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REVIEW ON BIOMETRIC FINGERPRINT IDENTIFICATION METHODOLOGY BY VARIOUS RESEARCH TECHNIQUES

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ABSTRACT

Most automatic systems for fingerprint comparison are based on minutiae matching and minutiae extraction. Minutiae are local discontinuities in the fingerprint pattern recognition system. A more than 150 of different minutiae types have been identified. In practice only ridge ending and ridge bifurcation minutiae types are used in fingerprint recognition. Minutiae matching is the step which comes after minutiae extraction and it is here that we match the minutiae obtained from two sample fingerprint images and test whether they are from the same fingerprint or not. However, a crucial step that needs to be carried out before we can use brute force and match minutiae on two images is alignment of the images. Alignment is necessary so that we correctly match the images. We also need to take care of difference in positioning of minutiae due to plastic deformations in the finger. The algorithms prevalent for minutiae-matching either include the use of details of ridges on which minutiae are present, or use the Hough transform. Both these methods and most other methods are difficult to implement and several complicated functions need to be implemented which are discussed herewith. This survey remains a work in progress. Cases are evolving as rapidly as the technology. There are few rigorous evaluations of the merits of an identity-driven approach to development, and in particular the use of biometrics. More research is needed to assess and add to the impressions given in this paper.

KEYWORDS: Alignment, Descriptor, Matching Score, Fingerprint, Minutiae Matching

INTRODUCTION

The analysis of fingerprints for matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are aggregate characteristics of ridges, and minutia points, which are unique features found within the patterns. It is also necessary to know the structure and properties of human skin in order to successfully employ some of the imaging technologies. The three basic patterns of fingerprint ridges are the arch, loop, and whorl. The main objective of this review was to explain a methodology by each researcher by getting performance and accurate program for fingerprint identification. Review involves different fields: pattern recognition, statistical tests, minutiae detection, performing algorithm programming. Because day by day fingerprint recognition for pattern recognition and detection are widely used techniques and more can be used in other applications. Added to that, high security issues led to a lot of research on fingerprint recognition, meaning that the techniques used are advanced.

Study on Fingerprint Recognition User Mechanism

As shown in Figure 1, the fingerprint recognition mechanism goes through two steps of feature extraction and fingerprint matching [6]. The feature extraction step is the step for configuring minutiae data files to be used in the finger print matching step and is conducted in three steps of preprocessing, minutiae extraction, post processing, as shown in Figure 2.

