



Fingerprint Recognition in Biometric Security - A Sate of the Art

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I. INTRODUCTION

Humans have used body characteristics like face, voce, finger prints, Iris, etc. to acknowledge one another. Automatic recognition of those characteristics referred to as a biometrics; currently days it's become a full of life analysis space in pattern recognition. Over a decade's fingerprint is one amongst the oldest style of identification due to their individuality, consistency, the in trinsic ease in acquisition, distinctiveness, persistence and high matching accuracy rate. As we know, No 2 folks have an equivalent set of fingerprints even identical twins fingerprints. Finger ridge patterns don't amendment throughout the lifetime of a personal. This property makes fingerprint a wonderful biometric symbol and can also be used as rhetorical proof. it's received a lot of and a lot of attention throughout the last amount because of the necessity for society in a very big selection of applications. Among the biometric options, the fingerprint is taken into account one amongst the foremost sensible ones. Fingerprint recognition needs a lowest effort from the user and provides comparatively sensible performance. Fingerprint recognition refers to the machine-controlled technique of corroborative a match between 2 human fingerprints. Fingerprints square measure one amongst several kinds of bioscience accustomed establish people and verify their identity.

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Figure 1.1 : Sample Finger Prints

Basically Skin of human fingertips consists of ridges and valleys and that they compounding along type the distinctive patterns. A fingerprint is that the composition of the many ridges and furrows. Fingerprints largely aren't distinguished by their ridges and furrows however square measure distinguished by point that square measure some abnormal points on the ridges. point is split in to 2 elements such as: termination and bifurcation. Termination is additionally referred to as ending and bifurcation is additionally referred to as branch. There are more point consists of ridges and furrows natural depression is additionally referred as follows.

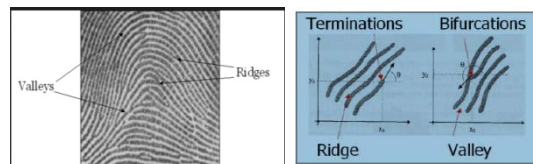


Figure 1.2 : pictures Showing Ridges and Valleys with Termination and Bifurcations

The human fingerprint is comprised of varied varieties of ridge patterns, historically classified in step with The decades-old Henry system: left loop, right loop, arch, whorl, and tented arch.

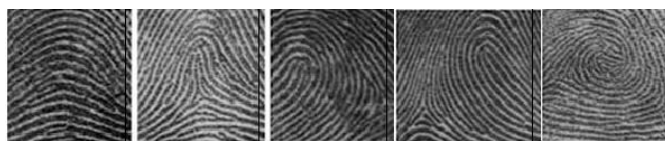


Fig.1.3 : left loop, right loop, arch, whorl, and tented arch of a Fingerprint

Fingerprint recognition system has been triple-crown for several application areas like laptop login, checking account recovery and cheque process. however the fingerprint recognition system still faces with defect in accuracy rate. the first objectives of the projected system can perform a lot of accuracy rate.

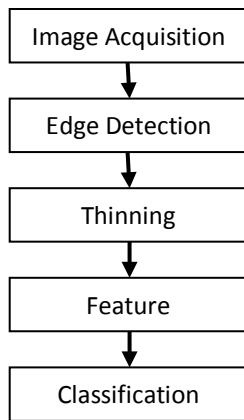


Figure 1.4 : Gender Classification Process

a) Image Acquisition

In any vision system the primary stage is that the image acquisition stage that is hardware dependent. variety of strategies square measure accustomed acquire fingerprints. Among them, the inked impression technique remains the foremost fashionable one. Inkless fingerprint scanners also are gift eliminating the intermediate digitization method. During this method we tend to usually use trivia extraction algorithmic program achieved by Binarization technique.

b) Edge Detection

An edge is that the boundary between 2 regions with comparatively distinct grey level properties. The set of pixels obtained from the sting detection algorithmic program rarely characterizes a boundary fully due to noise, breaks within the boundary and alternative effects that introduce spurious intensity discontinuities. Thus, edge detection algorithms usually square measure followed by linking and alternative boundary detection procedures designed to assemble edge pixels into meaning boundaries.

c) Thinning

Generally this technique is employed to neutralize all the constituent by examining the neighborhood of every constituent within the binary image and supported a specific set of pixel-deletion criteria. It conjointly checks whether or not the constituent is deleted or not. These sub-iterations continue till no a lot of pixels is deleted. the applying of the cutting algorithmic program to a fingerprint image preserves the property of the ridge structures whereas forming the binary image skeleton. This skeleton image is then utilized in the following extraction of trivia. Specially the cutting algorithmic program is employed to represent the structural form of a plane region is to scale back it to a graph. This reduction could also be accomplished by getting the skeleton of the region via cutting algorithmic program. However in broad spectrum the cutting algorithmic program is employed

for edge detection. The cutting algorithmic program whereas deleting unwanted edge points ought to not:

- take away finish points.
- Break connectedness
- Cause excessive erosion of the region

d) Feature Extraction

Extraction of applicable options is one amongst the foremost necessary tasks for a recognition system. we tend to square measure exploitation back propagation algorithmic program to try to to this feature extraction. Feature Extraction is performed by following techniques.

