

# Recognition and Reformation of Twisted Fingerprints

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**ABSTRACT:** The finger print technique is used for person identification .But the distortion is the major cause for false-no match. Recognition system has two type's namely negative recognition system and positive recognition system. The false non-match case mostly happens in the negative recognition application. Malicious users may purposely distort fingerprint and may reject to be identified. In this paper A novel algorithm has been proposed to detect and rectify the skin distortion. Distortion detection and rectification is viewed as vector and regression problem respectively. To solve this, a database is used and is called as a reference database. This database stores the distorted fingerprints and their distortion fields is built and the nearest neighbour of input fingerprint is found in the database and the distortion field is used to transform the input finger print into the normal one.

**KEYWORDS:** Fingerprint, distortion, registration, nearest neighbour regression,

## I. INTRODUCTION

Technology for automatic recognition of fingerprints have advanced rapidly during the last forty years and still there are several challenges involving the recognition of low quality fingerprints exists. As observed matching fingerprint to image quality is very sensitive. The accuracy of matching algorithms varies significantly with image quality of different data sets. Matching the accuracies of plain rolled and latent fingerprint is different and longer than observed in evaluation of technology by NIST [1].

The type of finger print recognition system decides the consequences of a low quality fingerprints. A Positive system or negative systems are the classifications of a finger recognition system. Physical access system where the users are supposed to be identified & co-operative are a positive recognition system. A system where the users are unwilling to be identified & non-cooperative is called negative system. Rejection of legitimate users causing inconvenience might be an issue with low quality finger prints in case of a positive recognition system. The risk of the low quality finger print is high in case of a negative recognition system as people with wrong intentions may reduce the finger print quality purposely to hide their identity.

Several cases have been encountered by the public serving agencies where attempts trying to conceal their true identity by altering the fingerprints or trying to damage them have been made.

Detecting low quality fingerprints and to improve the quality so that the finger print system cannot be compromised by malicious users is very important for the negative fingerprint recognition system. Reasons for low quality fingerprint can be classified into photometric or geometrical. Degradation of fingerprint caused due to non ideal skin conditions, not clean sensor surface is photometric degradation. Degradation caused by skin distortion is geometrical degradation. Numerous studies have been carried out and numerous quality evaluation algorithms and algorithms for enhancement have been proposed for photometric degradation [13][14][15]. Whereas no attention has been given to study the geometrical degradation due to skin distortions despite being one of the important issue. on this paper we are making our attempts to overcome this issue, security level is as weak as the weak point for a negative fingerprint recognition system, Thus it is necessary to develop distorted fingerprint (DF) detection and rectification algorithms to overcome the problem.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 10, May 2016

Elastic distortion is introduced due to the inherent flexibility of fingertips, contact-based fingerprint acquisition procedure, and a purposely lateral force or torque, etc. Skin distortion increases the intra-class variations (difference among fingerprints from the same finger) and thus leads to false non-matches due to limited capability of existing fingerprint matchers in recognizing severely distorted fingerprints.

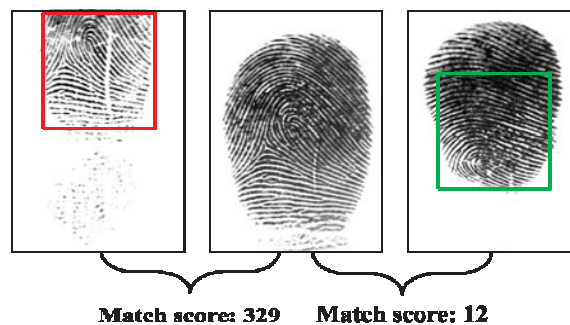


Fig.1. Three impressions of the same finger from a reference database have been collected. The left two are normal fingerprints and the right one contains severe distortion. The match score between the left two is much higher than the match score between the right two. This large difference is due to distortion rather than overlapping area. As shown by red and green rectangles, the overlapping area is similar in two cases.

To withstand large skin distortion matching algorithms can be made but there would be larger risk of more slowing down the matching speed of the system & more of false matching.

The fingerprint distortion problem is dealt with the proposal of novel algorithms in this paper. Fig.2 represents the flowchart of the proposed system. Distortion detection is analyzed first when a fingerprint input is given. Rectification of the distortion is performed on determining the extent of the distortion & input fingerprint is transformed to a normal one.

