press their fingerprints on fingerprint sensors improperly. The recognition rate is still low on distorted fingerprints with most existing fingerprint recognition algorithms. In case of negative recognition systems, people in the watch-list may purposely distort their fingerprints only to avoid identification. In case of positive recognition systems, users may require pressing their fingerprints many times for verification, and that may reduce the user experience. The distortion rectification concept is to transform a distorted fingerprint into a normal fingerprint. Initially the given fingerprint should be registered by pose estimation, and then distortion detection is performed on that fingerprint. If the fingerprint is detected as normal one, then the original fingerprint is directly returned. If the fingerprint is detected as distorted then the distortion field is estimated, and rectification is performed to transform the distorted fingerprint into a normal one. Databases like Tsinghua distorted fingerprint database (Tsinghua DF), FVC2004 DB1, and FVC2006 DB2 A are conducted for the process. Finally the results show that the proposed method can correctly rectify distorted fingerprints and also can improve the matching performance of existing fingerprint matcher.

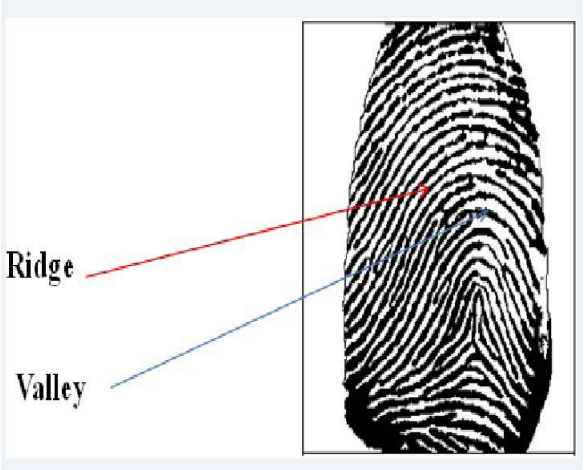

Figure 1. Fingerprint image with ridge and valley

II. SYSTEM ARCHITECTURE

In this technique, proposed system done by using following three stages i.e. Distortion Detection Distortion Rectification Latent Fingerprint Detection.

A. Distortion Detection

Distortion is the alteration or change of the initial form like an object, image, or wave shape. Distortion is specifically unwanted and strives to eliminate distortion or to minimize it. A number of things are responsible for the degradation of fingerprint image quality. Distortion is nothing but the reshaping of the initial patterns of the friction ridges of fingerprint image. This can be done by removing and reorganizing parts of skin from tips or by transplant alternative

ISSN: 2454 - 4248
114 – 117

skin with friction ridge patterns unto the fingertip [2]. It is desirable during fingerprint acquisition to automatically detect distortion so that severely distorted fingerprints can be rejected.

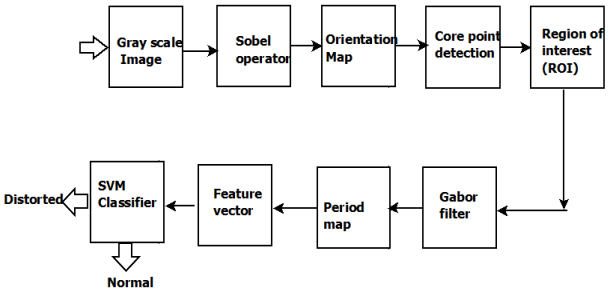

Figure 2. Block diagram of Distortion Detection of fingerprint image

1) Orientation map Extraction

Gradient method is used for extracting orientation map of fingerprint. Initially, the horizontal and vertical gradients are calculated at every picture element by using sobel operator. Sobel operator is available in image processing and computer vision, typically among edge detection. In this process, Image are divided in small blocks of size k computed the angle by analyzing the blocks. The operator uses the kernels that are convolved with the initial image, in which one for horizontal changes (equ 1) and one for vertical changes (equ 2).

$$\mathbf{G}_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} * \mathbf{A} \quad \text{---1)}$$

$$\mathbf{G}_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * \mathbf{A} \quad \text{---2)}$$

$$\mathbf{G} = \sqrt{\mathbf{G}_x^{\,2} + \mathbf{G}_y^{\,2}} \quad \text{---3)}$$

$$\mathbf{\Theta} = \operatorname{atan}\left(\frac{\mathbf{G}_y}{\mathbf{G}_x}\right) \quad \text{---4)}$$

Where,
A is the source image,
Gx and Gy are two images

2) Core Point Detection

Core is the center point on the each and every fingerprint image. The core point is used to align between the fingerprints in case of the fingerprint authentication systems. In order to detect core point, one of the methodologies is employed by point care method. Point care index is defined as the total rotation of the vectors along a curve in a vector field [2].

3) Region of Interest

After the process of core point detection, take above part of the core point on the orientation map of fingerprint image. So, for getting a portion from fingerprint region of interest is used. The region of interest is calculated as a location around the core point.

