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Modified Dactylogram Sifting

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Abstract— ***Fingerprint recognition has been with success utilized by enforcement agencies to spot suspects and victims for nearly a hundred years. Recent advances in automated fingerprint identification technology, in addition the growing would like for reliable person identification, have resulted in an increased use of fingerprints in both government and civilian applications such as border control, employment background checks, and secure facility access. Fingerprint obfuscation refers to the deliberate alteration of the fingerprint pattern by an individual for the purpose of masking his identity. Classify altered fingerprints into three classes based on the changes in ridge pattern due to alteration as obliterated, distorted and imitated. The projected algorithmic rule supported the trivialities based on the minutiae extracted satisfies the essential requirements and determine the alteration type automatically to reconstruct altered fingerprints. In order to conquer the drawbacks of existing techniques, we proposed an efficient and robust fingerprint matching technique via fuzzy based method. For some types of altered fingerprints where the ridge patterns are damaged locally or the ridge structure is still present on the finger but possibly at a different location, reconstruction is indeed possible by the proposed method. Further it is shown that authentication is retained even though fingerprint identity has altered.***

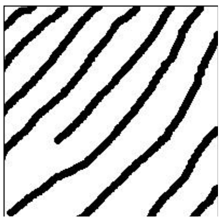
Keywords:Fingerprints,Alteration,Obfuscation,Minutiae extraction,Fuzzy based method

I. INTRODUCTION

Fingerprint matching has been successfully used by law enforcement for more than a century. The technology is now finding many other applications such as identity management and access control. The automated fingerprint recognition system and identify key challenges and research opportunities in the field. Fingerprint alteration refers to changes made in a person's finger ridge structure by means of abrading, cutting, or performing plastic surgery on the fingertips. Finger-print alteration is a serious attack on Automated Finger-print Identification Systems (AFIS) since it can reduce the similarity between fingerprint impressions from the same finger due to the loss of genuine minutiae, increase in spu-rious minutiae and distortion in spatial distribution of the minutiae. The widespread deployment of AFIS gives incentive to some individuals, e.g., criminals and illegal aliens, to evade fingerprint identification by altering their fingerprints. The objective of fingerprint alteration, also called fingerprint obfuscation, is to conceal one's identity by abrading, cutting, burning fingers or performing plastic surgery on fingertips [1]. If a person has a prior criminal record, he hopes that his altered fingerprints will not be successfully matched to his reference fingerprints stored in the law enforcement databases.

We classify altered fingerprints into three categories based on the changes in ridge pattern due to alteration. This categorization will assist us in following manner: 1) Getting a better understanding of the nature of alterations that can be encountered, 2) detecting altered fingerprints by modeling well-defined subcategories, and 3) developing methods for altered fingerprint restoration. The US Department of Homeland Security's US-VISIT program (www.dhs.gov/usvisit) provides visa-issuing posts and ports of entry with fingerprint recognition technology that enables the federal government to establish and verify the identity of those visiting the US. This large-scale automated fingerprint recognition system has processed more than 100 million visitors to the US since 2004.

In order to extract precise minutiae information, an input fingerprint image generally needs to be enhanced by convolving with certain types of orientation-selective filters, such as Gabor or steerable filters, along the ridge flow orientation at each pixel/block location [2, 3].The minutiae considered involve ridge ending and bifurcation.



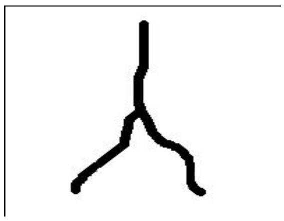


Figure-1a: Ridge ending Figure-1b: Bifurcation

Altered fingerprint matching is a challenging problem due to the following reasons: (i) friction ridge structure can be severely damaged by abrading, cutting, burning, or applying strong chemicals on fingertips, resulting in a number of unreliable minutiae (ii) even if the ridge