1. Gauss Network technique.
2. Gradient technique.
3. Numerical technique.
4. Directive adaptive strategies.

Feature extraction cares with the quantification of texture characteristics in terms of a set of descriptors or quantitative feature measurements typically stated as a feature vector. it's fascinating to get representations for fingerprints that square measure scale, translation, and rotation invariant. Scale unchangingness isn't a major drawback since most fingerprint pictures may be scaled as per the dpi specification of the sensors. the current implementation of feature extraction assumes that the fingerprints square measure vertically bound. In reality, the fingerprints in our info aren't precisely vertically bound; the fingerprints could also be oriented up to removed from the assumed vertical orientation. This image rotation is part handled by a cyclic rotation of the feature values within the Finger Code within the matching stage.

e) Classification

RBF Neural Network classifier have a capability to be told from their expertise is that the key part within the drawback finding strategy of a pattern recognition task. A neural networks system is seen as Associate in nursing {information process information science |informatics| IP |science| scientific discipline} system composed of an outsized range of interconnected processing components. Every process part conjointly referred to as node, vegetative cell calculates its activity domestically on the idea of the activities of the cells to that it's connected. The strengths of its connections square measure modified in step with some transfer perform that expressly determines the cell's output, given its input. the educational algorithmic program determines the performance of the neural networks system. It ought to be noted that this network configuration is meant to just accept the load values that square measure obtained by protruding a take a look at pictures into image-space.

II. LITERATURE SURVEY

Jain et.al. (2005) discussed in this paper about the attacks designed to extract information about the original biometric data of an individual from the stored template. These attacks are intended to either circumvent the security afforded by the system or to deter the normal functioning of the system. The different types of attacks discussed are; a fake biometric trait, Illegally intercepted data may be resubmitted to the system, The feature extractor may be replaced by a Trojan horse program that produces pre-determined feature sets, Legitimate feature sets may be replaced with synthetic feature sets, The matcher may be replaced by a Trojan horse program that always outputs high scores thereby defying system security, The templates stored in the database may be modified or removed, or new templates may be introduced in the database. The data in the communication channel between various modules of the system may be altered. The final decision output by the biometric system may be overridden. After discussing these attacks they suggested watermarking and steganography principles to enhance the integrity of biometric templates.

Ratha et.al. (2001) in this paper fingerprint authentication and the detail the stages of the fingerprint authentication process. Mostly they focused on vulnerable points of a biometric system for which they use a pattern recognition framework for a generic biometric system to help identify the possible attack points. As well they discussed the "Brute force attack directed at matching fingerprint minutiae" analyzes the resilience of a minutiae-based fingerprint authentication system in terms of the probability of a successful brute force attack. Even they tried "WSQ-based data hiding" and "Image-based challenge/response method," and "cancelable biometrics" to alleviate some of security threats.

Ross et.al. (2001) proposed a hybrid approach to fingerprint matching that combines a minutiae-based representation of the fingerprint with a Gabor-filter (texture-based) representation for matching purposes. The proposed algorithm first aligns the two fingerprints using the minutiae points extracted from both the images, and then uses texture information to perform detailed matching. As a result, more information than minutiae points is being used to match fingerprints. The resultant matching score is combined with that obtained using the minutiae-based matching algorithm. Verification results suggest that the proposed hybrid approach is better suited for images acquired using compact solid-state sensors.

detection of center purpose within the fingerprint image. Otherwise, the algorithmic program is found to be terribly effective.

Mohamed et.al. (2002) proposed a fingerprint classification system and its performance in an

identification system. The classification scheme is based on fingerprint feature extraction, which involves encoding the singular points (Core and Delta) together with their relative positions and directions obtained from a binarised fingerprint image. Image analysis is carried in four stages, namely, segmentation, directional image estimation, singular-point extraction and feature encoding. A fuzzy-neural network classifier is used to implement the classification of input feature codes according to the well known Henry system.

