Improved Neuro-Fuzzy Approach for Finger Print Recognition

Reena Mittal[1], Deepika Arora[2]

[1]M.Tech Scholar, Department of Computer Science & Engineering, R.P. Inderaprastha Institute of Technology, Karnal

[2]Assistant Profrssor, Department of Computer Science & Engineering, R.P. Inderaprastha Institute of Technology, Karnal

Abstract: *Bio-metric schemes work on interactive bio-metric facts to discover any given person. The most not unusual used biometric parameters are signature, fingerprints, Face, keystroke and iris these biometrics vary with environment and age. Fingerprint authentication states the car-mated way of identifying a counterpart among humans the usage of their fingerprints. However, their individuality and uniformity over they have been used for terribly long time, as extra these days fingerprints have grow to be automatic because of enhancements in computing. Fingerprint alteration is the method to the considerate obfuscation of the fingerprints via all and sundry for protecting his/her identity. Fingerprint category refers back to the problem of assigning fingerprints to one of numerous pre-particular training. automated class can be used as a pre-processing step for fingerprint matching, reducing matching time and complexity by means of narrowing the quest area to a subset of a usually large database. computerized fingerprint identity is one of the maximum important biometric technologies. as a way to efficiently suit fingerprints in a huge database, an indexing scheme is vital. Fingerprint category, which refers to assigning a fingerprint picture into a number of pre-specific instructions, gives a viable indexing mechanism. In practice, however large intra-elegance and small interclass variations in worldwide sample configuration and poor pleasant of fingerprint photos make the classification trouble very tough. A fingerprint classification algorithm requires a robust feature extractor which need to be able to dependable extract salient functions from input imagesIndex Terms—Finger Print Recognition, Automated fingerprint recognition systems (AFRSs), Pattern recognition.*

1. Introduction

Biometrics, which alludes to making sense of an individual in light of his or her physiological or behavioral attributes, has the usefulness to dependably recognize among an authorized character and a fraud. when you consider that biometric traits are specific, can't be forgotten or misplaced, and the person to be authenticated wishes to be physically present at the point of identity, biometrics is inherently more dependable and more successful than traditional expertise-primarily based and -token-based techniques. Biometrics also has a number of dangers. as an example, if a password or an id card is compromised, it is able to be easily changed. but, once a biometrics is compromised, it is not viable to update it. similarly, customers will have a different password for every account, as a consequence if the password for one account is compromised, the other debts are still secure. But, if a biometrics is compromised, all biometrics-primarily based money owed can be broken-in. among all biometrics (e.g., face, fingerprint, hand geometry, iris, retina, signature, voice print, facial thermo gram, hand vein, gait, ear, odor, keystroke dynamics, and so on.), fingerprint-based totally identification is one of the most mature and tested technique.

Figure 1: Fingerprint Feature selection and extraction.

Fingerprints are the ridge and furrow outlines on the tip of the finger and have been utilized extensively for confidential identification of people. Figure 1 displays an example of a fingerprint. The biological properties of fingerprint formation are well understood and fingerprints have been utilized for identification intentions for centuries. As the commencing of the 20th century, fingerprints have been extensively utilized for identification of convicts by the assorted forensic departments concerning the world. Due to its convict connotations, a little people sense uncomfortable in bestowing their fingerprints for identification in civilian applications. Though, as fingerprint-based biometric arrangements proposal affirmative identification alongside a extremely elevated degree of assurance, and compact solid state fingerprint sensors can be embedded in assorted arrangements (e.g., cellular phones), fingerprint-based authentication is becoming extra and extra accepted in a number of civilian and business requests such as, welfare disbursement, cellular phone admission, and laptop computer log-in.

The potential of inexpensive and compact solid state scanners as well as robust fingerprint matchers are two vital factors in the popularity of fingerprint-based identification systems. Fingerprints additionally have a number of disadvantages as contrasted to supplementary biometrics. For example, concerning 4% of the populace does not have good quality fingerprints, manual operatives become usual scratches on their fingers that poses a difficulty to the matching arrangement, finger skin peels off due to meteorological conditions, fingers develop usual perpetual creases, provisional creases are industrialized after the labor are immersed in water for a long period, and grimy fingers cannot be properly imaged alongside the continuing fingerprint sensors. Further, as fingerprints cannot be seized lacking the user's vision, they are not suited for precise requests such as surveillance.

