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ROBUST LATENT FINGERPRINT MATCHING USING SUPPORT VECTOR MACHINE

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Abstract

Fingerprint identification and matching play an important role in crime investigation. In crime scenes (latent prints) , fingerprints are partially available. Because latents are usually distorted fingerprints with small area. Due to these characteristics, latents have a significantly smaller number of minutiae points compared to full (rolled or plain) fingerprints. The automatic matching of full fingerprint with latent gets complicated because of the less minutiae points and noise characteristics. There are numerous algorithms to match two full fingerprints, those algorithms do not perform well for matching full fingerprint with latents. In order to over this problem, we propose a new algorithm that uses support vector machine(SVM) for matching latents with fingerprint database. This algorithm consider both minutia points and orientation field information for efficient matching. To be consistent with the common practice in latent matching, the orientation field is reconstructed from minutiae. Since the proposed algorithm relies only on manually marked minutiae, it can be easily used in law enforcement applications.

Keywords: Minutiae, Orientation, Descriptor based Hough transform, Minutiae cylinder code,svm.

1. Introduction

Fingerprints are most useful biometric feature in our body .Due to their durability, stability and uniqueness. Fingerprints are considered the best passwords .In places of access security, high degree authentication ,and restricted entry, fingerprints suggests easy and cheap solutions .In the minutiae matching process, the minutiae feature of given fingerprint is compared with the minutiae template ,and the matched minutiae will be found out. If the matching score exceeds a predefined threshold, the two fingerprints can be regarded as belonging to a same finger. Then the both fingerprint found matching, hough circle process takes place, protects our fingerprints from tracing.

Basically skin of human fingertips consists of ridges and valleys and they mixing together form the distinctive patterns. At the time of pregnancy these distinctive patterns are fully developed and are permanent throughout the whole lifespan .Those patterns are called fingerprints .From different researches it has been observed that no two persons have the same fingerprints, so they are unique for each individual because of the above mentioned characteristic, fingerprints are very popular for biometrics applications. Fingerprint matching is very complex pattern recognition problem so manual fingerprint matching is not only time taking but experts also takes long time for education and training . Fingerprints have remarkable permanency and uniqueness throughout the time. From observations we conclude that the fingerprints offer more secure and reliable personal identification than passwords, id-cards or key can provide. Examples such as computers and mobile phones equipped with fingerprint sensing devices for fingerprint based password protection are being implemented to replace ordinary password protection methods.

Nowadays, automated fingerprint identification system (AFIS) has become an indispensable tool for law enforcement agencies. There are three types of fingerprints(i)rolled, which is obtained by rolling the finger “nail-to-nail”.(ii) plain, which is obtained by placing the finger flat on a paper(iii)latents.

Latent

Latent prints are those that cannot be seen by the naked eye. They are caused by the perspiration and other materials that may be on the ridges of the skin. The method used for obtaining latent prints depends on the type of surface to be examined, the manner in which the prints were left, and the quantity of material taken to the crime lab. They are compared to the prints of all persons known to have been at the scene of the crime or who had legal access to the crime scene. This procedure eliminates all but the criminal's prints. Making such prints visible is a matter of both skill and luck. Since these algorithms are usually tuned and evaluated using FVC databases (plain fingerprints) or NIST Special Database 4 (rolled fingerprints), their performances on latent fingerprints are unknown. Main work is latent fingerprints are compare to the rolled fingerprint and identify the correct person.

Some of the relevant works in the field fingerprint identification and comparison is mentioned in the following section. This paper is organized as follows. Section 2 describes the related work. Section 3 briefly describes the proposed methodology. Section 4 deals with the experimental results. Section 5 includes the conclusion and future enhancement.

2. Background and related work

We survey the techniques are relevant to latent fingerprint matching and achieve the good accuracy. In this techniques are mainly used in the crime sense areas.

Paulino A.A, Feng.J and Jain A.K(2011) [1] Proposed a Latent fingerprint matching using descriptor-based Hough transform. Minutiae are very important features for fingerprint representation ,and most practical fingerprint recognition systems only store the minutiae template in the database for further usage. The conventional methods to utilize minutiae information are treating it is a point set and finding the matched points from different minutiae sets. Given a latent fingerprint (with manually marked minutiae) and a rolled fingerprint, we extract additional features from both prints, align them in the same coordinate system, and compute a match score between them. The matching approach uses minutiae and orientation field from both latent and rolled prints.

