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Fingerprint Matching using Ridge and Minutiae Features

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Abstract: Fingerprint authentication is the most consistent and practicable methods of person appreciation. The only problem with functionality of Fingerprint authentication System is it depends on the eminence of image. The quality of fingerprint image affects by both surroundings and scanner's-surface. The Fingerprint Trivia-Matching is not possible until the eminence of fingerprint image improve. The inadequacy of image processing is that it can only interact with pixel values but not with location of pixels. The only solution to this problem is to select Region of Interest. An efficient Fingerprint authentication System is presented based on ROI. The intent of the research is to study ROI based Fingerprint Trivia Matching.

Keywords: Fingerprint, Fingerprint appreciation, Histogram Equalization, Linearization, contraction, Region of Interest, Trivia Marking.

I. INTRODUCTION

Biometric is a methods of recognize a person appreciation based on their physiological or behavioral characteristics. Behavioral uniqueness are changed with age but physiological uniqueness never changed. Fingerprint appreciation is advantageous for all the biometric properties. A number of biometric uniqueness are being used in various application since of its universality, uniqueness, eternalness, measurability, concert, adequacy and circumvention.

Fingerprint Appreciation

Fingerprint appreciation can be categorize into two sub domain that is fingerprint authentication and fingerprint recognition. Fingerprint authentication is also called one-toone similar. we evaluate a prosecutor fingerprint with an enrollee fingerprint, where we match both the fingerprints. This method is used to verify a person's legitimacy. Fingerprint recognition is also called one-to many similar. It is mainly used to specify any person's uniqueness by his fingerprint. This method is conventionally used for solve crime and catch thieves.

Techniques for Fingerprint Appreciation

Trivia Extraction based Techniques

Frequently accepted finger scan expertise is based on Trivia. Trivia based technique generate the fingerprint by its local features, like annihilation and divergence. When Trivia points contest between two fingerprints so fingerprint are match. This approach has been authentically studied, and it is the backbone of the current available fingerprint Appreciation products.

Prototype Matching

Attribute extraction are recognized on series of ridges as reluctant to different points which design the basis of Prototype matching techniques over Trivia Extraction. Minutiae points can be change by wear and scratch and the main disadvantage are that these are discriminating to proper adjustment of finger and need large storage for templates.

Association based Techniques

Association based technique is used to contest two fingerprints, the fingerprint are familiar and compute the association for each consequent pixel. They can match ridge shapes, breaks, etc. Main disadvantages of this method are its computational impediment and less acceptance to non-linear distortion and distinction variation.

Histogram Equalization

It is a technique for augment the fingerprint image. Fingerprint image enhancement is to create clearer for easy other operations. Histogram equalization is to extend the pixel value of an image so as to increase the perceptional information. The histogram of a original fingerprint image has the bimodal type , the histogram after the histogram equalization occupies all the range from 0 to 255 and the revelation effect is enhanced.

Linearization

A Fingerprint-Image-Linearization transform an 8-bit gray image to a 1-bit Binarized image where 0-value holds for ridges and 1-value for furrow. And after the linearization operation ridges are highlighted with black color and furrows are highlighted with white color. An adaptive linearization method is achieved to Binarized the fingerprint image. In this method image is split into blocks of 16 x 16 pixels. A pixel value is set 1 if its value is greater than the mean concentration value of the accepted block to which the pixel belongs

Region of Interest

This is a segmentation technique. The main motivation of the segmentation is to make the image simpler which can be representing very easily and to make image consequential that will be easy to evaluate. Generally ROI (Region of Interest) is very useful for evaluate a fingerprint image. It is a subset of an image or a dataset evaluate for a exacting purpose. When the image area has ineffective ridges and furrow so firstly it made wider and larger in all directions. To extraction of the ROI is performed in two steps, First block direction evaluation and direction multiplicity check, Second, used some Morphological methods.