Hsieh et.al. (2003) proposed an effective wavelet-based method for enhancement of fingerprint image, which uses both the global texture and local orientation characteristic as well the wavelet transform can improve the clarity and continuity of ridge structures based on the multi resolution analysis of global texture and local orientation. Based on the hierarchical relationship of 2D wavelet transform, all the detail sub-images are reconditioned by reference to the related location of the approximation sub-image. This mechanism not only saves the computational time but also effectively improves the quality of fingerprint image like blur region and broken ridge.

Park et.al. (2004) proposed a novel approach for fingerprint classification based on Discrete Fourier Transform and nonlinear discriminant analysis. The directional images are constructed from fingerprint images utilizing DFT. Applying directional filters in the frequency domain after the transformation by the DFT achieves effective low frequency filtering, reducing the noise effects in fingerprint images.

The constructed directional images contain the essential directional structure which is common within each class and discriminates between classes. Kernel-based nonlinear discriminant analysis performs dramatic dimension reduction giving high quality discriminant information for classification by capturing global difference among classes. The fast algorithm FFT for DFT speeds up the preprocessing to construct directional images. Once the transformation matrix by KDA/GSVD is computed, the classification in the reduced dimensional space saves computational complexities further.

Sai et.al. (2005) proposed an approach that uses localized secondary features derived from relative minutiae information. A flow network-based matching technique is introduced to obtain one-to-one correspondence of secondary features. This method balances the tradeoffs between maximizing the number of matches and minimizing total feature distance between query and reference fingerprints. A two-hidden-layer fully connected neural network is trained to generate the final similarity score based on minutiae matched in the overlapping areas. The secondary features and matching algorithm have the following advantages: (i) can be easily adapted to existing applications; (ii) Are invariant to orientations,

overcoming one of the biggest challenges in partial fingerprint matching and (iii) localized features and dynamic tolerance areas provide the power to handle the spatial distortions. Solving the minutia matching problem by converting it into a minimum cost flow problem gives us an efficient way to find the optimal one-to-one correspondence between minutiae when the number of minutiae is not large.

Chikkerur et.al. (2006) proposed representation of localized texture features and also outline dimensionality reduction and also algorithm for identification. They used a multi-resolution representation using Gabor expansion to represent the minutiae neighborhood. The bases are derived using self similar Gabor elementary functions computed at multiple scales and orientations. They are biorthogonal bases. This approach tries to minimize the squared difference between the reconstructed and the original image. The performances are measured using the Cumulative Match Curve.

Fernandez et.al. (2007) in this work reviewed existing approaches for fingerprint image-quality estimation, including the rationale behind the published measures and visual examples showing their behavior under different quality conditions. Existing approaches have been divided into: 1) those that use local features of the image; 2) those that use global features of the image; and 3) those that address the problem of quality assessment as a classification problem. Local and global image features are extracted using different sources: direction field, Gabor filter responses, power spectrum, and pixel intensity values. In this paper, they also studied the effect of rejecting low-quality samples using a selection of quality estimation algorithms that includes approaches based on the three classes,

Yang et.al. (2008) proposed a fingerprint verification system based on invariant moment features and nonlinear BPNN. A preprocessing enhancement with the STFT analysis makes the algorithm highly robust to poor-quality fingerprint images and improves the matching accuracy. Under the help of the enhancement, the reference point can be reliably and accurately determined with the complex filtering methods and LMS orientation estimation algorithm. Using the invariant moment analysis on sub-images, the extracted features have bound the effects of noise and non-linear distortions, while utilizing the invariant ability to the affine transformations of features to handle various input conditions. Matching the fingerprints is implemented by two measures: absolute distance and BPNN. The maximum, minimum and average elements of the vectors of input fingerprint, template fingerprint and the difference vectors of them are used as the BPNN inputs. As an excellent nonlinear classifier, the BPNN can improve the whole matching performance. But this system need to improve robustness and reliability of proposed method.

Taok et.al. (2009) proposed a AFR system based on use of neural networks in an underground radio-localization system. In a highly aggressive environment such as mines, reliability and robustness are essential to any operational system. Using UWB as the physical wireless propagation medium and combined with fingerprinting-geolocation and neural networks, this work tends to overcome many of the problems encountered in indoor environments. Moreover a comparison between MLP and RBF performance is presented, providing a clear evidence of the role and importance of the neural networks in offering good accuracy and precision to the final system.