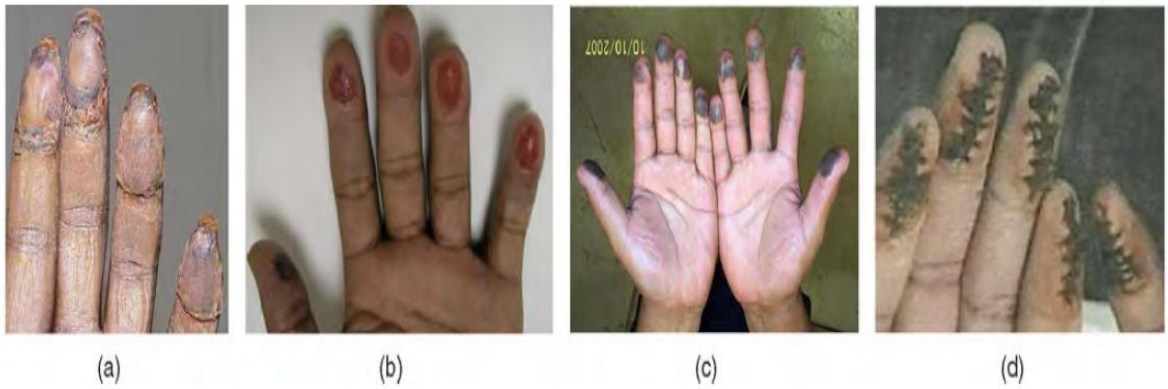


Figure-2: Photograph of altered fingerprint a) Transplanted friction ridge from skin sole b)Fingers that have been bitten c)Fingers burnt by acid d)Stitched fingers

structure is well-defined in local regions, minutiae distribution can be highly unusual during the procedure of switching skin patches in cases of ‘Z’-cut prints (Fig. 3a); and (iii) minutiae in well-defined ridge area may not belong to the fingerprint of interest if a portion of skin on the fingertip was transplanted from other parts of the body .Figure-2 shows the different types of alteration in fingerprint. Matching phase can be divided into two parts: (i) altered fingerprint restoration and (ii) altered fingerprint matching. The matching of altered fingerprint with the unaltered fingerprint stored in the database is the current work. Matching done using fuzzy logic by replacing the lost minutiae with the existing minutiae. Further it is shown that authentication is retained

II. RELATED WORK

Algorithms that provide better detection compared to NFIQ algorithm that can detect only up to 20 percent of altered fingerprint are defined. Here only two types of altered fingerprint is detected, because the image quality of obliterated fingerprint is either so good that they can be successfully matched to the mated fingerprint by automatic matchers or so poor that they can be easily detected by fingerprint quality control software and imitated fingerprints may look very natural and they are no images of this type currently available in the public domain to undertake such a study. Orientation field estimation and singular point detection is done to detect alteration. Due to the variation of singular points in terms of their number and location, the orientation field of natural fingerprints varies across individuals. Another approach for altered fingerprint detection is: minutiae–based and correlation-based. The former has several advantages over the latter such as lower time complexity, better space complexity, less requirement of hardware etc. The uniqueness of a fingerprint is due to unique pattern shown by the locations of the minutiae points – irregularities of a fingerprint – ridge endings, and bifurcations.

Altered fingerprint types, ‘Z’-cut cases are of special interest since the original ridge structure of the finger is still retained in the finger, but in different positions. Once the ‘Z’-cut prints are detected[4], the ridge structure in the triangular patches can be restored by reversing the transposing procedure. The restored ‘Z’-cut fingerprint and all other altered fingerprints are submitted to a special matcher which is robust to a large amount of skin distortion and utilizes local minutiae information.

III. PROPOSED SOLUTION

Motivated by the existing system’s problem we present a new matching technique for altered fingerprint using fuzzy logic which is capable of matching all possible altered fingerprint patterns. Performance is higher compared to the existing systems.

Database

A large database of altered fingerprints is obtainable to us from a law enforcement agency. It contains 4,433 altered fingerprints from 535 tenprint cards of 270 subjects. Among these altered images, if multiple pre-altered impressions of a finger exist, the simplest quality fingerprint image assessed by NIST Fingerprint Image Quality (NFIQ) software [5] is selected as a reference fingerprint.