Contraction

The ridge contraction process in used to remove the redundant pixels and reduce the thickness of ridge till the one pixel wide. This is done by using the Matlab‟s contraction function that is bimorphs Then the thinned image is filtered by using the following three MATLAB‟s functions. This is used to remove some H breaks, inaccessible points and spikes. Bimorphs, bimorphs (binary Image, ‟clean', k), bimorphs (binary Image, ‟spur', k), The thinned fingerprint image contained single pixel width and discontinuities. The conditions for better contraction result , Each ridge should be thinned to its centre pixel. b) Noise and singular pixels should be removed. c) No further removal of pixels should be possible after accomplish of contraction process.

Trivia Marking

After fingerprint crumple contraction process, a minutia marking is done by using 3 X 3 pixel windows. In minutiae marking the concept of Crossing Number (CN) is mainly used. In 3 X 3 pixel window if the central pixel is 0 and has only 1devalue neighbour, then the central pixel is a crumple ending and if the central pixel is 1 and has exactly 3 one-value neighbours, then the central pixel is a ridge branch or divergence .

Trivia Matching

When all Trivia points of two fingerprint images are extract in selected region of interest. Now, Trivia matching are performed for authentication.

Find Total Minutia Points

This is used to calculate the total number of crumple and variance points separately And it compare the calculate value with the original image values.

Find Location of Trivia Points

It works on the basis of Minutia Marking process. Simply, when minutia points marked on the image it also store the location of the point. This stored information it used to compare two different images at authentication process. If both the images belongs to the same person then the location of crumple/divergence will match. Otherwise, matching of fingerprint images unsuccessful.

II. RELATED WORK

A narrative Trivia-based fingerprint matching algorithm is proposed. Trivia matching algorithm has to solve two problems correspondence and similarity calculation. For the correspondence problem, we assign each minutia two descriptors texture-based and minutiae-based descriptors, and use an alignment-based greedy matching algorithm to establish the correspondence between Trivia. For the similarity computation, we extract a 17-D feature vector from the matching result, and convert the feature vector into a matching score using support vector classifier. The proposed algorithm is tested on FVC2002 databases and compared to all participators in FVC2002. According to equal error rate, the proposed algorithm ranks 1st on DB3, the most difficult database in FVC2002, and on the average ranks 2nd on all 4 databases.

Descriptor-based minutiae matching algorithm is proposed in this paper. Different from most existing matching algorithms, the proposed algorithm puts more prominence on Trivia descriptors and the computation of matching scores. Combining texture information and adjacent Trivia, we obtain a descriptor with high discerning ability. Based on this descriptor, a simple alignment-based greedy matching algorithm is used to establish the correspondences between Trivia. A 17-D feature vector is computed from the matching result and converted to a matching score by a support vector classifier. Experimental results on FVC2002 show that the proposed algorithm is relative to the best algorithms in the competition. The current algorithm can be improved along two directions. The first direction is to improve the accuracy by designing more complex matching approach. The second direction is to speed up the algorithm, and to study how the performance changes while some information is not used, like crumple, point of reference images or frequency images.