Hou et.al. (2010) in this review paper they summarized the progress on fingerprint orientation estimation, which can be categorized into local estimation and global modeling. The former is easy to code and advantageous in preserving true singularities. By contrast, the latter is able to yield more reliable solution in the presence of perturbations. Despite the numerous efforts in this field, the issue of fingerprint orientation estimation is far from being adequately addressed and further exploration is still necessary, in particular, to investigate orientation modeling with ability to preserve singularity and to develop advanced methods for local structure inference using global information.

Bansal et.al. (2011) in their review paper they broadly classified the fingerprint classification techniques as those working on binarized images and those that work on gray scale images directly. The approaches are distinguished on the basis of several factors like: the kind of input images they handle i.e. whether binary or gray scale, techniques of binarization and segmentation involved, whether thinning is required or not and the amount of effort required in the post processing stage, if exists. But low quality fingerprint images need preprocessing to increase contrast, and reduce different types of noises as noisy pixels also generate a lot of spurious minutiae as they also get enhanced during the preprocessing steps

Zhang et.al. (2012) in this paper studies image local features induced by the phase congruency model, which is supported by strong psychophysical and neurophysiological evidences, for FKP recognition. So they developed a new effective feature extraction and matching method for FKP recognition. For this they analyzed three commonly used local features, the local orientation, the local phase, and the phase congruency systematically and presented a method for computing them efficiently using the phase congruency computation framework. Coding and matching algorithm for each local feature was presented.

Yoon et.al. (2012) proposed a algorithm based on the features extracted from the orientation field and minutiae satisfies the three essential requirements for

alteration detection algorithm: 1) fast operational time, 2) high true positive rate at low false positive rate, and 3) ease of integration into AFIS. The proposed algorithm and the NFIQ criterion were tested on a large public domain fingerprint database (NIST SD14) as natural fingerprints and an altered fingerprint database provided by a law enforcement agency.

Subrat Kumar Sahu et al. (2012) projected a brand new technique for fingerprint image improvement yet as matching algorithmic program supported directional curvature technique (DCT) of native ridges and a changed Tree primarily based matching approach. during this technique in preprocessing stage, the Fingerprint is De-noised, Binarized, cut and also the approximate core points square measure calculated by DCT algorithmic program. The trivium points square measure extracted by guide filtering over the image. characteristic all the trivium accurately yet as rejecting false trivium. Here they focused on the cutting and matching algorithmic program for the identification method wherever cutting method uses a changed approach of reiterative Rotation Invariant cutting algorithmic program (RITA) that is ensures the properly characteristic the trivium purpose

Madhuri et al.(2012) printed a SURF (Speeded up strong Features) primarily based technique during which they used native strong options for fingerprint illustration and matching as SURF (Speeded up strong Features) are reported to be strong and distinctive in representing native image info and located to be rotation-invariant interest purpose detector and descriptor. This approach perform person recognition in presence of revolved and partial fingerprint pictures and would be expeditiously able to differentiate between real and shammer matches of accuracy and speed. however fails once we image with the less quality is taken.

Ritu Kaur et.al.(2012) proposed a a novel method to estimate gender by analyzing fingerprints using fast Fourier transform (FFT), discrete cosine transform (DCT) and power spectral density (PSD).

Gender identification results using frequency domain analysis showed that this method could be considered as a prime candidate for use in forensic anthropology in order to minimize the suspects search list and give a likelihood probability value of the gender of a suspect. This method uses a optimal thresholding for each transform is chosen for better results. But when this method is tested on low quality images , it has issues of accuracy. Hence to enhance the performance a good quality fingerprint images must be used. Hence to improve the performance in real time scenarios with low quality patterns, it need be preprocessed and represented (SSS) properly .In future, more work

Gnanasivam P et.al.(2012) proposed a novel method wavelet transform (DWT) and singular value decomposition (SVD). The classification is achieved by extracting the energy computed from all the sub-bands

of DWT combined with of gender Classification from fingerprint is proposed based on discrete the spatial features of non-zero singular values obtained from the SVD of fingerprint images. K nearest neighbor (KNN) used as a classifier. The SVD approach is selected for the gender discrimination because of its good information packing characteristics and potential strengths in demonstrating results. The SVD method is considered as an information oriented technique since it uses principal components analysis procedures (PCA), a form of factor analysis, to concentrate information before examining the primary analytic issues of interest K-nearest neighbors (KNN), gives very strong consistent results. It uses the database which was generated in the learning stage of the proposed system and it classifies genders of the fingerprints.

But singular values are not with lower magnitude are not visible hence the performacce may get affected on low quality inputs. Hence there should be some method which will help in increasing the magnitude of the invisible pixels.

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