2. Fingerprint Matching

Fingerprint matching methods [1] can be mainly categorized as minutiae established and correlation based. Minutiae based method early locates the minutiae points in a given fingerprint picture and matches their comparative placements in a stored template fingerprint. A good quality fingerprint encompasses amid 60 and 80 minutiae, but disparate fingerprints have disparate number of minutiae. The presentation of minutiae-based methods rely on the precise detection of minutiae points and the use of urbane matching methods to difference two minutiae fields that experience non-rigid transformations. Correlation based methods [2] difference the globe outline of ridges and valleys to discern if the ridges in the two fingerprints align. The globe way to fingerprint representation is normally utilized for indexing and does not proposal reliable fingerprint discrimination. The ridge construction in a fingerprint can be believed as an oriented sense outlines possessing a dominant spatial frequency and orientation in a innate neighborhood. The frequency is due to inter ridge-spacing present in a fingerprint and the orientation is due to the flow outline exhibited by ridges. Most textured pictures encompass a slim scope of spatial frequencies. For a normal fingerprint pictures scanned at 500 dpi, there is a slight variation in the spatial frequencies amid disparate fingerprints. This implies that there is an optimal scale (spatial frequency) for analyzing the fingerprint texture. By seizing the frequency and orientation of ridges in innate spans in the fingerprint, a different representation of the fingerprint is possible. The counseled scheme early detects the core point in a fingerprint picture employing two disparate techniques. Core point is described as the north most point of inner-most ridge line. In habits, the core point corresponds to center of north most loop kind singularity. A little fingerprint do not encompass loop or whorl singularities, consequently it is tough to delineate core. In that kind of pictures, core is normally associated alongside the maximum ridge line curvature. Noticing a core point is not a trivial task; consequently two disparate methods have been utilized to notice optimal core point location. A circular span concerning the core point is placed and tessellated into 128 sectors.

Figure 2: Optional core point location

The pixel intensities in every single sector are normalized to a steady mean and variance. The circular span is filtered employing a bank of sixteen Gabor filters [3][4] to produce a set of sixteen filtered images. Gabor filter-banks are a well

recognized method to arrest functional data in specific group bypass channels. Two such methods have been debated in and. The average definite deviation alongside in a sector quantifies the underlying ridge construction and is utilized as a feature. The feature vector (2048 benefits in length) is the collection of all the features, computed from all the 128 sectors, in every single filtered image. The feature vector arrests the innate data and the arranged enumeration of the tessellation arrests the invariant globe connections amid the innate patterns. The matching period computes the Euclidean distance amid the two corresponding feature vectors. It is desirable to attain representations for fingerprints that are translation and rotation invariant. In the counseled scheme, translation is seized care of by a reference point that is core point across the feature extraction period and the picture rotation is grasped by a cyclic rotation of the feature benefits in the feature vector. The features are cyclically rotated to produce feature vectors corresponding to disparate orientations to present the matching.

3. Literature Survey

Daxin Tian et al., 2014 [1] In this research paper they propose a bio-inspired model for making handover decision in heterogeneous wireless networks. It is based on an extended attractor selection model, which is biologically inspired by the self-adaptability and robustness of cellular response to the changes in dynamic environments. The goal of the proposed model is to guarantee multiple terminals' satisfaction by meeting the QoS requirements of those terminals' applications, and this model also attempts to ensure the fairness of network resources allocation, in the meanwhile, to enable the QoS-oriented handover decision adaptive to dynamic wireless environments. Some numerical simulations are preformed to validate their proposed bio-inspired model in terms of adaptive attractor selection in different noisy environments. And the results of some other simulations prove that the proposed handover scheme can adapt terminals' network selection to the varying wireless environment and benefits the QoS of multiple terminal applications simultaneously and automatically. Furthermore, the comparative analysis also shows that the bio-inspired model outperforms the utility function based handover decision scheme in terms of ensuring a better QoS satisfaction and a better fairness of network resources allocation in dynamic heterogeneous wireless networks.