Based on minutiae, local minutiae descriptors are built and used in the Hough descriptor-based alignment and scoring algorithms. latent fingerprints orientation field are reconstructed using manual only and rolled fingerprint orientation field are reconstructed using gradient based method. There are a number of features that may be used to estimate alignment parameters between two fingerprints, including singular points, orientation field, ridges, and minutiae. our approach to align two fingerprints is based on minutiae. introduced an alignment method for minutiae matching that estimates rotation, scale, and translation parameters using a Generalized Hough Transform. Given two sets of points (minutiae), a matching score is computed for each transformation in the discretized set of all allowed transformations. For each pair of minutiae, one minutia from each image(latent or full), and for given scale and rotation parameters, unique translation parameters can be computed. The transformation that gives the maximum score is considered the best one.

The descriptor-based Hough transform alignment algorithm takes as input two sets of minutiae, and , and two sets of local descriptors and , one set corresponding to the latent and one to the rolled print. Each set contains a local descriptor for each minutia. For robustness, ten sets of alignment parameters with strong evidence are considered. the alignment computationally efficient and also more accurate, we use a two-step approach to compute the alignment parameters for a fingerprint pair. The first step is to perform the voting using the Descriptor-based Hough Transform. This second step consists of using the minutiae pairs that vote for a peak to compute a rigid transformation between the two fingerprints.

Jain A.K and Feng.J, (2011)[3] proposed a latent fingerprint matching based on a reference points (singularity), overall image characteristics (ridge quality map, ridge flow map, and ridge wavelength map), minutiae, and skeleton. The effect of the secondary features (dots, incipient ridges, and pores) has also been examined. AFIS have played an important role in many forensics and civilian applications. In this feature extraction process latent fingerprint images are manually extracted and rolled fingerprint images are automatically extracted. To obtain all of the features, except for the secondary features (dots, incipient ridges, and pores), which are manually marked. Fingerprint matching is the important role in crime senses.

The baseline matching algorithm is not only a matcher for minutiae-only templates, but also serves as a framework to match and fuse various extended features. The baseline matching algorithm considered the three characteristics,(i.e.) Local minutiae matching, Global minutiae matching, Matching score computation local minutiae matching are compared to the two fingerprints of minutiae In the baseline algorithm, a neighbouring minutiae-based descriptor is used since only minutiae information is available. In the global minutiae matching using to the greedy approach. Greedy strategy is used to find matching minutia pairs in the decreasing order of similarity. In order to give priority to those minutia pairs that are not only similar to each other but also dissimilar with other minutiae. The skeleton image contains more information than minutiae. The skeleton matching algorithm is similar in spirit to the "ridges in sequence". Manual feature markings for poor quality latent fingerprints is a time-consuming and tedious task.

Feng.J and Jain A.K (2008)[4] proposed a Filtering Large Fingerprint Database for Latent Matching. Considering the huge size of fingerprint databases maintained by law enforcement agencies, exhaustive one-to-one matching is impractical and a database filtering technique is necessary to reduce the search space. latents, multiple pattern types are specified. Orientation field (defined in blocks of 16*16) is first estimated using gradient-based algorithm and then manually modified. For fingerprints whose pattern area is visible, reference points (for arch)m or singular points (for non-arch) are manually marked. Before minutiae matching is performed, a background (database) fingerprint undergoes multi-stage filtering, which consists of three stages: pattern filtering, singularity filtering, and orientation filtering. Orientation filtering checks if orientation fields around singular points of two fingerprints are consistent.

Singularity filtering performs the important role in multistage filtering approach. the similarity between relationships of any two pairs of corresponding singular points is computed and the mean similarity is compared to a predefined threshold to determine if it should pass. The relationships between two singular points include the distance, the angle between their directions, and the angle between the direction of one singular point and the line connecting them. To compare orientation field, they are first aligned according to singular points. Then the difference of orientations at a set of sampling points is computed. A multi-stage filtering system, which utilizes information on pattern type, singular points and orientation field, is proposed in order to speed up a latent fingerprint matching system. The minutiae matching algorithm was performed only for the fingerprints passing all three filtering stages. In this filtering approach taking time is more.

