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Machine learning system for detection and rectification of fingerprints

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Abstract: Elastic distortion of fingerprint is one amongst the foremost downside in fingerprint matching. Since current fingerprint matching systems cannot match seriously distorted fingerprints, malicious persons could deliberately distort their fingerprints to cover their identity. Existing distortion detection strategies need availableness of specialized hardware or fingerprint video, limiting their use in real applications. The study and implementation of a fingerprint recognition system based on minutiae-based matching quite frequently used in various fingerprint algorithms and techniques. Human fingerprints are rich in details called minutiae, which can be used as identification marks for fingerprint verification. The goal of this project is to develop a complete system for fingerprint verification through extraction and matching minutiae. To achieve good minutiae extraction in fingerprints with varying in quality, orientation field estimation, pre-processing in form of image enhancement, fingerprint classification, feature extraction and database matching, finally it extracts the desired personal details.

Keywords- Fingerprint, Distortion, Rectification, Nearest neighbor, Latent

1. Introduction

Biometric recognition or biometrics is defined as the application of anatomical or behavioral identifiers or traits that are highly unique in nature for personal identification [1]. Examples for biometric traits are fingerprint (fingerprint), iris, ear, face, facial thermo gram, hand thermo gram, hand vein, hand geometry, face, retina, signature and voice. The word biometrics is derived from Greek words bios (life) and metron (measurement). Biometric identifiers are measurements from living human body. Any biometric trait can be used for personal identification as long as Distinctiveness: The biometrics of any two persons should be sufficiently.

Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints. Because of their uniqueness and consistency over time, fingerprints have been used for over a century, more recently becoming automated due to advancement in computing capabilities. Digital image processing is a process of manipulating images in a digital computer. This processing can be achieved by development of a computer based algorithm in order to process these images. It is a technology widely used for digital image operations like feature extraction, pattern recognition, segmentation and classification.

Image process could be a method of reworking a picture into digital type and perform some operations on it. Biometrics is that the activity and applied mathematics analysis of people's physical and behavioral characteristics. Image processing is needed for distinctive a private whose biometric image is hold on within the information antecedently. Faces, fingerprints, irises eg.., are image based biometrics. Biometrics used for identification and access management, or for distinguishing people that are below police investigation. The basic truth of identity

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verification is that each fingerprint is exclusive and a personal may be known by his or her physical or behavioral characteristics. There are 2 main forms of biometric identifiers: Physiological characteristics: the form or composition of the body,eg: fingerprint, face recognition, DNA, palm print, handling geometry, iris recognition etc.. and Behavioral characteristics: The behavior of a person,eg: gait,voice etc.. Biometric technology presents many benefits over totally different security strategies supported either some information (PIN, Password, etc.) or physical devices (key,card, etc.). A fingerprint consists of ridges and valleys [3].

2. Literature review

It is wanted to mechanically discover distortion throughout fingerprint acquisition stage in order that severely distorted fingerprints may be rejected. many researchers have planned to discover improper force using specially designed hardware [3], [4], [5]. Bolle et al. [3] planned a way to find excessive force and force exerted by employing a force sensing element. They showed that controlled fingerprint acquisition results in improved matching performance [4]. Fuji [5] planned a way to find distortion by detective work deformation of a clear film connected to the detector surface. Dorai et al. [6] planned a way to find distortion by analysing the motion in fingerprint video However, the above strategies have the subsequent limitations: (i) they want special force sensors or fingerprint sensors with video capturing capability; (ii) they cannot find distorted pictures in existing fingerprint databases; and (iii) they can not determine fingerprints distorted before pressing on the detector. However, allowing larger distortion in matching will unavoidably result in higher false match rate.