4) Gabor Filter

A Gabor filter is typically a linear filter which is used for edge detection and additionally for edge brightening in an image processing. A group of Gabor filters having different frequencies and different orientations is also useful for extracting features from an image. Gabor filters allow a certain band of frequency. Initially, Gabor filters are applied to the given images and Then a mask will be used which will represent the filter.

P_1	P_8	P_7
P_2	P	P_6
P_3	P_4	P_5

Figure 3. Pixel block

5) Period map Extraction

After the process of Gabor filter we will get array of pixels i.e. called period map. By using above part of the core point on the orientation map Period map is computed.

6) SVM Classifier

Support vector machines are learning models used for classification purpose. SVM is used to classify the given fingerprints whether it is distorted or normal. SVM can classify both linear and nonlinear separable class problems. SVM belongs to the class of kernel method where Kernel function plays an important role in SVM because it is a kind of similarity measure between the input objects. Kernel function used for classification should be appropriate as it may affect the accuracy of model. There are four types of kernel function in Support Vector Machine which are Radial Basic Function (RBF), Linear, Polynomial and Sigmoid.

ISSN: 2454 - 4248
114 – 117

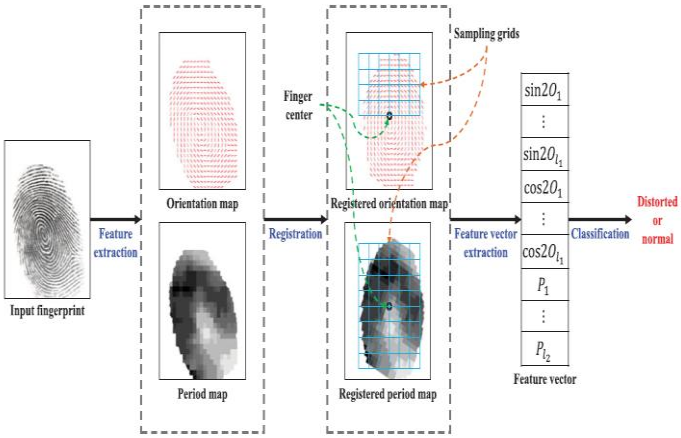

Figure 4. Distortion detection process

B. *Distortion Rectification*

The purpose of rectification of distorted fingerprints is to improve matching performance of the system. In order to evaluate the proposed rectification algorithm, a matching experiment on NIST was conducted on SD27 latent database which contains some distorted latent Fingerprint images. in this process Verifinger is used as the fingerprint matcher. For making the Experiment more effective, we will use all 27,000 file fingerprints In the NIST SD14 database as the background database. So the features extracted from the enhanced fingerprint images are used by the algorithm. The distortion Detection result is not reliable, as the small area of latent fingerprints and thus rectification Algorithm is applied to all latent fingerprints.

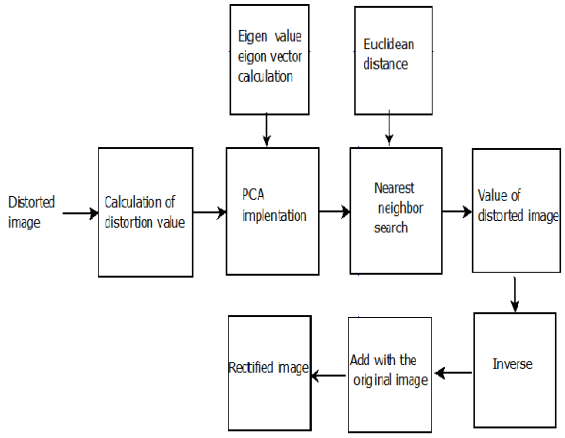

Figure 5. Block diagram of Rectification of fingerprint image

1) *Distortion value Calculation*

ith pair of normal fingerprint and distorted fingerprint is taken initially. Calculation of The distortion value of the *ith* pair of fingerprints is done initially between array of two fingerprint images. all the values of training fingerprints can be considered as feature vector.

2) *PCA Impementation*

PCA is a type of transform which uses Eigen decomposition to get the transform matrix. PCA can be computed by Eigen value decomposition of a covariance matrix [2].

3) *Nearest Neighbor Method*

Reference database is consisting of more than 100 images and also it contains corresponding distortion values. Whenever a new image comes for the verification, find the Euclidian distance between new fingerprint image and reference database fingerprint images and then a minimum distance of image will be taken and also corresponding distortion value of that image.

4) *Geometric Transformation*

In this, inverse of distortion value of nearest image is calculated and then add this inverse value to the original image and in this way we get rectified image.

