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Fingerprint Image Enhancement Based on Various Techniques, Feature Extraction and Matching

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Abstract - *Exact involuntary individual recognition is critical in a diversity of applications in our electronically organized society. Biometrics, which mentions to recognition based on physical or behavioral characteristics, is being increasingly adopted to give positive recognition with a high degree of confidence. Among all biometric techniques, fingerprint-based authentication schemes have established most attention because of long history of fingerprints and their general apply in forensics. Fingerprints are a great source for recognition of individuals. Fingerprint recognition is one of the forms of biometric recognition. However obtaining a decent fingerprint image is not always easy. So, fingerprint image should be pre-processed by matching. The main objective of this work is to propose an image matching algorithm which is useful to every image for matching. For professional enhancement and feature extraction procedures, the segmented structures should be invalid of every noise. A pre-processing method containing of field course, ridge frequency estimated, filtering, partition and enhancement is performed. The attained image is useful to a thinning algorithm and following minutiae removal. The association of image pre-processing and minutiae extraction is deliberated. The simulations are performed in the MATLAB atmosphere to estimate the performance of the implemented algorithms. MATLAB provides a valuable atmosphere for these progresses. Outcome and interpretation of the fingerprint images*

Keywords*: *Fingerprinting, pattern recognition, feature extraction, image enhancement, fingerprints minutia.

1. INTRODUCTION

Today there is approximately no area of technical attempt that is not impacted in some way by digital image processing. The regions of function of digital image processing are so varied that some form of organization is attractive in attempting to imprison the breadth of this field. One of simplest ways to expand a basic understanding of the extent of image processing applications is to classify images according to their source (e.g., visual, X-ray, and so on) [1]. The main energy source for images in use nowadays is the electromagnetic energy spectrum. Other important sources of energy include ultrasonic, acoustic, and electronic. Image noise is usually regarded as an unwanted by-product of image capture because it causes distortions here in the image that can difficult to understand the subject of the photograph. Although these unnecessary fluctuations become known as "noise" by similarity with unnecessary sound. They are impossible to hear and can really be beneficial in several requests, such as dithering [2].The paper is organized as follows. In section 1, it provides introduction about figure prints.

In Section 2, it describes the design and implementation algorithms used in fingerprinting image processing technique and the results. Finally, conclusion is explained in Section 3

1.1 Biometrics

Biometrics devices that refer to identify an character based on his or her behavioral or physiological uniqueness, these devices have the capabilities to reliably distinguish between an authorized person and a fraud. Since biometric characteristics are unique for everyone and cannot be forgotten, and the specific person is to be authenticated and needs to be physically present at the point of identification, biometrics is essentially more capable and more reliable than conventional token-based and knowledge-based techniques. Biometrics also has a number of disadvantages. For instance if an ID card or a password is compromised, it can be simply replaced. Though, just the once a biometrics is compromised, it is not probable to change it. In the same way, users can have a singular password for every account, so the password for one account is compromised; the other accounts are still safe. However, if a biometrics is compromised, all biometrics-based accounts can be broken-in. Among all biometrics (e.g., face, finger-print, hand geometry, signature, iris, voice print, retina, facial thermo-gram, hand vein, gait, ear, odor, keystroke dynamics, etc.), finger-print-based recognition is one of the most mature and verified technique. [3].

1.2 Fingerprinting Processing

Prints of fingers are the natural patterns present on the epidermis of the tip of the finger. The finger prints are of three types such as:(1) WHORL (2) ARCH (3) LOOP. The finger-prints are made of valleys and long narrow lines. The interleaved pattern of ridges and valleys are the mainly evident structural characteristic of finger-prints. The prints of fingers of every single or individual is measured to be unique. No two persons have the same set of prints of fingers. In-fact, Finger ridge patterns do not change throughout the life of an individual. This property makes prints of fingers an excellent biometric identifier. So it is one of the most popular and effective means for identification of an individual and used as forensic evidence. Skin on human tip of the fingers contains valleys and long narrow lines which together forms unique identifiable patterns. These patterns are completely developed during pregnancy and are permanent and remain throughout the lifetime. Prints of those patterns are called prints of fingers. Injuries like cuts, only time consuming but training of expert's and education takes a long time [4].

1.3 Fingerprint Individuality

Until lately, the proof of latent finger-prints examiners was admitted in courts without much inspection and face. However in the 1993, the Supreme Court ruled that the dependability of an expert scientific proof must be established. Additionally, the court stated that when assessing dependability the subsequent five factors must be

measured: (i) whether the exacting technique or methodology in question has been subject to a arithmetical estimation (hypothesis testing), (ii) whether the standards calculating the technique's operations exist and have been maintained, (iii) whether its error rate has been established, (iv) whether it has been peer reviewed, and available (v) whether it has a broad extensive receiving. The two fundamental premises on which finger-prints identification is based are: (i) print of fingers of an individual are unique. (ii) finger-prints details are permanent, and the strength of the first basis has been recognized by empirical observations based on the anatomy as well as and morphogenesis of roughness ridge skin. It is the second basis which is being challenged in latest court case [5].