The most common technique to handle distortion is to create the fingerprint matcher to distortion [10], [11], [12]. In alternative words, they manage distortion on a case by case basis, ie., for each pair of fingerprints to be compared. For the largely used minutiae-based fingerprint matching technique, the subsequent 3 kinds of methods are adopted to handle distortion: (i) assume a global rigid transformation and use a tolerant box of mounted size [10]; (ii) expressly model the spatial transformation by skinny plate spline model [11]; and (iii) enforce constraint on distortion regionally [12].Various ways for handling distortion throughout matching have additionally been utilized in image-based mediator

Ross et al. [13], [14] learn the distortion pattern from a group of training pictures of identical finger and transform the template with the average distortion. They show higher minutiae matching accuracy. But this methodology has the subsequent limitations: (i) exploit multiple pictures of a similar finger is inconvenient in some applications and existing fingerprint databases typically contain only 1 finger print image; and (ii) even if more images per finger are available, it is not essentially sufficient to hide numerous skin distortions.

Used for Distortion Rectification Senior and Bolle [15] developed a stimulating methodology to get rid of the distortion before matching stage. This technique is predicated on an assumption that the ridges in a fingerprint are perpetually spaced. In order that they manage distortion by normalizing ridge density within the whole fingerprint into a fixed value. Since they didn't have a distortion detection technique, they apply the distortion rectification technique to each fingerprint. Compared to the opposite strategies reviewed above, Senior and Bolle methodology has the subsequent advantages: (i) it doesn't need specialized hardware; (ii) it can handle a single input finger image; and (iii) it doesn't need a group of training pictures of a similar finger.

3. Proposed method

In current system is able to deal with various type of elastic distortion as long as such distortion type is included in the training set. In addition, rectify the latent fingerprint distortion using

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another methodology is named dictionary-based orientation methodology. The proposed technique belongs to the family of dictionary-based regularization. during this paper, a collection of localized dictionaries is used. The use of localized dictionaries is motivated by the actual fact that ridge orientations totally different in several locations of fingerprints have different characteristics. Thus, instead of using a single dictionary of orientation patches for the whole fingerprint as [16], then construct a separate dictionary of orientation patches for each location. Each dictionary contains only orientation patches that are likely to look at the corresponding location. By using localized dictionaries to correct noisy orientation fields, hope that both accuracy of distorted and latent fingerprints is increased.

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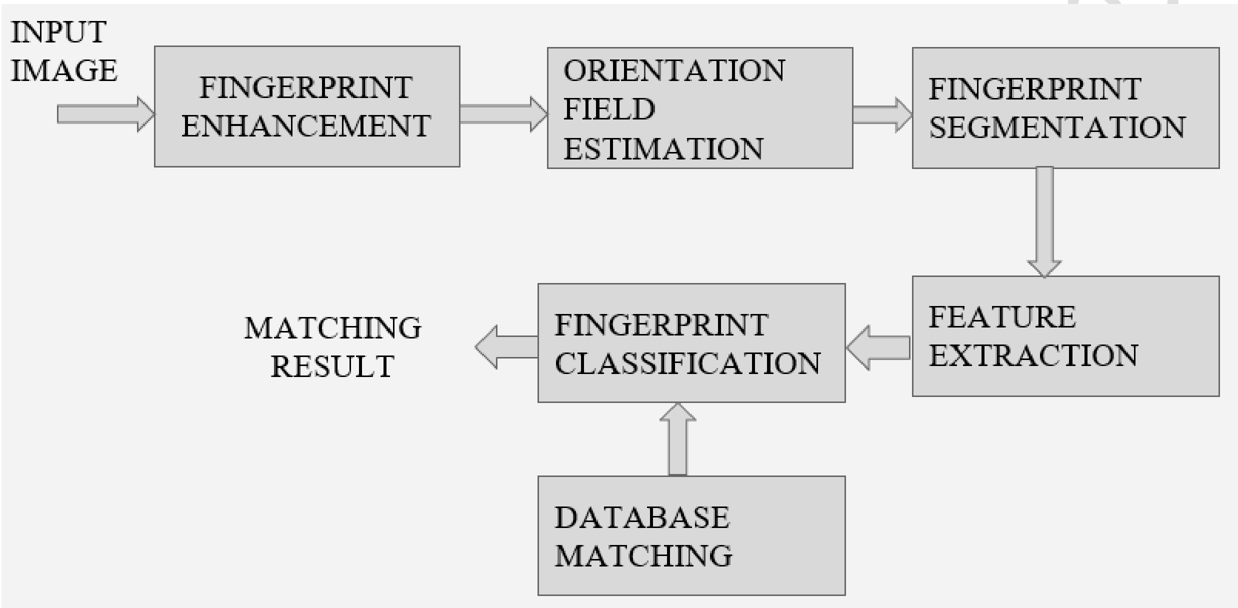