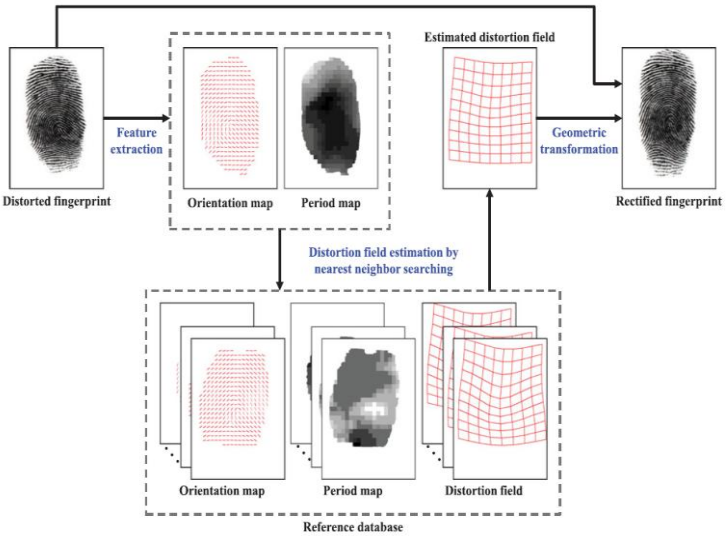

Figure 6. Distorted fingerprint Rectification process

III. CONCLUSION

In general within the case of distorted fingerprints incorrect non-match rates of fingerprint matchers are terribly high. a fingerprint distortion detection and rectification algorithms is needed to develop or to improve to overcome the problem. This is generating a security hole in automatic recognition of fingerprint systems which might be used by terrorists and criminals. A unique distorted fingerprint detection and rectification algorithm is described in this paper. The registered ridge orientation map of fingerprint and period map of a fingerprint are used or considered as the feature vector for distortion detection purpose and a SVM classifier is applied to classify the input fingerprint as distorted or normal. To solve the problem of distortion rectification, a nearest neighbor approach is applied for predicting the distortion field from the input distorted fingerprint and then the inverse of the distortion field is applied to transform the distorted fingerprint into a normal fingerprint. In this paper, FVC2004 DB1, Tsinghua DF database, and NIST SD27 database are used for this proposed system.

ISSN: 2454 - 4248
114 – 117

REFERENCES

[1] Xuanbin Si, Student Member, IEEE, Jianjiang Feng, Member, IEEE, Jie Zhou, Senior Member, IEEE, and Yuxuan Luo "Detection and Rectification of Distorted Fingerprints" IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 37, NO. 3, MARCH 2015.

[2] Silpamol K V Pillai Praveen Thulasidharan "Detection and Rectification of Distorted Fingerprints" 2017 International Conference on Intelligent Computing and Control.

[3] Xinjian Chen, Jie Tian, Senior Member, IEEE, and Xin Yang "A New Algorithm for Distorted Fingerprints" IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 15, NO. 3, MARCH 2006.

[4] Soweon Yoon, Anil K. Jain "Altered Fingerprints: Analysis and Detection" IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 34, NO. 3, MARCH 2012

[5] Amina Serir and Farida Bennabes "FINGERPRINT CLASSIFICATION BY BLOCK RIDGELET AND SVM" 10th International Conference on Information Science, Signal Processing and their Applications (ISSPA 2010)

[6] Nurul Ain Alias, Nor Haizan Mohamed Radzi "Fingerprint Classification using Support Vector Machine" 978-1-5090-1125-4/16/$31.00 ©2016 IEEE

[7] Lin Hong, Yifei Wan, and Anil Jain, "Fingerprint Image Enhancement: Algorithm and Performance Evaluation" IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 20, NO. 8, AUGUST 1998

[8] Jianjiang Feng, Anil K. Jain, "Fingerprint Reconstruction: From Minutiae to Phase" 0162-8828/11/$26.002011 IEEE

[9] Shan Gu, Jiwen Lu and Jie Zhou, "Efficient Rectification of Distorted Fingerprints" EEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. X, NO. X, XXXXX XXXX

[10] Roberto A. REYNA Dominique HOUZET Marie-France ALBENGE Daniel ESTEVE "Implementation of the SVM Neural Network Generalization Function for Image Processing" 0-7695-0740-9/00 $10.00 0 2000 IEEE

[11] Xiao Yang, Jianjiang Feng, Jie Zhou, "Localized Dictionaries Based Orientation Field Estimation for Latent Fingerprints" IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, VOL. 36, NO. 5, MAY 2014.

[12] Jianjiang Feng, Jie Zhou, and Anil K. Jain, "Orientation Field Estimation for Latent Fingerprint Enhancement" IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE

[13] Shijun Zhao1 Xiaowei Hao2Xiaodong Li "Segmentation of Fingerprint Images Using Support Vector Machines" 978-0-7695-3497-8/08 $25.00 © 2008 IEEE DOI 10.1109/IITA.2008.323

[14] Hong Dai "Research on SVM Improved Algorithm for Large Data Classification" 2018 IEEE 3rd International Conference on Big Data Analysis

[15] Xuanbin Si, Jianjiang Feng, Jie Zhou "Detecting Fingerprint Distortion fromn a Single Image" WIFS'2012, December, 2-5, 2012, Tenerife, Spain. 978-1-4673-2287-4/12/ $31.00 c2012 IEEE.