Marasco, Emanuela g Wu et al., 2014 [2] In this research paper Several issues related to the vulnerability of fingerprint recognition systems to attacks have been high-lighted in the biometrics literature. One such vulnerability involves the use of artificial fingers, where mate- rials such as play-doh, silicone, and gelatin are inscribed with fingerprint ridges. Researchers have demonstrated that some commercial fingerprint recognition systems can be deceived when these artificial fingers are placed on the sensor, i.e., the system successfully processes the ensuing fingerprint images thereby al- lowing an adversary to spoof the fingerprints of another individual. However, at the same time, several countermeasures that discriminate between live fingerprints and spoof artifacts have been proposed. While some of these anti-spoofing schemes are hardware-based, several software-based approaches have been proposed as

well. In this paper, they review the literature and present the state-of-the-art in fingerprint anti-spoofing.

Jain, Anil K., et al. (2016) [3] For Their study, they collected fingerprints of 309 children (0-5 years old) Their different times over a one year period. We show, for the first time, that fingerprints acquired from a child as young as 6 hours old exhibit distinguishing features necessary for recognition, and that state-of-the-art fingerprint technology achieves high recognition accuracy (98.9% true accept rate at 0.1% false accept rate) for children older than 6 months. Additionally, they use mixed-effects statistical models to study the persistence of child fingerprint recognition accuracy and show that the recognition accuracy is not significantly affected over the one year time lapse in Their data. Given rapidly growing requirements to recognize children for vaccination tracking, delivery of supplementary food, and national identification documents, Their study demonstrates that fingerprint recognition of young children (6 months and older) is a viable solution based on available capture and recognition technology.

Myers, L. J. et al. (2016) [4] In this paper, this dissertation investigates a cost effective fingerprint recognitions system for use with the combination of low quality images and damaged fingertips. A suitable database containing the full spectrum of damaged fingers and low quality prints was established. Due to the nature of such images, an effective enhancement algorithm, which included binarisation and thinning, was designed. Their different types of features were investigated for recognition purposes. These were a minutia overlay, Fourier wedge-ring detector, SVD invariants and moment invariants. Ten different types of classifiers were examined to determine an optimum combination of feature and classifier. Correlation and wavelet matching techniques were considered for verification scenarios. 100 % Recognition was achieved with a number of the techniques presented and the actual selection of a feature/classifier combination would be dependent on the requirements of specific applications.

Belguechi, Rima, et al. (2016) [5] In this paper, in order to ensure privacy constraints in biometrics, new algorithms called template protection schemes have been proposed in the last 10 years in the literature. Most of these algorithms require as input a feature having a fixed size. Texture features can be used within this context for fingerprints as the number of minutiae varies in general for different captures. BioHashing is a two authentication factor algorithm that can be used to ensure privacy while using biometrics. In this work, they compare different recent texture features from the literature within the BioHashing scheme while considering many constraints: efficiency, maximal representation size, and constant size description. Experiments are conducted on three fingerprint databases from the FVC competition. Results permit them to conclude on the texture features to be used within this context.

Di Martino et al. (2016) [6] In this paper, they focus in the reliability estimation of biometric systems output. We explain why this is a very important problem when deploying a biometric system and face it using a statistical approach. In particular, they present a solution based in the acontrario approach widely used in the image processing field. We show how this strategy could be adapted and its key advantages with respect to other state-of-the-art reliability measures. A comprehensive set of experiments is used to validate the approach, using different fingerprints databases, matching systems, and comparing the performance with other state-of-the-art confidence measure strategies.