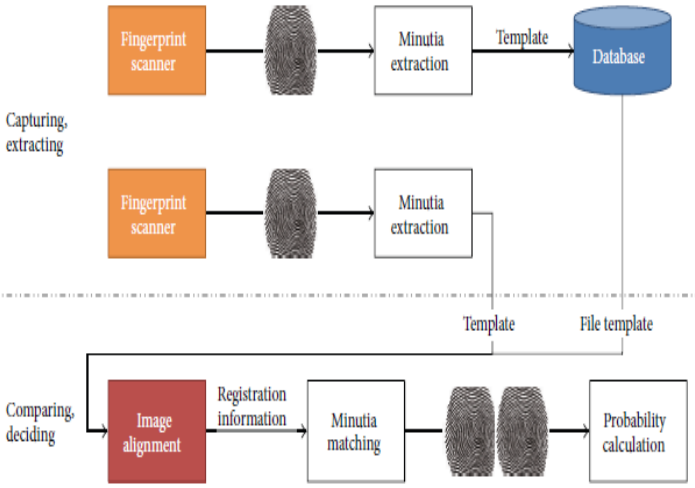

Figure 1: User Authentication Mechanism

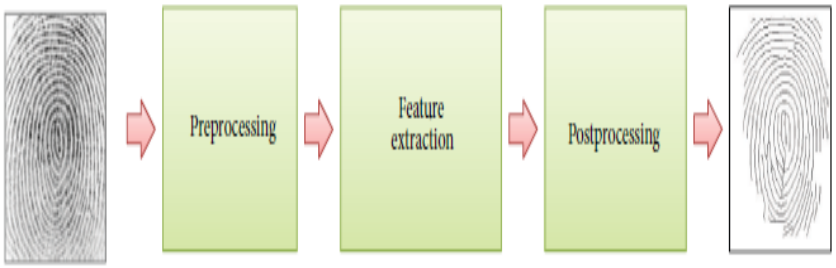

Figure 2: Procedure to Fingerprint Recognition

Preprocessing

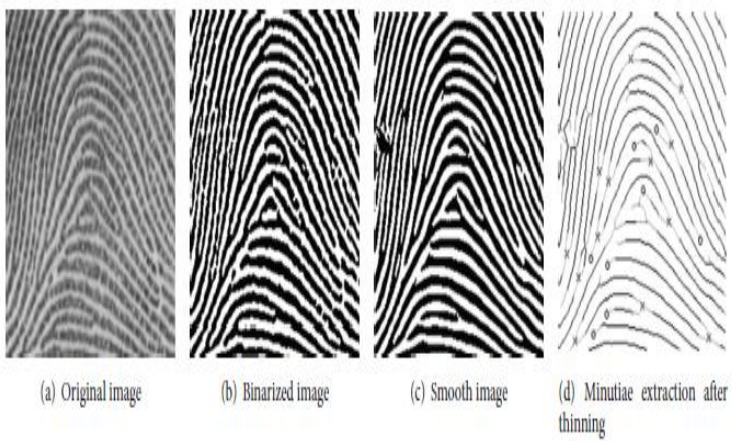

Figure 3: Preprocessing to Fingerprint Recognition

Image Improvement

A fingerprint image is classified into one of the images with a lot of noises. A fingerprint is a body part going through a lot of state changes such as injuries or moisture. Thus, fingerprint images obtained through the device are likely to be mixed with noises. In the image improvement step, the work clarifying the distinction between ridges and valleys is carried out by reducing noises. The most commonly used method is to use adaptive filter. It uses the fact that if knowing ridge local orientation around applied pixels and applying adaptive filter, ridges with the same direction become clear.

In this process, the bridge of neighboring rides resulting from noises is removed and the result of connecting broken ridges is often shown. Directional Fourier filter, Gabor filter and so forth, are widely used adaptive filters, and the method using mask operation is also used.

Binarization

When image improvement work is finished, the process of extracting ridges is started. As shown in Figure 3, fingerprint images usually have grayscale of 256 but this can be simplified into the binary information of ridges and valleys as binarized image of Figure 3(b). There is a difficulty that binarization cannot be done by using single intensity threshold because all fingerprint images do not have constant image contrast in the process of making binary images, and even the contrast ratio of the same person's fingerprints varies every time the device is pressed on. Therefore, the dynamic thresholding method is applied depending on image distribution pixel values and through it, the whole image is binarized into the ridge part and non ridge part.

Thinning

The final step of preprocessing to extract minutiae is the thinning step and this refers to the work reducing the width of ridges obtained after binarization into one pixel like minutiae extraction after thinning of Figure 3(d). This process must not only fully maintain co connectivity of found ridges but minimize wrong minutiae information that may occur through this step. As can be seen in Figure 3(c) smoothened image, the flow of ridges becomes often clear by applying the smoothing technique to binary images. Many algorithms have been using this method because minutiae can be found quickly and easily through simple mask operations with thinned fingerprint images. Preprocessing is the relatively time-consuming process. Since time consumption in the process of using adaptive filters and thinning accounts for the largest part, research on the algorithm which can ensure a high recognition rate while reducing the operation time of these two steps is needed.