Figure 1. Proposed Method

3.1 Fingerprint enhancement

Fingerprint image may contain good, medium and low-quality regions. Common types of Cuts, creases and bruises on the fingerprint. Parallel ridges are not well separated, the ridges are not continuous, degradation associated with a fingerprint image are fingerprint area resulting from segmentation can be divided into well defined region, recoverable region and unrecoverable region. The goal of an enhancement algorithm is to improve the quality of the recoverable region and mark the unrecoverable region too noisy for further processing. The fingerprint image enhancement methods are broadly classified into pixel-wise enhancement, contextual filtering and multi-resolution enhancement [1]. Among these most widely used method is contextual filtering. In pixel-wise enhancement, the new value of each pixel depends only on its previous value and some global parameters. These methods do not provide the needed results in the enhancement and are used as initial preprocessing methods.

3.2 Orientation field estimation

The first step in minutiae density feature extraction is the detection of minutiae points known as ridge ending and bifurcation. There are two methods used for finding the ridge ending and bifurcation from the fingerprint image. One is based on gray scale image and other is based on binarized image. The second method is used in this work. The different steps applied for finding minutiae points are explained below.

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Image binarization is a process which transforms the 8 bit gray scale image to a '1'- bit image with '0' value for ridges and '1' value for furrows. It is used for the extraction of ridge and valleys and to suppress all other gray scale values. After the operation, ridges in the fingerprint are highlighted with black color while furrows are white.
Thinning is done to make the ridges one pixel wide so that the ridge endings are easily found by scanning with a 3x3 window. It is a morphological operation that successively erodes away the foreground pixels until they are one pixel wide. The application of a thinning algorithm to a fingerprint image preserves the connectivity of the ridge structures while forming a skeletonized version of the binary image which is then used in the subsequent extraction of ridge ending.

3.3 Fingerprint Image Segmentation

Fingerprint preprocessing stages includes segmentation and enhancement. Segmentation is used to select the fingerprint region which consists of necessary information. The enhancement is needed to increase the overall quality of the Fingerprint. The quality of the fingerprint image is important since the success of matching methods depends upon the quality. fingerprint segmentation is an important step in automatic fingerprint identification system. The image captured by a sensor involves foreground area that originated from the contact of the fingertip with the sensor and background area or noisy area which is the boarders of the fingerprint image. The task of the fingerprint segmentation algorithm is to decide which part of the image belongs to the foreground and which part to the background. Accurate segmentation is especially important for the reliable extraction of features like minutiae and singular points.

3.3 Feature extraction

The fingerprint classified as obliteration type by Hough transform method comes to the matching stage. The proposed matching method uses three features namely Ridge Orientation Field (ROF), Ridge Texture (RT) and Ridge Frequency (RF). RT and RF are extracted from the unaltered region of the altered fingerprint. The computation of a single matching score from these three features is not possible since automatic selection of unaltered region from the altered fingerprint is not possible in one-to-many matching. Thus, the proposed method is implemented in two stages. First stage reduces the number of normal fingerprints to be matched in the second stage so that manual selection of unaltered region becomes easier.
First stage utilizes the approximated ridge orientation for matching. This stage starts with orientation estimation of altered and unaltered mate by orthogonal wavelet based method proposed in previous chapter. Alignment between normal and altered fingerprint is performed by using the estimated orientation. Matching score is computed in terms of Euclidian distance. The altered fingerprint is matched with normal fingerprints in the database until it becomes successful. The fingerprint goes to next stage once it is successful. Second stage starts with Region of Interest (ROI) selection from both altered and unaltered fingerprint. Fused matching between RT and RF is computed to confirm the successful matching of the first stage. A matching is declared as successful, if genuine match occurs in both the stage.