Wang, Kejun, et al. (2016) [7] In this paper, touchless fingerprint recognition with high acceptance, high security, hygiene advantages, is currently a hot research field of biometrics, but because of the different image principle of the non-contact fingerprint image and contact fingerprint image, the difference of the two fingerprint image is large. There are still a small number of fuzzy regions in the non-contact fingerprint image after pretreatment, and the traditional method of extracting the future from the detail points can lead to a serious decline in recognition accuracy because of false points. In this paper, the non-contact pretreatment in Their laboratory is used according to the characteristics of the contactless fingerprint image, the LBP operator, LGC operator and their improve algorithms are used for image processing; the nearest neighbor classifier is used for feature matching. The experimental result shows that the contactless fingerprint feature extraction method proposed in this paper can obtain higher division fingerprint feature.

Chan, Kevin et al. (2016) [8] In this paper, there has been an increase in biometric application and advancement, and researchers continuously move to improve the technology. Fingerprint recognition is one of the biometric modalities that has experienced this growth, with its increasing presence in Homeland Security and law enforcement. This study investigated the subject performance movement within a fingerprint recognition system. The performance of a biometric system can be tied to the population using it. Analysis of the population brings context and granularity to performance results. This study analyzed fingerprint data collected by the International Center for Biometric Research (ICBR) back in 2010. DET curves and Zoo plots were gathered and segregated by finger and force. Performance data and error rates of different force level were compared to find the optimum and most meager conditions for each finger.

Mohammed, Areej Abdallah Ebrahim, et al. (2016) [9] In this paper, objective of voting to allow voter to cast his/her votes fairly, efficiently and accurately. This project deals with the design and implementing of an electronic voting system using fingerprint recognition. The aim is to provide security, accuracy and to avoid illegal voting. The proposed system allows voter to scan his fingerprint, then compares it with the pre-saved fingerprints in the database. After the verification is done, voter is allowed to cast his/her vote through a keypad, and the system communicates with the voter through LCD. The casted vote is updated immediately making the system fast and unable to fraud the results which will be viewed on the LCD at the end of voting process

Zhang, Qing, et al. (2016) [10] In this paper, minutiae based matching methods are the most intensively

investigated matching methods in fingerprint recognition. However, the discriminative information contained in the extracted minutiae cannot be effectively used in recent related techniques. This paper proposes to analyze and use the discriminative information contained in the unsuccessfully matched minutiae in order to improve the recognition accuracy of the automatic fingerprint recognition systems. Specifically, they extract seven features from the unmatched minutiae, and for each of them, they calculate an auxiliary matching score. The combination of Their seven auxiliary matching scores with the matching score of the successfully matched minutiae enables Their matching method to get boosted recognition accuracy. The discrimination ability of the unmatched minutiae and the effectiveness of the proposed method are validated by the experimental results obtained using the FVC2000, FVC2002 and FVC2004 databases for international fingerprint verification competition. In the experiments, the fingerprint recognition accuracy is significantly promoted by the proposed method.

Peksinski, Jakub, et al. (2017) [11] In this paper, the authors presented the possibilities of using the Universal Image Quality Index (Q)—a popular measure for evaluation of digital image quality in order to identify users based on analysing their fingerprints with the use of a reference image. The applied quality measure is used both for analysing of fingerprints as well as in the process of synchronisation preceding the analysis.

Kundu, Sumana et al. (2017) [12] In this paper, a super-classifier with programming based boosting has been designed and established for fingerprint recognition. This multiple classifier set is comprised of three different classifiers. The first classifier is an OCA based modified RBFN with BP learning, second classifier is a combination of Malsburg learning and BP Network and third classifier is a SOM based modified RBFN with BP learning. These three individual classifiers perform fingerprint identification separately and these are fused together in a super-classifier which integrates the different conclusions using programming based boosting to perform the final decision regarding recognition. The learning of the system is efficient and effective. Also the performance measurement of the system in terms of accuracy, TPR, FPR and FNR of the classifier are substantially high and the recognition time of fingerprints are quite affordable.