3. Proposed Technique

The overview of the given model is as follows:

- Get the training fingerprint images and testing fingerprint images.
- In both fingerprints minutiae points are extracted and orientation field are constructed.
- Make a correct classification are based on the support vector machine .In the svm based only check the valid fingerprint images.

- Calculate the accuracy.

Training images are the rolled fingerprint images or plain fingerprint images. Test image are the latent fingerprint images and that images only contain the small information.SVM can improve the efficiency of matching performance. The proposed model is depicted in figure1. The latent fingerprint matching using svm techniques that are used in the proposed system has been explained in the following sections.

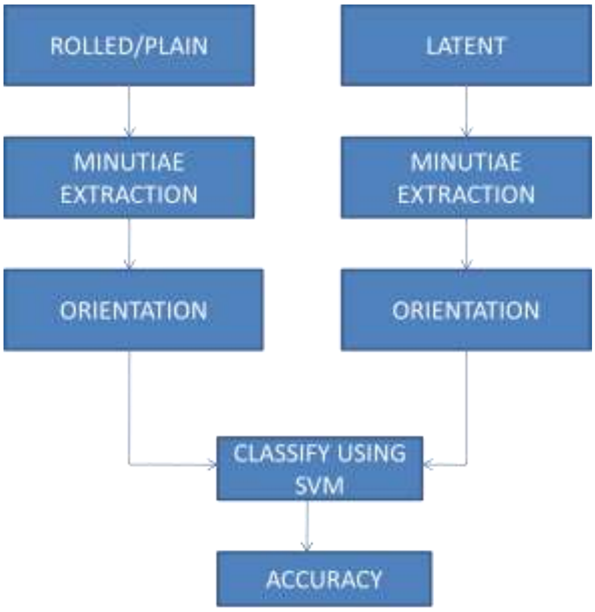

Fig. 1. Block diagram of proposed system

3.1 Training

Training images are the rolled fingerprint images or plain fingerprint images.

(i) Feature extraction

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. In our approach uses minutiae and orientation field from both latent and rolled prints .Training fingerprint images minutiae are automatically extracted.

Local minutiae structures have been used by many researchers to increase the distinctiveness of minutiae. Descriptor is classified in four categories of fingerprints: good quality, poor quality, small region, ugly. Minutia Cylinder Code (MCC), performs better in three of the four categories, and texture-based descriptor performs better for the small common region category. A cylinder contains several layers and each layer represents the density of neighbouring minutiae along the corresponding direction. The cylinder can be concatenated as a vector, and therefore the similarity between two minutia cylinders can be efficiently computed. A more detailed description of the cylinder generation and of the similarity between two cylinders can be found.

Fig.2. Minutiae cylinder code

(ii)Orientation field reconstruction

A robust orientation field estimation algorithm is indispensable for enhancing and recognizing poor quality latents. However, conventional orientation field estimation algorithms, which can satisfactorily process most live-scan and inked fingerprints, do not provide acceptable results for most latents. We believe that a major limitation of conventional algorithms is that they do not utilize prior knowledge of the ridge structure in fingerprints. Inspired by spelling correction techniques in natural language processing, we propose a novel fingerprint orientation field estimation algorithm based on prior knowledge of fingerprint structure. We represent prior knowledge of fingerprints using a dictionary of reference orientation patches. which is constructed using a set of true orientation fields, and the compatibility constraint between neighbouring orientation patches. Orientation field estimation for latent's is posed as an energy minimization problem, which is solved by loopy belief propagation.

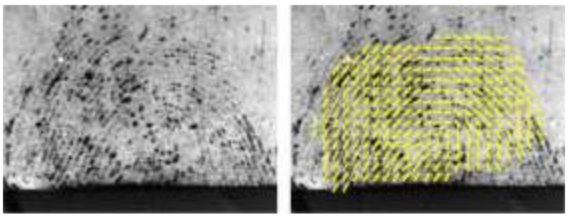

Fig. 3.orientation field reconstruction

3.2 Testing

Test image are the latent fingerprint images and that images only contain the small information. In this feature extraction process test fingerprint images are extracted. Extraction process work done by only manual. Minutiae descriptor performs the important role in fingerprint matching. Orientation field estimation using gradient based method is very reliable. Fingerprint minutiae based orientation field are constructed. Fingerprint alignment or registration process consists of estimating the parameters (rotation and translation)that align two fingerprints. There are a number of features that may be used to estimate alignment parameters between two fingerprints, including singular points, orientation field, ridges and minutiae. Alignments are based on the energy minimization.