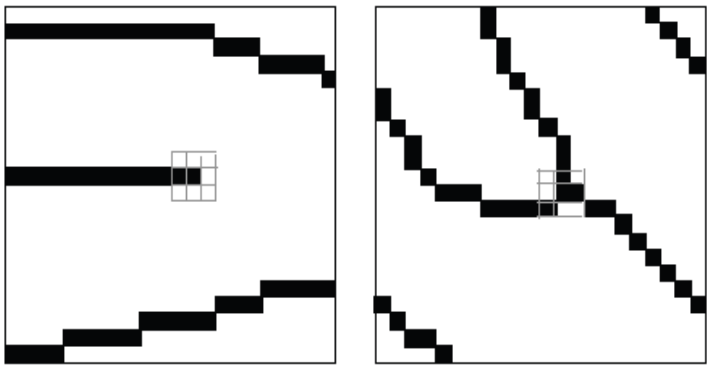

Figure 4: Feature Extraction of Fingerprint Recognition

Feature Extraction

After preprocessing is finished, the process of finding minutiae is carried out. As shown in Figure 4, by using thinned images, minutiae is distinguished by finding a point where a thin line ends for an endpoint and the point where three thin lines meet for bifurcation

Post processing

The false minutia caused by the damage of the original image is included in the found minutiae and these are

called false minutiae. Most false minutiae are created by incorrectly thinning the part where ridges are broken due to injuries and so forth, or the part where the shape of ridges is not shown well due to changes in binding force. By defining and removing false minutiae, post processing plays a role of reducing unnecessary operations in matching and increasing overall performance.

The Algorithm and Performance Evaluation

Zsolt et.al (2000) projected a effective fingerprint verification system [1]. During this technique they tried to validate the identity of a individual by exploit online fingerprints and trivialities matching by getting the reference image by filtering and careful trivialities extraction procedures. The trivialities correspondences square measure found employing a triangular matching algorithmic rule to address the robust deformation of fingerprint pictures attributable to static friction or finger rolling and also the final verification uses Dynamic Time warp. Triangular matching is quick and overcomes the relative nonlinear deformation gift within the fingerprint image pairs. In fact, triangular matching saves native regularities and compensates for world distortion. The Dynamic Time warp permits a really low false positive rate to be obtained. Thus claiming high accuracy and matching rate. However once assembling the image there square measure probabilities of losing the data associated resulting in the poor classification.

Shlomo et. al (2000) projected 2 ways for fingerprint image improvement i.e. first, victimization native bar graph feat, Wiener filtering, and image binarization. The second methodology uses a distinctive eolotropic filter for direct grayscale improvement. They use native bar graph feat for distinction growth and Wiener filtering for noise reduction. The binarization method is applied by adaptation thresholding primarily based on the native intensity mean. Dilution is then dole out that provides sensible results on fingerprints. Finally morphological filtering is applied to eliminate artifacts in rackety regions and to fill some gaps in valid ridgelines. The second methodology use a distinctive eolotropic filter for direct grayscale improvement that need binarization and dilution as intermediate steps acting quicker and economical.

Jim et.al (2003) projected a partial dilution theme for fingerprint recognition system to scale back the computation within the dilution method during this method the entire fingerprint image are often avoided if enough trivialities are extracted from the partial weakened space of a fingerprint image. The recognition system consists of 4 stages: preprocessing (image acquisition and background removal), image improvement (direction detection, binarization and thinning), trivialities extraction, and trivialities matching. Here they verify and use the core purpose (reference point) of a fingerprint image because the center of dilution method, and five hundredth of the fingerprint image is weakened at first.

If extracted trivialities of weakened space don't seem to be enough for matching, more dilution is performed. The fingerprint recognition system victimization the partial dilution has the higher performance in terms of recognition rate and computing time as incontestable by the experimental results. Additionally, associate adaptational methodology is bestowed to notice block direction. This adaptational methodology chooses eight pixels of a block to work out its block direction, and so a compensation method is employed to correct some wrong block directions. But, the partial dilution theme can be applied to different stages of the fingerprint recognition system, particularly in image binarization, which needs intensive computations.

Takahiro et al. (2004) projected the parallel ridge filtering methodology which might powerfully suppress non-parallel noise lines by utilizing the correspondence of ridges. The substantial improvement in elimination of noise

that's achieved by this methodology helps within the reduction of matching errors in poor-quality fingerprint pictures. However still this work have to be compelled to be extended with FPR a Secure and Secured Biometric in Web Banking-Survey regions that Contain very little ridge correspondence and parallel noise lines.