3.4 Fingerprint classification

For every ridge end point in the fingerprint image, Hough transform space consists of a sinusoidal curve with corresponding (ρi θj) values. The ridge end points lying on single line have same value of ρ and θ. These values are recorded on a 2D array known as Hough accumulator. The ρ and θ axes of accumulator are divided into a number of equal divisions of resolution $\Delta\rho$ and $\Delta\theta$ respectively. As the number of ridge end points lying on a single line increases, values in the corresponding cell of Hough accumulator also increases. Number of ridge end points is higher in altered fingerprint and this in turn leads to higher number of collinear ridge end points as compared to normal fingerprints. In fact the peak of the Hough accumulator of altered fingerprints becomes high. Increase in ridge ending density from imitation, through distortion to obliteration causes the increase in peak of Hough accumulator. This makes the classification of altered fingerprints possible. In order to detect collinear ridge end points, it is necessary to select a threshold that is low enough to ensure all possible cells are included while high enough to exclude unwanted cells.

4. Simulation results

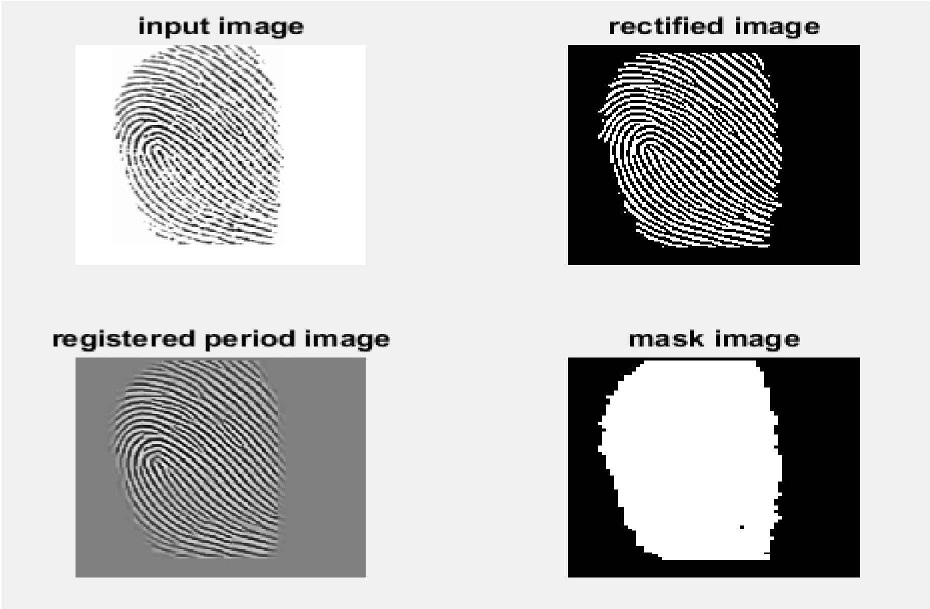

Figure 2. Detection and rectification of fingerprint

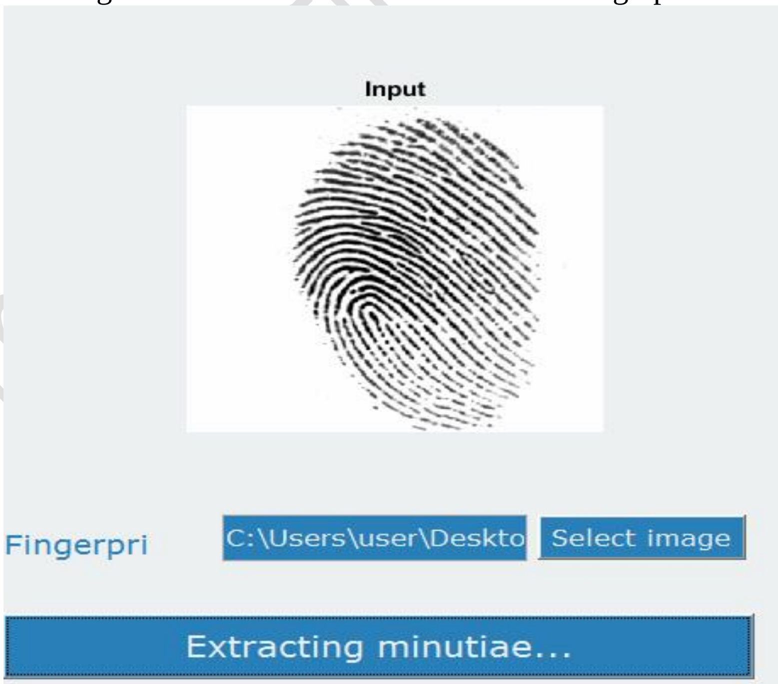

Figure 3. Classified outcome.