1.3 Fingerprint Sensors

The finger-prints images can be gathered either by an online or offline process. The finger-prints images gathered by the offline procedure are identified as the "inked" the online process are known as "live-scan" Inked fingerprint are of three types:(1) latent (2) rolled(3) Dab. In the rolled method of finger-prints acquisition, ink is applied to the finger tip and then rolled on a paper from one side of the nail to the other to form a feeling. This paper is then scanned at 600 dpi resolution by a standard scanner. Latent prints of fingers are formed when the fingers put down a skinny layer of grease and sweat on the surfaces that they touch due to the presence of sweat pores in our tip of the finger. The rolled prints of fingers have a larger ridge and groove area due to the rolling procedure except have better deformations due to the normal nature of the rolling process. In the dab method of finger-prints acquisition, ink is applied to the finger tip and then pressed onto a paper without systematic. The paper is after that scanned into a digital image. Typically, dab inked prints of fingers have fewer nonlinear deformation other than smaller area the rolled inked prints of fingers. Forensic scientists dye this impression which is in general found at the scene of a crime with color and then scan the fingerprints. A live-scan finger print is obtained openly from the finger with no the transitional use of paper (at a resolution of 600dpi). Normally, live-scan sensors acquire a series of dab prints of fingers when a finger is pushed on the sensor face. on behalf of rolled live-scan prints of fingers , the user rolls her/his finger from one last part of the nail to the additional on the sensor face and the sensor acquires a number of dab finger-prints images. The rolled fingerprints image is then constructed by mosaic king the multiple dab images acquire during the rolling process [7].

1.5 Fingerprint illustration

The global representation schemes of the finger-prints used for classification can be broadly categorized into four main categories: (i) structure-based (ii) frequency-based (iii) knowledge-based (iv) Hybrid-based. Structure-based approach uses the predictable direction field in a finger-prints image.

Frequency-based approaches use the frequency spectrum of the prints of fingers for representation. The knowledge-based finger-prints representation technique uses the locations of particular points (delta and core) to categorize fingerprints into five major classes (whorl, arch, right loop, left loop, and tented arch). A knowledge-based approach tries to acquire the knowledge of a person authority by deriving rules for every group by h-constructing the models and therefore, does not require training. Hybrid approaches combine two or more approaches for illustration. [7]

1.6 Fingerprint Classification

Huge volumes of prints of fingers are collected and then stored every day in a large range of applications, including driver license registration, access control and forensics. Automatic identity identification based on prints of fingers requires that the input fingerprints be matched with a huge number of prints of fingers stored in a record (the FBI record currently contains more than 630 million prints of fingers). To decrease the search time and computational difficulty, it is desirable to classify these prints of fingers in consistent manner and accurate such that the input finger-prints need to be matched only with a subset of the prints of fingers in the record. Classification is a technique used to assign a finger-print into one of the some pre-specified types previously recognized in the journalism (and used in forensic applications) which can give an indexing mechanism. Finger-prints categorization can be viewed as a coarse stage matching of the prints of fingers. An input fingerprint is first matched to one of the pre-specified types among after that it is compared to a separation of the proof equivalent to that fingerprints type [9].