Guorong et al. (2005) projected associate internet-based personality verification system victimization lossless information concealing and fingerprint recognition technologies. Here at the shopper aspect, the SHA-256 hash of the initial fingerprint image and sensitive personal info square measure encrypted and embedded into the fingerprint image victimization a complicated lossless information concealing theme and at the service supplier aspect, once the hidden information square measure extracted out, the fingerprint image are often recovered with none distortion attributable to the usage of the lossless information concealing theme. Hence, the originality of the fingerprint image is ensured via hash check. However in image watermarking the information recovery could be a challenge task in period of time situations.

Jan Lukas et al. (2005) during this work they projected to use the sensor's pattern noise for camera identification from pictures. Here the pattern noise is extracted from the pictures employing a wavelet-based denoising filter. for every camera underneath investigation initial its reference pattern noise as a high frequency unfold spectrum watermark, whose presence within the image is established employing a correlation detector is decided that is a singular identification fingerprint. For this they tried victimization the method of flat-fielding if the camera in possession or by averaging the noise obtained from multiple pictures. To spot the camera from a given image, we tend to contemplate the reference pattern noise as a high-frequency unfold spectrum watermark, whose presence within the image is established employing a correlation detector. However once malicious meddling happens then finding the meddling space could be a tough job and identification becomes tough.

Jinwei et al. (2006) projected a framework for fingerprint recognition by combining the world structure (the model-based orientation field) and also the native cues (minutiae). So, during this work associate intuitive illustration for fingerprints that preserves the entire orientation field within the templet besides trivialities and different options On average, it wants but 420 bytes to store all the data, and have extraction and matching are often wiped out concerning zero.30 s per fingerprint, that makes it appropriate for large-scale on-line process..Based on this illustration, fingerprint matching is performed by combining the world structure (orientation field) and also the native cues (minutiae). Thus representing fingerprints with a whole set of complementary options isn't solely necessary for storing however additionally terribly useful for recognition. however this world-and-local illustration framework are often extended more by together with another global or native options obtainable within the fingerprint pictures like the ridge density map.

Gorka et al. (2007) in their thesis report examinationed varied approaches supported binzatiarion, skeltonization and trivialities matching algorithmic rule. Once through analysis they tried to boost these ways to present higher performances in adverse things. To mitigate this issue, during this work they urged a increased binarization methodology within the frequency domain to enhance quality of the fingerprint recognition systems with the conception of ridges and their orientations. Similarly, Skeletonization is required as a preprocessing step with the aim of getting the trivialities from the fingerprint. Because it could be a reality that the prime quality skeleton is associate emphatic think about the fingerprint recognition. Thus guaranteed that a strong skeletoned image can ensure a reliable extraction of options and finally they projected trivialities matching algorithms explore many variations of the geometric hashing methodology to get associate effectiveness operate

Ahmet et al. (2008) projected introduced a brand new supply DSLR (Digital single lens reflex) camera

identification theme supported sensing element mud traces. during this methodology the mud spots within the image square measure detected supported a (Gaussian) intensity loss model and form properties. The placement and form of mud specks before of the imaging sensing element and their persistence create mud spots a helpful fingerprint for DSLR cameras. Although several DSLR cameras escort intrinsical mud removal mechanisms, these hardware-based removal solutions don't seem to be as effective as they claim to be. However biggest challenge during this analysis direction is that the detection of mud spots in terribly advanced regions and lo -numbers.

Stephen et al. (2009) projected a concavity and convexity improvement methodology of binarization for preprocessing the fingerprint pictures of non-uniform brightness for fingerprint authentication. This methodology isn't involved with the orientations of theridges/valleys however solely depends on the native pixels info. Here they compared preprocessing results with the discriminate analysis and native threshold ways. Though the discriminant analysis and native threshold ways turn out sensible ends up in some pictures, they unsuccessful in most of {the pictures the pictures the photographs} attributable to high variety of ridge bursts.