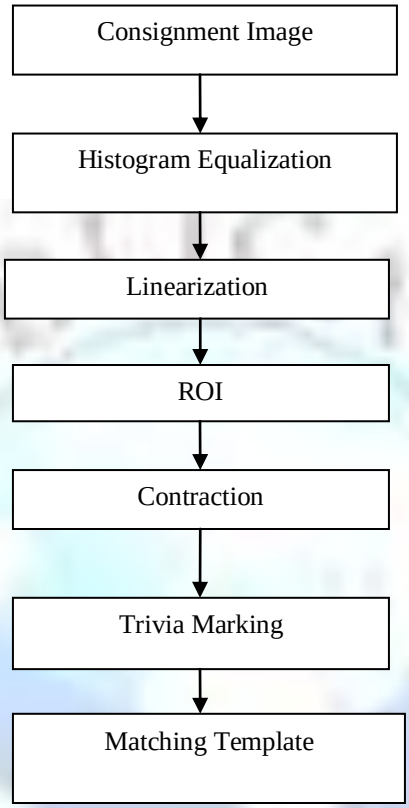
A critical step in routine fingerprint matching is to routinely and dependably extract Trivia from the input fingerprint images. However, the concert of a Trivia extraction algorithm relies heavily on the quality of the input fingerprint images. In order to ensure that the performance of an routine fingerprint identification/authentication system will be robust with respect to the quality of input fingerprint images, it is essential to integrate a fingerprint augmentation algorithm in the Trivia extraction module. We present a fast fingerprint augmentation algorithm, which can adaptively improve the clarity of ridge and valley structures of input fingerprint images based on the estimated local ridge point of reference and frequency. We have evaluated the concert of the image augmentation algorithm using the goodness index of the extract trivia and the accurateness of an online fingerprint authentication system. Experimental results show that incorporating the augmentation algorithm improves both the goodness index and the authentication accuracy. We have developed a fast fingerprint augmentation algorithm which can adaptively improve the clarity of ridge and valley structures based on the local ridge point of reference and ridge frequency estimated from the imputed image. The performance of the algorithm was evaluated using the goodness index of the extracted Trivia and the concert of an online fingerprint authentication system which incorporates our fingerprint augmentation algorithm in its minutiae extraction module. Experimental results show that our augmentation algorithm is capable of improving both the goodness index and the authentication performance. The algorithm also identifies the unrecoverable corrupted regions in the fingerprint and removes them from further processing. This is a very important property because such unrecoverable regions do appear in some of the corrupted fingerprint images and they are extremely harmful to Trivia extraction. These properties suggest that our enhancement algorithm should be integrated into an online fingerprint authentication/recognition system. The global ridge and valley pattern of fingerprint images presents a certain degree of regularity. A global model of the ridges and valleys that can be constructed from partial "valid" regions can be used to correct the errors in the estimated orientation images, which, in turn, will help the enhancement. Currently, we are investigating such a model-based augmentation algorithm. The configurations of ridges and valleys within a local neighborhood vary with the quality of input fingerprint images, so well-defined sinusoidal-shaped waves of ridges and valleys may not always be observed. Global features are needed for a more precise region mask classification.

III PROPOSED SYSTEM

We proposed a prototype which is vigorous and secure for Fingerprint Matching. It has two important operations in pre-processing stage as Histogram Equalization, and Selection of ROI. These two operations make this algorithm competent. The Histogram Equalization improved the quality of Input-image, which actually help to produce perfect calculation. The

researches conclude that the Fingerprint authentication is feasible even the quality of the fingerprint image got pretentious. The ROI based approach reduces the processing time of algorithm by working on segment not the complete image, which means it makes fingerprint matching faster. The authentication is done for selected region that validate the pattern. The journalism of this technique is deeply studied and experimentally executed in MATLAB.

Fingerprint Matching Block Diagram



Experimental Results

The set of experiment is intended to estimate the perceptive ability of the proposed descriptors. To conduct this set of experiments, we need a lot of matched Trivia and unmatched Trivia. To obtain matched Trivia, the Trivia matching algorithm proposed in is used to output the matched Trivia for the 280 genuine matches in FVC2002 DB1_B, and then the matching results are checked and revised manually. Totally 2000 pairs of matched Trivia are selected. To collect unmatched Trivia, we select 2000 pairs of Trivia randomly from 20 pairs of different fingerprints. To make un-matched Trivia not too easy, each pair of unrivaled Trivia is required to have at least 25% common sampling points for orientation-based descriptors. The resemblance degrees of all matched Trivia and unrivaled Trivia are computed. If the resemblance degree between a pair of Trivia is higher than or equal to a threshold, they are inferred as a pair of matched Trivia, otherwise, they are inferred as a pair of unrivaled Trivia. When the similarity degree between a pair of unmatched Trivia is higher than or equal to a threshold and inferred as a pair of matched Trivia, an error called false match occurs. When the resemblance degree between a pair of matched Trivia is lower than a threshold and inferred as a pair of unrivaled Trivia, an error called false non-match occurs. The ratio of false matches to all unmatched Trivia is called fake match rate (FMR), and the ratio of false non-matches to all matched Trivia is called fake non-match rate (FNMR). By changing the threshold, we obtain a ROC curve with false match rate as x-axis and false non-match rate as y-axis. the ROC curves for point of reference-based, texture based, Trivia-based and combined descriptors are plotted, we observe that texture-based descriptor is better than orientation–based one, and combined descriptor is better than both Trivia-based one and texture-based one.