3.3 Classify using svm

In svm based image classification are performed and achieve the great performance of matching process.SVM Learning machines based on statistical learning theory. SVM which has shown outstanding classification performance in practice as the classifier. The large margin between positive and negative examples has been proven to lead to good generalizations. An SVM is a hyper plane that separates the positive and negative examples with maximum margin. The examples closest to the hyper plane are called support vectors. As we can see, most images are classified correctly, while only few image are classified in wrong. It validated the effectiveness of grid search method in parameter selection and the SVM algorithm in image classification.

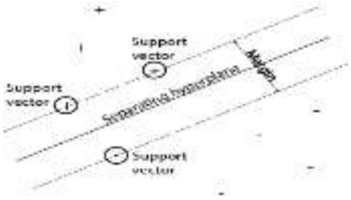

Fig. 4.support vector machine

3.4 Accuracy

As for the classification experiments, it used the accuracy as the evaluation criteria.

$$\text{Accuracy} = \frac{tp + tn}{tp + tn + fp + fn}$$

where *tp* (true positive) said the positive samples that the classifications are right; *tn* (true negative) said the negative samples that the classifications are correct; *fp* (false positive) said the positive samples that the classifications are wrong; *fn* (false negative) said the negative samples that the classifications are wrong. Although it also has the recall rate (recall) and other standards to assess the classification algorithm, the classification accuracy is one of the most widely and intuitive evaluation criteria. Here consider two classes classification problems, the two types of samples were recorded as positive samples, and negative samples. The molecular is the sum about the *tp* and the *tn* and the denominator is all the test samples.

4. Implementation and Result

In this section, we first provide a description of the two databases used in our experiments, and the algorithms to be compared with the proposed algorithm. First, the getting the fingerprint images(rolled/latent) and then perform the feature extraction process. The Result shows the minutiae points are marked. Before minutiae calculation we describe a two process .First process is binary image calculation and then second one is thin image calculation. The output for the original image and binary image is shown below.

Fig. 5.Original image

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Fig.6. Binary image

Binary image only possible to see the region of interest and non region of interest. But we need a exact ridges and then only a minutiae points marking, that purpose binary image are further developing a thin image. The output for the thin image is shown below.

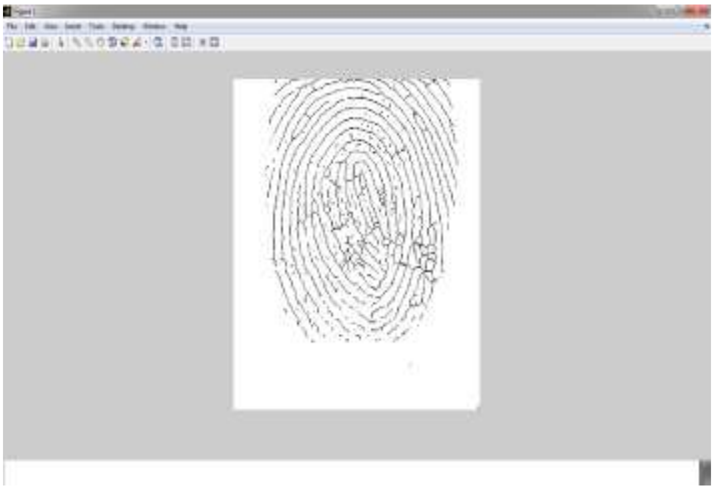

Fig.7. Thin image

In figure8 clearly explain the minutiae extraction process. Red colour square points are the ridges of fingerprint(starting point) and blue colour square points are some differences(disjoint sets) of ridges are noted.