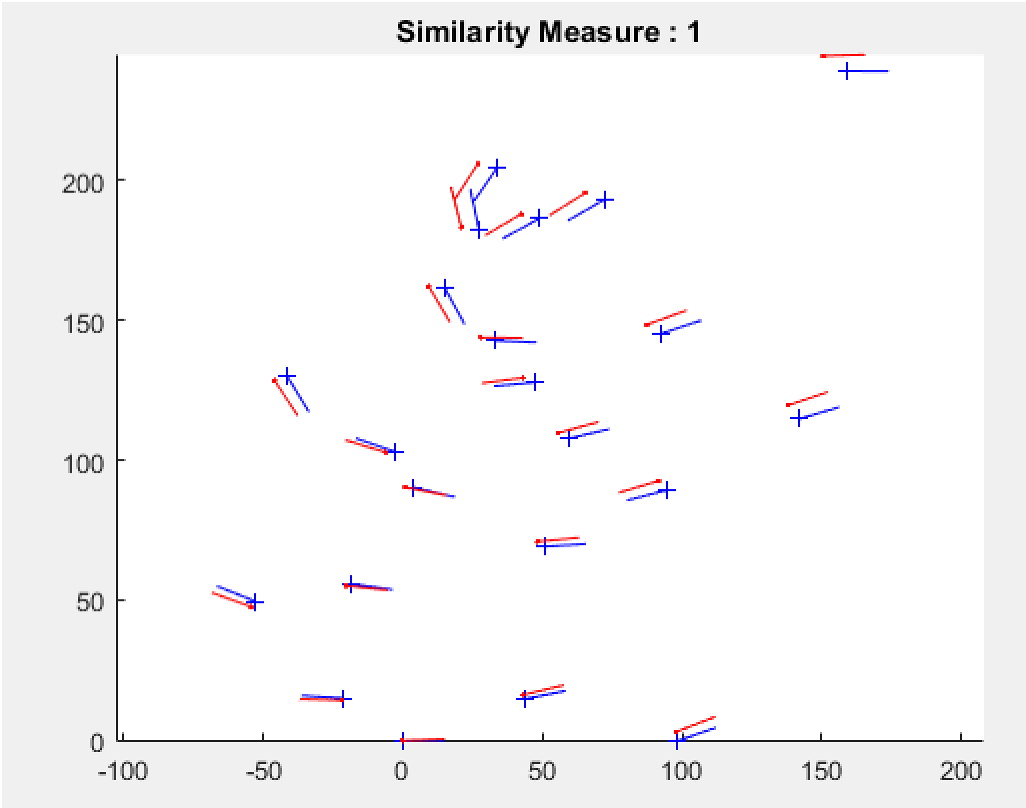

Figure 4. Detection of fingerprints

4. Conclusion

Wrong non-match rates of fingerprint matchers are terribly high within the case of critically distorted fingerprints. This generates a security hole in automatic recognition of fingerprint systems which might be used by terrorists and criminals. For this reasoning, it's necessary to develop a new fingerprint distortion detection and rectification algorithmic program to fill the hole. In this paper, investigate a unique distorted fingerprint detection and rectification algorithm. For distortion detection, two features (orientation map and period map) of a fingerprint are needed because the feature vector and a SVM classifier is trained to classify given input fingerprint as distorted or normal. For distortion rectification, distance methodology is employed to predict the distortion field from the input distorted fingerprint so the inverse of the distortion field is employed to convert the distorted fingerprint into a standard one. From this work, find the way to recognize the distorted fingerprints and use a dictionary-based orientation field estimation approach for latent fingerprint distortion detection and then by increasing accuracy.

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