Coalition

Coalition is a decisive step for the proposed algorithm, as misalignment of two fingerprints of the same finger certainly produces a false similar result. Although coalition-based algorithms are most widely adopted matching algorithm in fingerprint matching, few of these algorithms have reported the performances of coalition. In our algorithm, two fingerprints are aligned using the top n most similar minutiae pair. If none of the n pairs is correct, a Misalignment occurs. We test the texture-based, Trivia-based and combined descriptors using 280 pairs of mated fingerprints on DB1_B. Coalition result is compared to the ground truth matching results described. The numbers of misalignment of three descriptors are given. It can be concluded that coalition based on combined descriptors is very reliable.

Authority of Covetous Approach

After two fingerprints are aligned, matching minutiae pairs are found according to the decreasing order of normalized similarity. Such a greedy strategy is valid only when matched minutiae pair ranks first among all candidate pairs. The candidate pairs of a matched pair (pi, qj) include (pi, qj), {(pi, qn)|qn ∈ N(qj)} and {(pm, qj)|pm ∈ N(pi)}, where N(p) denotes the set of neighboring minutiae of minutia p. To validate the greedy approach for different descriptors, we select 1000 pairs of matched Trivia from the ground truth matching results described in Section 6.1, and compute the ranks of matched pairs among candidate pairs. The percentages of rank 1, 2 and 3 of matched pairs for three descriptors are given. From the table, we can observe that using combined descriptors, 99.1% of all matched pairs ranks first, so greedy approach is valid.

Trait vector

One of the assistance trait vector is proposed to describe the similar degree of fingerprints. To evaluate the perceptive ability of different features, we perform 280 authentic matches and 2880 aspirant matches on FVC2002 DB1_B, and output matching trait vectors. Since the Trait vector is not computed when the number of matching Trivia is less than 3, we obtain trait vectors of 279 genuine matches and 1845 pretender matches. For all these samples, each of the 17 dimensions is normalize to a real number between 0 and 1. For those dimensions that authentic matches should be smaller than pretender matches generally, such as biLength, triAngle1, reimage, missSP, etc., the feature x is replaced by 1−x. Then each feature is used to classify a sample as a authentic match or an pretender match by evaluate it to a threshold. By computing FMR and FNMR under a set of thresholds, we plot the ROC curve of each of the 17 feature.

Function Covetous Match Algorithm

Initialize flag1 and flag2 with 0;

flag1[i0] = 1;

flag2 [j0] = 1;

For m = 1 to N1×N2

i = L (m).i; j = L(m).j;

if (flag1[i]=0) & (flag2[j]=0)

& (pi and qj are matchable)

Insert (i, j) into MP;

flag1 [i] = 1;

flag2 [j] = 1;

endif

endfor

CONCLUSION

A descriptor-based Trivia matching algorithm is proposed in this paper. Different from most existing similar algorithms, the proposed algorithm puts more emphasis on Trivia descriptors and the calculation of similar scores. Combine consistency information and neighboring Trivia, we obtain a descriptor with high perceptive capability. Based on this descriptor, a simple coalition-based greedy matching algorithm is used to ascertain the correspondence between Trivia. A 17-D feature vector is computed from the similar result and converted to a similar score by a support vector classifier. Tentative results on FVC2002 show that the proposed algorithm is relative to the best algorithms in the rivalry. The current algorithm can be better along two directions. The first direction is to improve the exactness by designing more complex similar strategy. The second direction is to speed up the algorithm, and to study how the concert changes while some in sequence is not used, like crumple, orientation images or frequency images.

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