In this paper classification task is performed by SVM classifier & feature vector using the registered ridge orientation map & period map of a fingerprint which is viewed as a two case classification problem. Rectification of distorted fingerprint is taken as a regression problem; the input is a distorted fingerprint & the output is a distortion field. Distortion fields are built offline corresponding to the reference fingerprints which are distorted from various databases to solve the problem. Once this is done then on the online stage the input fingerprint is matched with the nearest neighbor from the reference distorted fingerprint available in the database & the respective distortion field is used to rectify the input fingerprint. With the proposed system there will be no changes or additional hardware required & can be easily incorporated in to the existing recognition system thus saving time & resources.

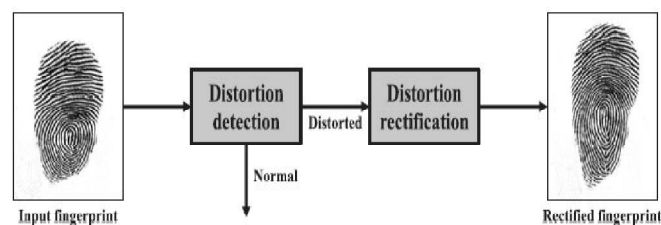


Fig.2. Proposed distortion detection and rectification system shows how the overall system architecture works.

The paper has been organized in topics as follows. In Section 2, Review of related works. Section 3, ways to detect distorted fingerprints. In Section 4, distorted fingerprint rectification algorithm in details. In Section 5, Summary & scope for future research.

## II. RELATED WORK

Recognizing the distorted fingerprints has become very much necessary, researchers have proposed a number of methods which can be classified into four categories.

### 1 Based on Special Hardware

Several hardware specially design ned has been proposed to detect the distortion during the fingerprint registering process. The results have been improved performance of matching the fingerprints in a controlled manner.

However, the limitations are: (i)special force sensors or fingerprint sensors with video capturing capability is required ;(ii) they cannot detect distorted fingerprint images in existing fingerprint databases.

### 2 Distortion-Tolerant Matching

Make the fingerprint matcher tolerant is the most popular way to handle distortion to distortion [3],[4], [5], [6], [7],[8].

However, allowing larger distortion in matching will inevitably result in higher false match rate. Also allowing larger Distortions in matching will also slowdown the matching speed.

### 3 Based on Finger-Specific Statistics

Rossetal.[10],[11] proposed a system where a set of images of the same finger was obtained and the deformation pattern was observed & the template was matched with the average deformation. This method had accuracy in matching the fingerprints.

Limitations of this method are :(i)acquiring multiple images of the same finger would be not possible in some applications and existing fingerprint databases contains only one image per finger ;and (ii) it is not necessarily sufficient to cover various skin distortions even if multiple images per finger are available.

### 4 Based on General Statistics

The method proposed in this paper shares the advantages of Senior and Bolle [12] method over other methods, while overcoming most of its limitations. Rather than making impractical assumptions based on uniform ridge period made our method is based on the statistics learnt from the real distorted fingerprints. Our method can overcome the problems of distortion caused due to finger rotations & also overcome many of the distortion issues. Experiments & research have been carried out to validate the methods proposed. The current work is a significant update of our preliminary study in [2], which detects distortion based on simple hand-crafted features and has no rectification functionality.

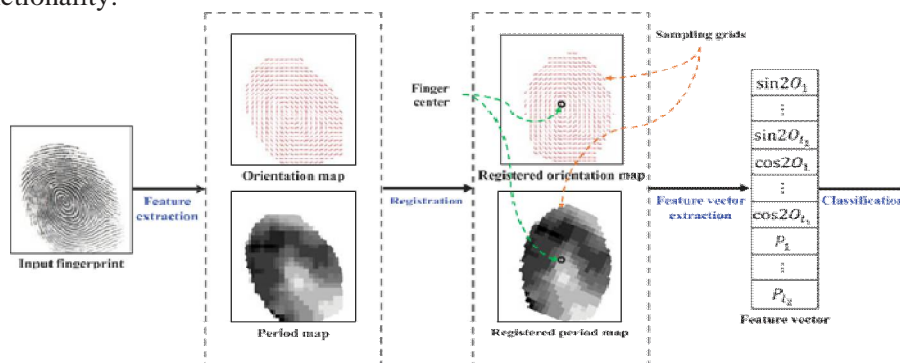


Fig.3. Flowchart of fingerprint distortion detection.  $O_i$  represents ridge orientation at the  $i$ th sampling grid of registered orientation map, while  $P_j$  represents ridge period at the  $j$ th sampling grid of registered period map.  $I_1$  and  $I_2$  represent the number of sampling points in registered orientation map and registered period map, respectively.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 10, May 2016

## III. FINGERPRINT DISTORTION DETECTION

Fingerprint distortion detection is of two-class classification problem. The registered ridge orientation map and period map as the feature vector, which is classified by a SVN classifier are used.