Spurious Minutiae in Altered Region

Minutiae in the altered region are most likely unreliable since, for instance, scars generate abrupt ridge endings and mutilation forms unusual ridge pattern. In transplanted cases, the ridge structure in the altered region does not belong to the finger of interest. Valid fingerprint region in the altered fingerprint is defined as the unaltered region where genuine friction ridge structure of the finger appears. To establish the valid fingerprint region, region of interest (ROI) of a fingerprint is obtained by measuring dynamic range in local regions, and altered regions also are manually marked. ROI is defined as the local image blocks with dynamic range in gray-scale intensity over 20 after the highest and the lowest 10% gray values in a block are discarded. This is followed by morphological operators to fill holes and remove isolated small regions. With the altered region that is currently marked manually, spurious minutiae in invalid fingerprint region (i.e., either in the altered region or outside ROI) are discarded. The number of valid minutiae can vary a lot according to the area of valid fingerprint region.

Restoration and Matching of Altered Fingerprint

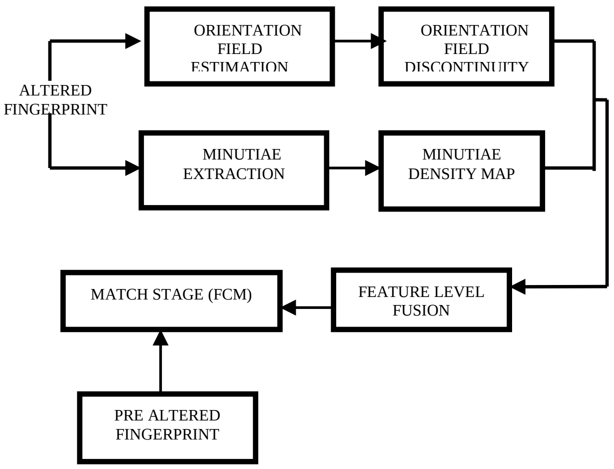


Figure 4: Flow Chart for Matching of Altered Fingerprint

Analysis of Orientation Field

Orientation field describes the ridge flow of fingerprints. Good quality fingerprints have a smooth orientation field except near the singular points (e.g., core and delta).Based on this fact, many orientation field models have been developed by combining the global orientation field model for the continuous flow field of the fingerprint with the local orientation field model around the singular points. The global orientation field model represents either arch-type fingerprints, which do not have any singularity, or the overall ridge orientation field except singularity in fingerprints. If the global orientation field model alone is used for orientation field approximation, the difference between the observed orientation field and the model will ideally be nonzero only around the singular points. On the other hand, for obfuscated fingerprints, the model fitting error is observed in the altered region as well. Thus, we use the difference between the observed orientation field extracted from the fingerprint image and the orientation field approximated by the model as a feature vector for classifying a fingerprint as natural fingerprint or altered one.

Analysis of Minutiae Distribution

Based on the minutiae extracted from the Altered-fingerprint by the minutiae extractor in, minutiae density map is constructed by using the Parzen window method with uniform kernel function. Kernel density estimation is a non parametric way to estimate the probability density function. Let Sm be the set of minutiae of the fingerprint,

Sm = {x|x=(x,y) is the position of minutiae}

Then, the minutiae density map from Sm is computed as follows:

The initial minutiae density map, Md(x), is obtained by

Md(x) = ∑ Kr(x-x0)

Kr(x-x0) uniform kernel function centered at x0 with radius r.

Low-pass filtering Md(x,y) is smoothed by a Gaussian filter of size 30 X 30 pixels with a standard deviation of 10 pixels. Normalization. Md(x,y) is transformed to lie in the interval [0 1] by

$$Md(x,y) = \begin{cases} Md(x,y)/T, & \text{if } Md(x,y) \leq T \\ 1 & \text{, otherwise} \end{cases}$$

Where T is a predetermined threshold.

The minutiae density maps of altered fingerprints are detected. In the natural fingerprint, minutiae are well spread and distributed almost uniformly. In the altered fingerprints, on the other hand, the distributions of minutiae are quite different: 1) Many spurious minutiae are extracted along scars and in the obliterated region due to ridge discontinuity, and 2) an excessive number of minutiae appear when a new ridge-like pattern is formed after alteration. The examples demonstrate that minutiae distribution can be useful for detecting altered fingerprints.