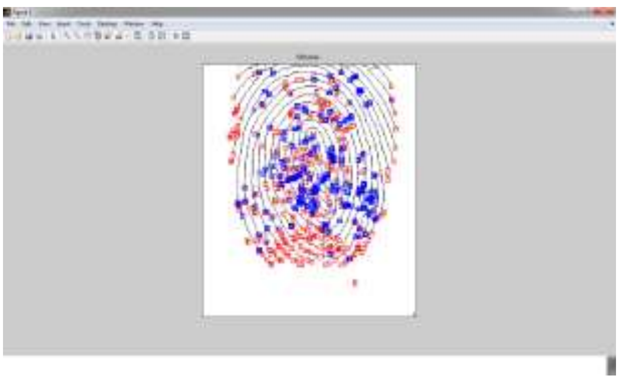

Fig.8. Minutiae

5. Conclusion

We have proposed a system for matching latent fingerprints with rolled fingerprints. The matching module consists of minutiae extracted, orientation field constructed, svm based classifying and calculate the accuracy. A comparison between the alignment performance of the proposed algorithm and the well-known support vector machine shows the superior performance of the proposed method. Svm based classifying perform the faster and more accurate .It is also well suited for speedup latent matching.

References

[1]. A. Paulino, J. Feng, and A. K. Jain,Oct 2011,"Latent fingerprint matching using descriptor-based Hough transform," in Proc. Int. Joint Conf. Biometrics, pp. 1–7.

[2]. R. Cappelli, M. Ferrara, and D. Maltoni,Dec 2010 ,"Minutia cylinder-code: A new representation and matching technique for fingerprint recognition," IEEE Trans. Pattern Anal. Mach. Intell., vol. 32, no. 12, pp. 2128–2141,

[3]. Jain A.K and J. Feng,Jan 2011, "Latent fingerprint matching," IEEE Trans.Pattern Anal. Mach. Intell., vol. 33, no. 1, pp. 88–100.

[4]. J. Feng and A. K. Jain,Dec 2008, "Filtering large fingerprint database for latent matching," in Proc. ICPR,, pp. 1–4.

[5]. M. Tico and P. Kuosmanen,Aug 2003, "Fingerprint matching using and orientation- based minutia descriptor," IEEE Trans. Pattern Anal. Mach. Intell., vol. 25, no. 8, pp. 1009–1014.

[6]. J. Qi, S. Yang, and Y. Wang,2005, "Fingerprint matching combining the global orientation field with minutia," Pattern Recognit.Lett., vol. 26,pp. 2424–2430.

[7]. J. Gu, J. Zhou, and C. Yang,Jul 2006, "Fingerprint recognition by combining global structure and local cues," IEEE Trans. Image Process., vol. 15,no. 7, pp. 1952–1964.

[8]. X. Jiang and W.-Y. Yau,2000, "Fingerprint minutiae matching based on the local and global structures," in Proc. 15th Int. Conf. Pattern Recognit., pp. 1038–1041.

[9]. W.Xu, X. Chen, and J. Feng,Aug 2007, "A robust fingerprint matching approach: Growing and fusing of local structures," in Proc. Int. Conf. Biometrics, Seoul, Korea, pp. 134–143.

[10].J. Feng,2008, "Combining minutiae descriptors for fingerprint matching," Pattern Recognit., vol. 41, pp. 342–352.

[11].J. Feng, S. Yoon, and A. K. Jain,Jun 2009, "Latent fingerprint matching: Fusion of rolled and plain fingerprints," in Proc. Int. Conf. Biometrics (ICB), Alghero, Italy, pp. 695–70.

[12].JainA.K, J. Feng, A. Nagar, and K. Nandakumar,Jun 2008, "On matching latent fingerprints," in Proc. CVPR Workshops on Biometrics, , pp.1–8.

[13].M. Vatsa, R. Singh, A. Noore, and K. Morris,Oct 2011, "Simultaneous latent fingerprint recognition," Appl. Soft Comput., vol. 11, no. 7, pp. 4260–4266.

[14].J. Feng and J. Zhou,2011, "A performance evaluation of fingerprint minutia descriptors," in Proc. Int. Conf. Hand-Based Biometrics, pp. 1–6.

[15].J. Feng and A. K. Jain,Feb 2011, "Fingerprint reconstruction: From minutiae to phase," IEEE Trans. Pattern Anal. Mach. Intell., vol. 33, no. 2, pp.209–223.

[16].R. Cappelli, M. Ferrara, D. Maltoni, and M. Tistarelli,Dec 2010, "MCC*:* A baseline algorithm for fingerprint verification in FVC-on Going," in Proc.11th Int. Conf. Control, Automation, Robotics and Vision,pp. 19–23.

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