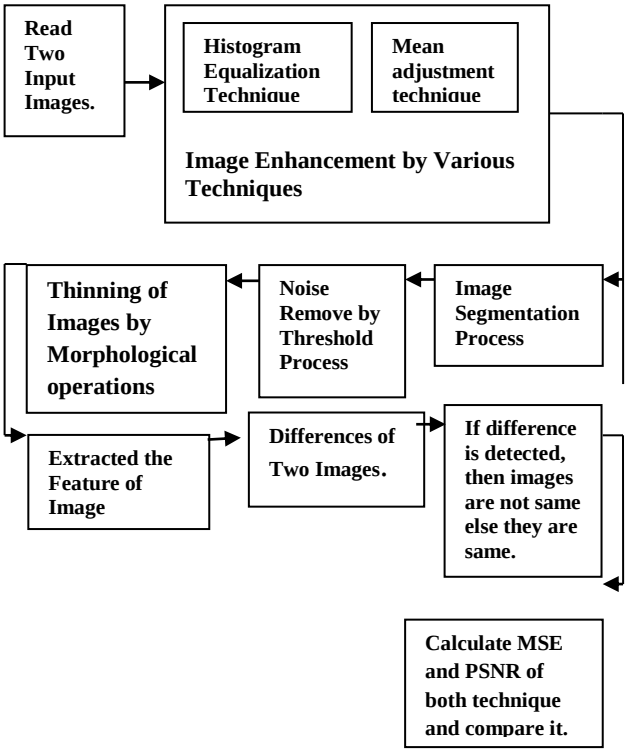
1.7 Fingerprint Verification

A biometric system which is used can be operated in two modes: 1) identification mode. 2) Verification mode. In the verification mode, a biometric system either rejects or accepts a user's claimed uniqueness while a biometric system working in the identification mode establishes the uniqueness of the user without a claimed uniqueness. Finger-prints identification is a more complex problem than finger-prints verification since a huge number of comparisons require to be performed in identification. A number of national applications work in verification mode on a normal basis and execute identification only at the time of the user register to check the reliability of the record (e.g., finding duplicates). For example, in an ATM application, after a user has been registered and issued an ATM card, the gathered finger-prints need to be matched only with a single pattern finger-prints stored on the ATM card on every transaction. A classic verification system can be divided into two modules: (i) verification (ii) enrollment. The verification element is invoked during the process phase. The enrollment element scans the finger-prints of a individual during a sensing machine and then stores a representation (called pattern) of the fingerprints in the record [10]

1.8 Information Fusion

An amount of finger-prints verification systems have been experienced on large databases but most of them are not able to meet the rigid performance necessities in high security applications. Each finger-prints verification configuration uses dissimilar feature extraction and /or matching algorithms to produce a matching score which is used for verification. A grouping system which harnesses different information sources is possible to improve the overall system performance. The outputs of different classifiers can be combined to achieve a decision which is more exact than the decisions made by any one of the person [11].

Matching



2.2 Proposed Algorithm of Fingerprinting Matching Based on Various Techniques Result

2.2.1 Pre-processing

Fingerprint images with low down contrast, noisy composite surroundings, and artificial traces ridges cannot be segmented properly. The fingerprint image

2. DESIGN AND IMPLEMENTATION AND RESULT

In latest years, there have been important advancements in algorithms for the image processin

A. Proposed Algorithm of Fingerprint should be pre-processed before matching. Pre processing is the procedure of modify a gray scale image to a white and black image. In MATLAB, a value of zero represents that the pixel is black and one represents that the pixel is white. One is of casualty and one for evaluation. The figure 1 and 2 show the original 1st and 2nd image correspondingly therefore, it is required to enhance the image.

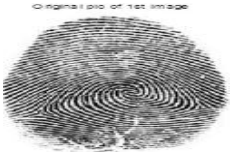


Figure1: Original Input First Fingerprint Image

Figure2: Original Input Second Fingerprint Image

2.2.2 Enhancement

Enhancement algorithm is used whose aim is to enhance the image feature by removing the noise present in the reduced quality images without blurring the well details of the images. Figure 3rd and 4th shows the enhancement of image by histogram equalization technique and by mean adjustment

technique. Histogram equalization is used to enhance the image by sinking the intensity of the image. Enhancement of images is done by pixel approach. Using pixels, it can influence the intensity of images. Enhancement is calculated with help of PSNR and mean square error parameter.

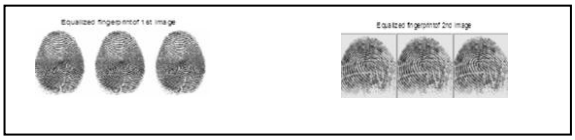


Figure: 3 Image enhancements by histogram equalization technique

Figure: 4 Image enhancements by mean adjustment technique

2.2.3 Segmentation

Segmentation involves partitioning an image into groups of pixels which are all the same with respect to various criterions. Special groups should not cross each other and neighboring groups must be varied. Segmentation is mainly partition of G, B, R and colors as of the images. Initially, it requirements simply gray scale images. So GBR is transformed to gray scale image and then separate these bands. Segmented output is shown in figure 5 and 6.

Figure5: segmented fingerprint by histogram Equalization technique

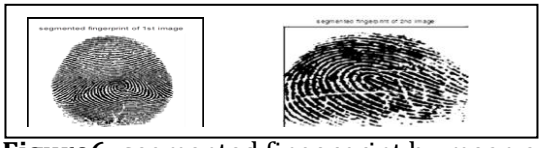


Figure6: segmented fingerprint by mean adjustment technique

2.2.4 Thinning of image

The aim of thinning is to reduce the fingerprint to lines one pixel wide. Thinning is a morphological procedure performed on binary images. This is achieved with following iterations of pixels from different sides of each image (north, south, east, and west). Results are shown in figure 7 and 8.