Restoration and Matching

Finger Print Matching Algorithm

1. Divide an input image into non overlapping blocks with size x*y
2. Compute the gradients $\partial x(i, j)$ and $\partial y(i, j)$ at each pixel *(i, j)* which is the centre of the block. The gradient operator can be chosen according to the computational complexity.
3. For each unidentified region apply fuzzy filtering(i.e. copying neighbouring pixels)
   a. Identify ridges, bifurcated area and minutia by applying local orientation
   b. Local Orientation algorithm calculates the threshold value of the pixel region.

$$V_x(i,j) = \sum_{u=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} 2\partial_x(u,v)\partial_y(u,v),$$

$$V_y(i,j) = \sum_{u=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} \partial_x^2(u,v)\partial_y^2(u,v)$$

Subsequently,

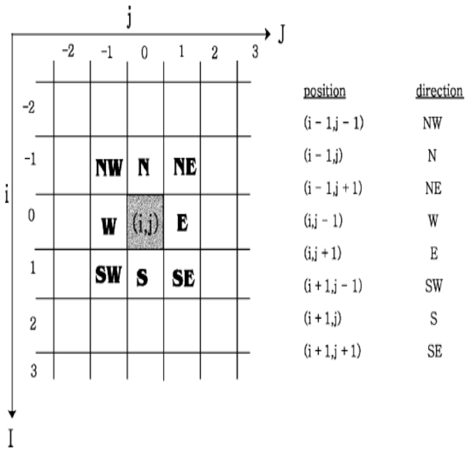
$$\theta(i,j) = \frac{1}{2}\tan^{-1}\left(\frac{V_y(i,j)}{V_x(i,j)}\right)$$

Here, the θ (i, j) is the least square estimate of the local ridge orientation of the block centered at pixel (i,j).

   c. Apply Fine turning Operation as shown below

Procedure:
If : $B_{(i,j)} \neq 0$ *then:* $\theta = 0.5 \tan^{-1}(B/A)$
else: $\theta = \pi/2$,*end*
if $\theta < 0$ *then*
if : $A < 0$ *then:* $\theta = \theta + \pi/2$
else: $\theta = \theta + \pi$,*end*
else
if : $A < 0$ *then:* $\theta = \pi/2$,*end*
end

d. Apply fuzzy on following clusters



4. Check the image with existing database image

IV. IMPLEMENTATION AND EXPERIMENTAL RESULTS

Matching performance of altered fingerprints is evaluated by the Cumulative Match Characteristic (CMC) curves. We view altered fingerprint matching in the same spirit as latent fingerprint matching in the sense that these are high profile cases where a forensic examiner needs to examine top N retrieved candidates from the background database.

As a fingerprint matcher, Neurotechnology VeriFinger SDK 6.3 is used to extract minutiae and match the minutiae templates. The altered fingerprint database consists of 1,332 pre/post-altered fingerprint pairs. Three minutiae sets are evaluated: (i) all the minutiae extracted from the altered fingerprints, (ii) a subset of minutiae from the altered fingerprints by removing spurious minutiae in invalid fingerprint region, and (iii) a subset of minutiae from the restored fingerprint image by removing spurious minutiae in invalid fingerprint region. Note that all the minutiae in altered fingerprints are automatically extracted by the matcher, and then spurious minutiae in invalid region are masked out.

Fingerprint alteration is not always successful in lowering the genuine match scores. Furthermore, the severity of the alteration does not predict degradation in matching performance. The fingerprint alteration appears to be severe due to the skin transplantation over a large area. However, it can be successfully matched to its pre-altered mate; the match score with its true mate is sufficiently high to be correctly identified at the top rank. Removal of spurious minutiae in the altered region can improve the matching performance. In most of altered fingerprint matching, it is observed that minutiae pairing results are globally inconsistent due to a number of spurious minutiae from scars, mutilated region or background. By removing spurious minutiae, the matcher is able to find more consistent mates in minutiae pairings, which results in higher genuine match score.

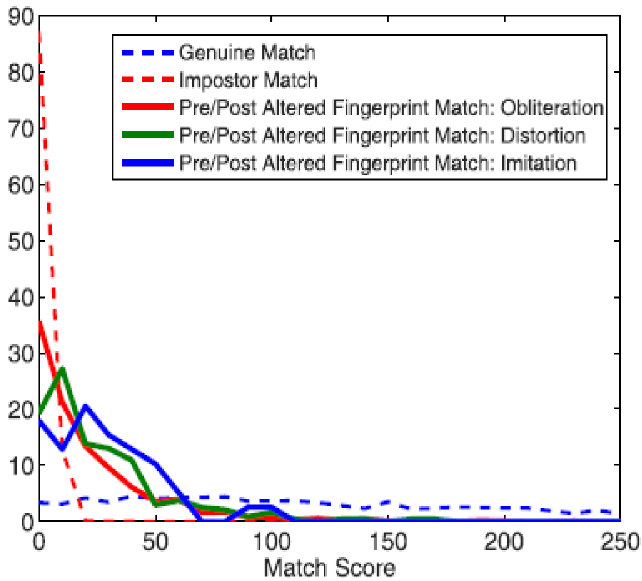


Figure 5: Match Score of pre /post alteration fingerprint pairs according to type and genuine and impostor pairs