The projected concavity and convexity improvement methodology overcomes the ridge burst downside and produces sensible results even in poor quality images. Conventionally, shadow compensation is dole out throughout preprocessing like noise removal. In shadow removal, brightness compensation is achieved if the illumination influence is understood. during this work, by skipping this method, process speed was improved. however in future this methodology are often improved FPR a Secure and Secured Biometric in Web Banking-Survey by combining template matching and easy principal element analysis.

Ravi et al. (2009) projected a methodology a way a technique for fingerprint Recognition victimization detail Score Matching method (FRMSM).In this methodology for fingerprint dilution the Block Filter is employed that scans the image at the boundary to preserves the standard of the image and extract the trivialities from the weakened image. The pre-processing the initial fingerprint involves image binarization, ridge dilution, and noise removal. Fingerprint Recognition victimization detail Score Matching methodology is employed for matching the detail points. The false matching quantitative relation is best compared to the present algorithmic rule. But extracting the detail in caliber pictures could be a major issue and will cause misclassification.

Neeta et al. (2010) projected alignment-based elastic matching algorithmic rule is capable of finding the correspondences between trivialities while not resorting to complete analysis. during this work relies on the conception of segmentation victimization Morphological operations, detail marking by specially considering the triple branch reckoning, detail unification by mouldering a branch into 3 terminations and matching within the unified x-y system. Once a 2-step transformation so as to extend the preciseness of the detail localization method and elimination of spurious detail with higher accuracy there's a scope of more improvement in terms of potency and accuracy which might be achieved by up the hardware to capture the image or by up the image improvement techniques. In order that the input image to the dilution stage can be created higher this might improve the long run stages and also the final outcome.

Shashi et al. (2010) projected Fingerprint Verification supported fusion of trivialities and Ridges victimization Strength Factors within which the trivialities and ridge ways square measure combined. In FVMRSF methodology within the preprocessing stage the Fingerprint is Binarised and weakened. The trivialities Matching Score is decided victimization Block Filter and Ridge matching score is calculable victimization Hough rework. The strength factors Alpha (α) and Beta (β) square measure wont to generate Hybrid matching score for matching of fingerprints. Then the trivialities and also

the ridge parameters square measure amalgamate victimization the Strength Factors to enhance the performance. However the performance might are improved by adding the rippling rework because it helps in compact fingerprint recognition.

Kazuya et al. (2010) projected a technique to pick out pixels used for camera identification in keeping with the feel complexness to enhance the accuracy of camera identification. During this methodology camera identification accuracy is reduced by the image process engine like motion blur correction, distinction improvement, and noise reduction. Additionally urged {a methodology a way a technique} for up the identification accuracy by the image restoration method In this paper, we've got shown the improved camera identification methodology. The identification accuracy is improved by choosing pixels used for correlation calculation in keeping with the feel complexness. And also the identification accuracy is additionally improved by the image restoration that restores the PNU noise varied by the image process engine. However still there's huge concern to own a systematic methodology to properly estimate the restoration operate is left to the long run work.

Miroslav et al. (2010) developed a quick algorithms for locating if a given fingerprint already resides within the info and for decisive whether or not a given image was taken by a camera whose fingerprint is within the info. Here they accomplished that in worst case complexness remains proportional to the info size however doesn't rely on the sensing element resolution. The algorithmic rule works by extracting a digest of the question fingerprint fashioned by the foremost extreme ten, 000 fingerprint values and so some matches their positions with the positions of pixels within the digests of all info fingerprints. The algorithmic rule needs a distributed arrangement that must be updated with each new fingerprint enclosed within the info. The algorithmic rule is meant to create certain that the likelihood of a match and warning for the quick search is a twin of the corresponding error possibilities of the direct brute-force search. at that time they additionally claim that the quick algorithmic rule doesn't believe any structure or special properties of the fingerprints within the info. thus it are often utilized in any application wherever a info contains n-dimensional components and n could be a fastened sizable amount. The sole demand is that the weather carries with it real numbers or integers from an outsized vary. However integers from a tiny low vary would cause ill-defined ranks. Associate extreme case once the rank correlation and consequently, the quick search algorithmic rule can't be used, square measure binary vectors.