Figure7: Fingerprint Thinning Image by histogram equalization technique

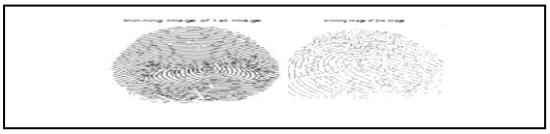


Figure8: Fingerprint Thinning Image by mean Adjustment technique

2.2.5 Feature Extraction of Images

Behind thinning process, features of images are necessary to be extracted. Thus area props are used for feature extraction Process. And whole features inside original thinned image are established. Hereafter, both images are useful to fingerprinting matching structure which matches images pixel with pixel. For this, it calculates the dissimilarity of the images. If both are matched, then dissimilarity image shows no error. But if both are dissimilar, then it

shows error image as shown in figure 9 and 10 and 11 and 12.

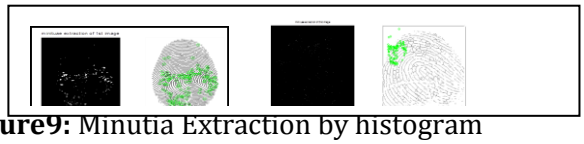


Figure9: Minutia Extraction by histogram Equalization technique

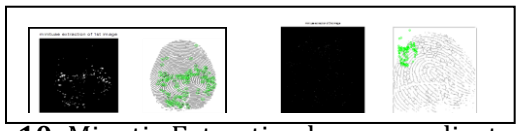


Figure10: Minutia Extraction by mean adjustment technique

Figure11: Difference of both images by histogram equalization technique

Figure12: Difference of both images by mean adjustment technique

Table1: Proposed Parameters Comparison by histogram equalization technique

Parameters	Image1	Image2
MSE	0.0179	0.333
PSNR	65.629	52.936

Table2: Proposed Parameters Comparison by mean adjustment technique

Parameters	Image1	Image2
MSE	219	189
PSNR	19.957	18.836

Table3: Comparison between histogram equalization technique parameter and mean adjustment technique parameter

Mean Square Error Comparison (MSE)		
Images	MSE of Histogram Equalization Technique	MSE of Mean Adjustment Technique
Image1	0.0179	219
Image 2	0.333	189
Peak signal to noise ratio comparison (PSNR)		
Images	PSNR of Histogram Equalization Technique	PSNR of Mean Adjustment Technique
Image1	65.629	19.957
Image 2	52.936	18.836

III.CONCLUSION

The aim of this paper is to propose a system of image matching. It is used in the purpose of fingerprint matching system. It is used to learn the security collision of incomplete fingerprints on repeated fingerprint recognition systems and to increase an automatic system that can overcome the challenges offered by partial fingerprint matching. The proposed algorithm is implemented in MATLAB. The dependability of any natural fingerprint system powerfully relies on correctness obtained in the minutia extraction procedure. A number of factors are destructive to the correct location of minutia. Among them, poor image feature is the most serious

one. In this work, we have shared many methods to enhancement of image by various techniques. The proposed system shows that it has more value of PSNR, in case of histogram technique and less value of PSNR in case of mean adjustment technique. It also shows that it provides low computation time in mean adjustment technique compared to histogram equalization technique. The results provide by mean adjustment technique good image matching software which is used to match any format of images or any size but histogram equalization technique used to match 225 size or 0&1 size.

Reference

[1]Anil Jain, Fundamentals of Digital Image Processing**,** Prentice Hall, 1st ed., 1989.

[2] B. Chanda, D.D. Majumder, Digital Image Processing and Analysis, Prentice-Hall,2006

[3]. M. Sonka, V. Hlavac, R. Boyle: Image Processing, Analysis, Second Edition, Brooks/Cole Publishing, USA, 1999

[4]. Wayman, J., Jain, A., Maltoni, D., Maio, D.: Biometric Systems. Springer (2005)

[5] Y. Hoshino, N. Yamashita, and S. Hiratsuka, "Fingerprint identification system," in 2nd. USA–Japan Computer Conf., 1975,

[6] S. Pankanti, S. Prabhakar, and A. K. Jain, "On the Individuality of Fingerprints," IEEE Trans. PAMI,

[7]D. Maltoni, D. Maio, A. K. Jain and S. Prabhakar, "Hand-book of Fingerprint Recognition," Springer, Berlin, 2003

[8] R. M. Stock and S. W. Swonger, "Development and evaluation of a reader of fingerprint maching," Cornell Aeronautical Laboratory, Ithaca, NY, Tech. Rep. CAL XM-2478-X-1:13-17, 1969

[9] L. Hong and A. K. Jain, "Classification of fingerprint images" in Proc. 11th Scandinavian Conf. Image Analysis, Kangerlussaq, Greenland, June 1990

[10] A. Jain, L. Hong, and R. Bolle, "On-line fingerprint verification," IEEE Trans. Pattern Anal. Machine Intell., vol. 19, Apr. 1997.

[11] A. Ross and A.K. Jain, "Information fusion in biometrics,"Pattern Recognition Letters, IEEE Trans. PAMI