Drahanský, Martin et al. (2017) [13] In this paper, It tries to find answers to the questions whether the fingerprint recognition is really so reliable and secure. The most biometric systems based on fingerprint recognition have very low error rates, but are these error rates really telling them everything about the quality of such a biometric system? What happens when they use spoofs to deceive the biometric system? What happens when the genuine user has any kind of skin disease on his fingertips? And could they acquire a fingerprint with acceptable quality if there are some distortions on a finger or there are some environmental effects influencing the scanning technology? Reading this chapter brings you an introduction of preparation of finger fakes (spoofs), spoof detection methods, summarization of

skin diseases and their influence on papillary lines, and finally the environmental effects are discussed at the end.
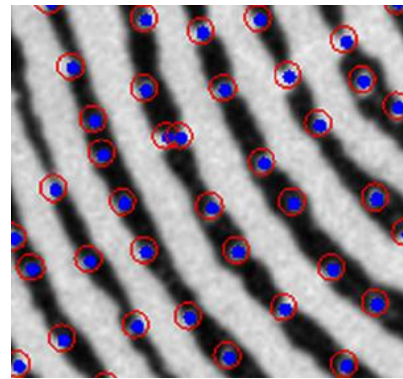
4. Proposed Work

Figure 3: Pore Extraction.

extraordinary values wherein zero denotes isolated factors, 1 denotes ridge ending factors, 2 denotes persevering with ridge factors, three denotes bifurcation points, and four denotes crossing points.
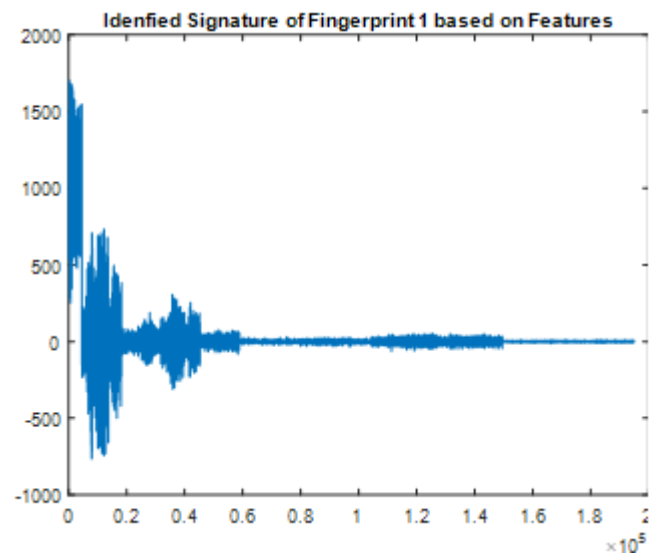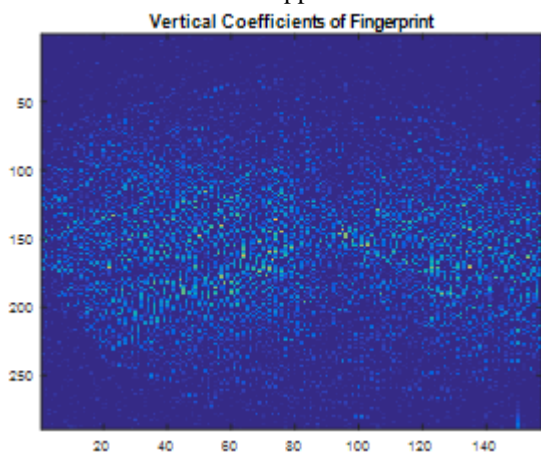

Figure 4: Identified Signature of Person 1.

Figure 5: Identified Signature of Person 2.

totally neuro-Fuzzy algorithm will increase the recognition charge and it reduces the processing time.

Figure 6: Identified Signature of Person 1 and Person 2 Overlapped.

Figure 7: Vertical coefficient of Fingerprint.

Table 1: Accuracy Table for different methods

FVC 2002 Database	Base paper Qiongxiu Li	Proposed Work
40 images (10 person)	82.93%	97.12%