### 1 Fingerprint Registration

Registering fingerprints in a fixed co-ordinate system helps in extracting a proper feature vector. To achieve a proper feature vector we have proposed an approach based on multi-reference registering of fingerprints.

In the following we describe how the reference fingerprints are prepared in the offline stage, and how to register an input fingerprint in the online stage.

#### 1.1 Reference Fingerprints

Distorted fingerprint database was collected to have the realistic statistics of fingerprint distortion. Data was collected using a scanner. Each participant was asked to register their fingerprint on the scanner first in the normal way & then by applying different types of pressure to have the distortion samples.

A total of 500 fingerprints consisting of 100 normal ones and 200 pair each of normal & distorted fingerprints from the database were used for the experiment. In order to register proper fingerprints of various patterns large number of references were used, distorted fingerprint is registered for fingerprint whose core points can be correctly detected by a Poincare index based algorithm [9].

#### 2 Feature Vector Extractions

The finger centre is marked in the sample grid as shown in Fig.3. Note that the two sampling grids are different. The whole finger print is covered in the period map in the sampling grid, while only top of the finger print is covered in the sampling grid of an orientation map.

## IV DISTORTED FINGERPRINT RECTIFICATION

A normal fingerprint can be distorted which is unknown by applying unknown distortion field 'd'. A distorted fingerprint can be rectified applying inverse field 'd' by estimating the distortion field 'd' from the fingerprint. The distortion field is highly dimensional due to which addressing the regression problem is quite a task. (even if we use a block-wise distortion field). A nearest neighbour regression approach is used for this task.

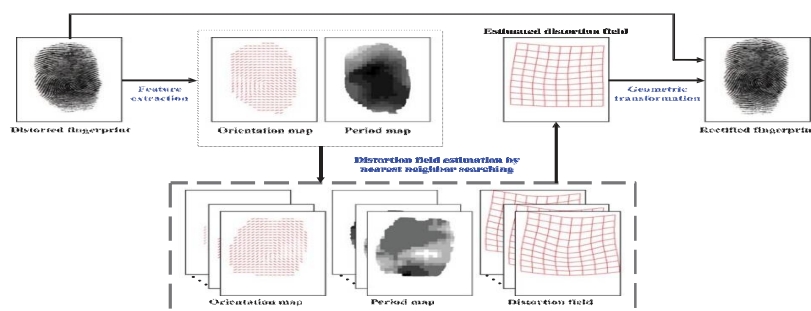


Fig 4 Examples of 10 distortion types in database. The blue arrows show the directions of force or torque, and red grids represent the distortion grids which are calculated from matched minutiae between the normal fingerprint and the distorted fingerprint.

The algorithm for the rectification of distorted fingerprint will consist of two stages, online & offline stages. In the proposed system a database of distorted reference fingerprints is generated by transforming several normal reference fingerprints with various distortion fields sampled from the statistical model of distortion fields. In the online stage, giving distorted input fingerprint (which is detected by the algorithm described in Section 3), we retrieve its nearest neighbour in the distorted reference fingerprint database and then use the inverse of the corresponding distortion field to rectify the distorted input fingerprint. The distorted fingerprint rectification flow chart is shown in Fig 4.

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## V. CONCLUSION

There is report of increase in rates of false non match fingerprint in the case of severely distorted fingerprints. This has resulted in huge security gap in automatic fingerprint recognition systems which can be wrongly utilized for malicious activities.

To avoid this it is necessary to develop a fingerprint distortion detection and rectification algorithm to fill the hole.

This paper described a novel distorted fingerprint detection and rectification algorithm. For distortion detection the registered ridge orientation map and period map of a fingerprint are used as the feature vector and a SVM classifier is trained to classify the input fingerprint as distorted or normal. For distortion rectification a nearest neighbour regression approach is used to predict the distortion field from the input distorted field from the input distorted fingerprint and then the inverse of the distortion field is used to transform the distorted fingerprint into a normal one

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