Sara et al. (2010) urged a reliable authentication mechanism that isn't keen about a series of characters, however rather on a technology that's distinctive and solely possessed by the individual known as Finger ID. This method is aims to market the convenience for the net user since he/she won't have to be compelled to bear in mind multiple passwords for a multiple variety of accounts. The accessibility, usability and security tips are tested on the Finger ID web site and browser by suggests that of diverse activities and located that the online accounts a safer, accessible and usable one. However this will increase the price of the system.

Chandra et al. (2011) projected a technique a way to get a noise-free fingerprint image they projected the finger print classifications, characteristics and preprocessing techniques. Wherever they applied the bar graph on 256 grey scale finger print image with the default threshold value; then the histogram-equalized image is obtained. Next, histogram-equalized image is given underneath the binarization method. Finally the binarized fingerprint image is filtered with the implementation of the Median filtering technique so as to provide the noise free image. The comparison of the median filtered image with the initial rackety image shows the depth of the noise unfold within the original image. Their experimental result shows the noise rate that was eliminated within the input fingerprint image and quality of the filtered image victimization the applied math –Correlation tool.

Bayram et al. (2012) projected a technique to represent sensing element fingerprints in binary quantized type because the massive size and random nature of sensing element fingerprints makes them inconvenient to store. In their work they analyzed the modification within the performance caused attributable to loss of data attributable to binarization. Hence, binarization of sensing element fingerprints is a good methodology that provides extensive storage gain and complexness reduction whiles not a big reduction in fingerprint matching accuracy. However this may not be effective for rackety or info lost fingerprints resulting in the misclassification.

Yoon et al. (2012) projected a algorithmic rule supported the options extracted from the orientation field and trivialities satisfies the 3 essential needs for alteration detection algorithm:1) quick operational time, 2) high true positive rate at low false positive rate, and 3) easy integration into AFIS. The projected algorithmic rule and also the NFIQ criterion were tested on an outsized property right fingerprint info (NIST SD14) as natural fingerprints associated an altered fingerprint info provided by a enforcement agency.

Romany et al. (2012) projected a brand new technique to fingerprint recognition primarily based a window that contain core purpose this window are input ANN system to be model. This methodology could be a adaptation singular purpose detection methodology that will increase the accuracy of the algorithmic rule. This sturdy methodology for locating the core purpose of a fingerprint The world threshold reduces probabilities of incorrectly locating a core purpose attributable to presence of discontinuities like scars or wrinkles, which can occur within the existing processes. Since the detection relies on a world threshold, the strategy solely offers America associate approximate location of the core purpose. For precise detection of the core purpose, we tend to use the pure mathematics of region technique over a smaller search window victimization ANN. They show that as image size window that contain core purpose in center decreases the system performance additionally decrease however not the dimension.

Bart°un˙ek et al. (2013) proposed an adaptive fingerprint enhancement method. The method extends previous work by focusing on preprocessing of data on a global and a local level [3]. A preprocessing using the non-linear SMQT dynamic range adjustment method is used to enhance the global contrast of the fingerprint image prior to further processing. Estimation of the fundamental frequency of the fingerprint image is improved in the global analysis by utilizing a median filter leading to a robust estimation of the local area size. A low-order SMQT dynamic range adjustment is conducted locally in order to achieve reliable features extraction used in the matched filter design and in the image segmentation. The matched filter block is improved by applying order statistical filtering to the extracted features, thus reducing spurious outliers in the feature data. The proposed method combines and updates existing processing blocks into a new and robust fingerprint enhancement system. The updated processing blocks lead to a drastically increased method performance where the EER is improved by a factor two, and the AAC is improved by a factor 12, in relation to the original method. The proposed method improves the performance in relation to the NIST method, and this is particularly pronounced on fingerprint images having a low image quality. The evaluation results indicate that the method is able to adapt to varying fingerprint image qualities, and it is stressed that the proposed method has not been tuned in favor towards any database. Rather, one global configuration has been used during the evaluation campaign. The proposed algorithm is insensitive to the varying characteristics of fingerprint images obtained by different sensors. A performance improvement is observed on databases with bad quality fingerprints (FVC2000 Db3a and FVC2004 Db2a). The ability of the proposed method to adapt to various images is emphasized in the results obtained on the FVC2000 Db3a database where the users' age ranges from 5 to 73 years. A possible future research direction is to perform a detailed and systematic analysis of the

impact of the different chosen design parameters. Furthermore, various optimizations of the implemented processing steps could reduce the number of instructions required by the proposed method.