5. Conclusion

The massive deployment of automated Fingerprint identification systems (AFIS) in regulation enforcement and border manipulate packages has heightened the want for ensuring that these structures aren't compromised. at the same time as several problems related to fingerprint system safety have been investigated, along with the usage of fake fingerprints for masquerading identification, the problem of fingerprint alteration or obfuscation has acquired very little attention. Fingerprint obfuscation refers back to the deliberate alteration of the fingerprint pattern through an individual for the purpose of masking his identification. numerous features for fingerprint photograph processing were presented and exploited in proposed system. The enhancement is implemented steadily, i.e., block smart operations are averted, in the spatial area. It does certainly now not be afflicted by blocking off artifacts. For trivialities extraction Fuzzy Rule based totally method is used. because the proposed paintings deletes the false trivia the use of fuzzy policies it is reliable. For submit-processing Neural network algorithm is used. earlier than schooling the network with the extracted capabilities the premiere weights are calculated. The simulation outcomes show that the proposed fuzzy based

References

[1] Daxin Tian, Jianshan Zhou, Honggang Qi, Yingrong Lu, Yunpeng Wang, Jian Wang, and Anping He. "A Bio-Inspired QoS-Oriented Handover Model in Heterogeneous Wireless Networks." Journal of Applied Mathematics 2014 (2014).

[2] Marasco, Emanuela, and Arun Ross. "A Survey on Antispoofing Schemes for Fingerprint Recognition Systems." ACM Computing Surveys (CSUR) 47, no. 2 (2014): 28.

[3] Jain, Anil K., Sunpreet S. Arora, Kai Cao, Lacey Best-Rowden, and Anjoo Bhatnagar. "Fingerprint Recognition of Young Children." IEEE Transactions on Information Forensics and Security (2016).

[4] Myers, L. J. "A cost effective fingerprint recognition system for use with low quality prints and damaged fingertips." (2016).

[5] Belguechi, Rima, Adel Hafiane, Estelle Cherrier, and Christophe Rosenberger. "Comparative study on texture features for fingerprint recognition: application to the BioHashing template protection scheme." Journal of Electronic Imaging 25, no. 1 (2016): 013033-013033.

[6] Di Martino, Luis, Alicia Fernandez, Rafael Grompone von Gioi, Federico Lecumberry, and Javier Preciozzi. "A statistical approach to reliability estimation for fingerprint recognition." In Biometrics Special Interest Group (BIOSIG), 2016 International Conference of the, pp. 1-8. IEEE, 2016.

[7] Wang, Kejun, Jinyi Jiang, Yi Cao, Xianglei Xing, and Rongyi Zhang. "Preprocessing Algorithm Research of Touchless Fingerprint Feature Extraction and Matching." In Chinese Conference on Pattern Recognition, pp. 436-450. Springer Singapore, 2016.

[8] Chan, Kevin, Andrew Radcliff, Jeffrey Chudik, Katrina Molina, Alex Hirsch, Brennon Morning, Evan Pulliam, and Stephen Elliott. "Subject Movement at Different Force Levels in a Fingerprint Recognition System." In Proceedings of the International Conference on Security and Management (SAM), p. 223. The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp), 2016.

[9] Mohammed, Areej Abdallah Ebrahim, Ekram Abdallah Abdalrahman Osman, and Zeinab Elnazeir Mohammed Abdelraheim. "Implementation of Electronic Voting System Using Fingerprint Recognition Technique." PhD diss., Sudan University of Science and Technology, 2016.

[10] Zhang, Qing, Yilong Yin, and Gongping Yang. "Unmatched minutiae: useful information to boost fingerprint recognition." Neurocomputing 171 (2016): 1401-1413.

[11] Peksinski, Jakub, Grzegorz Mikolajczak, and Janusz Kowalski. "The Use of the Universal Quality Index for User Recognition Based on Fingerprint Analysis." In Multimedia and Network Information Systems, pp. 75-87. Springer International Publishing, 2017.

[12] Kundu, Sumana, and Goutam Sarker. "A Programming Based Boosting in Super-Classifier for Fingerprint

Recognition." In Advances in Computational Intelligence: Proceedings of International Conference on Computational Intelligence 2015, pp. 319-329. Springer Singapore, 2017.

[13] Drahanský, Martin, Ondrej Kanich, and Eva Brezinová. "Challenges for Fingerprint Recognition—Spoofing, Skin Diseases, and Environmental Effects." In Handbook of Biometrics for Forensic Science, pp. 63-83. Springer International Publishing, 2017.