V.CONCLUSIONS AND FURTHER RESEARCH

Reconstruction of altered fingerprints is done. For some types of altered fingerprints where the ridge patterns are damaged locally or the ridge structure is still present on the finger but possibly at a different location, reconstruction is indeed possible. Match altered fingerprints to their unaltered mates. A matcher specialized for altered fingerprints can be developed to link them to unaltered mates in the database utilizing whatever information is available in the altered fingerprints. Previous work on this topic [10,1] addressed the automatic detection of altered fingerprints based on the abnormality in orientation field and minutiae distribution.

Ongoing research on matching altered fingerprints is addressing the following topics:

• Localize the altered region automatically to improve the matching performance by removing spurious minutiae in the altered region as well as classify'Z'-cut cases which are of special interest due to the possibility of restoration;

• Develop a new fingerprint matching algorithm specialized to altered fingerprint matching which is robust to skin distortion and that maximally uses local ridge structure in valid fingerprint region

• Use multibiometrics [6] to combat the growing threat of individuals evading AFIS. Federal agencies in the United States have adopted or are planning to adopt multibiometrics in their identity management systems (the FBI's NGI [7] and DoD's ABIS [8]). However, other biometric traits can also be altered successfully. It has been reported that plastic surgery can significantly degrade the performance of face recognition systems [9] and that cataract surgery can reduce the accuracy of iris recognition systems [10]. To effectively deal with the problem of evading identification by altering biometric traits, a systematic study of possible alteration approaches for each major biometric trait is needed.

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VI . REFERENCES

[1] S. Yoon, J. Feng , and A. K. Jain. Altered fingerprints: Analysis and detection. *IEEE Trans. Pattern Analysis and Machine Intelligence* , 2012.
[2] L. Hong, Y. Wan, and A. Jain, "Fingerprint image enhancement: Algorithm and performance evalution," *IEEE Trans. Pattern Analysis and Machine Intelligence*, vol. 20, no. 8, pp. 777–789, 1998.
[3] R. Bolle S. Chikkerur, S. Pankanti and V. Govindaraju, "Minutiae verification in fingerprint images using steerable wedge filters," in *Indian Conf. on Computer Vision, Graphics & Image Processing*,2004.
[4] On Matching Altered Fingerprints Soweon Yoon, Qijun Zhao, and Anil K. Jain Department of Computer Science and Engineering Michigan State University East Lansing, MI, U.S.A. {yoonsowo,qjzhao,jain}@cse.msu.edu
[5] E. Tabassi, C. Wilson, and C. Watson. Fingerprint Imagequality.NISTIR7151,August2004.http://fingerprint.nist.gov/NFIS/ir_7151.pdf.
[6] The FBI's Next Generation Identification (NGI), http://www.fbi. gov/hq/cjisd/ngi.htm, 2011.
[7]DoD Biometrics Task Force, http://www.biometrics.dod.mil/, 2011.
[8] R. Singh, M. Vatsa, H.S. Bhatt, S. Bharadwaj, A. Noore, and S.S. Nooreyezdan, "Plastic Surgery: A New Dimension to Face Recognition," IEEE Trans. Information Forensics and Security, vol. 5, no. 3, pp. 441-448, Sept. 2010.
[9] R. Roizenblatt, P. Schor, F. Dante, J. Roizenblatt, and R. Belfort, "Iris Recognition as a Biometric Method After Cataract Surgery," Am. J. Ophthalmology, vol. 140, no. 5, pp. 969-969, 2005.
[10] J. Feng, A. K. Jain, and A. Ross. Detecting Altered Fingerprints. In *Proc. 20th International Conference on Pattern Recognition*, pages 1622–1625, August 2010.