Chen et al. (2013) proposed a novel algorithm for fingerprint and palmprint minutiae identification is proposed to save time [5]. A hierarchical strategy is proposed and utilized in the matching stage. The hierarchical strategy can reject many fingerprints (in the database of the AFIS) which do not belong to the same finger as the input fingerprint quickly, thus it can save much time. Experimental results show that the proposed algorithm can save almost 50% searching time compared to the traditional method and illustrate its effectiveness. Not as the conventional methods based on classification and indexing, the proposed method does not use more features or information than minutiae, and it can be integrated to the conventional identification systems in future.

Li and Kot et al. (2013) introduce a novel system for fingerprint privacy protection by combining two fingerprints into a new identity [2]. In the enrollment, the system captures two fingerprints from two different fingers. A combined minutiae template containing only a partial minutiae feature of each of the two fingerprints will be generated and stored in a database. To make the combined minutiae template look real as an original minutiae template, three different coding strategies are introduced during the combined minutiae template generation process. In the authentication process, two query fingerprints from the same two fingers are required. A two-stage fingerprint matching process is proposed for matching the two query fingerprints against the enrolled template. Our combined minutiae template has a similar topology to an original minutiae template. Therefore, we are able to combine two different fingerprints into a new virtual identity by reconstructing a real-look alike combined fingerprint from the combined minutiae template. The experimental results show that our system achieves a very low error rate with FRR at FAR. It is also difficult for an attacker to break other traditional systems by using the combined minutiae templates. Compared with the state-of-the-art technique, our technique can generate a better new virtual identity (i.e., the combined fingerprint) when the two different fingerprints are randomly chosen. The analysis shows that it is not easy for the attacker to recover the original minutiae templates from a combined minutiae template or a combined fingerprint.

Paulino et al. (2013) have presented a fingerprint matching algorithm designed for matching latents to rolled/plain fingerprints which is based on a descriptor-based Hough Transform alignment [4]. A comparison between the alignment performance of the proposed algorithm and the well-known Generalized Hough Transform shows the superior performance of the proposed method. We also reported matching results for two different latent fingerprint databases with a large background database of around 32K rolled prints. They compared the performance of the proposed matcher with three different state-of-the-art fingerprint matchers. Experimental results show that the proposed algorithm performs better than the three fingerprint matchers used in the study across all image qualities.

A score-level fusion of the proposed matcher and one of the commercial matchers COTS2) shows a further boost in the matching performance. They plan to include a texture-based descriptor to improve the matching accuracy especially when the overlap between the latent and rolled prints is small. In our future work, following the recommendations they plan to include additional automatically extracted features to improve the matching performance without an increase in manual labor (latent examiner's markups). Although the proposed matcher is more accurate than the two COTS matchers, they are significantly faster. They also plan to develop an indexing algorithm to speed up latent matching. Major headings should be typeset in boldface with the first letter of important words capitalized.

CONCLUSIONS

The main improvements that can be done are 1) automatically compute the local ridge frequency, that is used in Gabor filters and minutiae templates. 2) Improve the minutiae templates, try different shapes (thin or thick minutia point).This part seems to be the most difficult: it requires a lot of training and tunning. 3) Use another algorithm for correspondence based on human strategy when doing this, add more information in the feature vector (orientation for example). 4) Use fingerprint classification to speed up the algorithm. 5) Allow non linear transformation in the matching process. This paper shows best scenario by using number of techniques used for Fingerprint Recognition system in recent years. Hope this paper might help augment the general user's understanding of biometrics and fingerprint technology, particularly with respect to its utility, acceptability, and familiarity and moreover, to lead as well to a heightened awareness of the important role that biometrics can be expected to play in enhancing the overall security of systems.

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