A Biometric Fusion of Hand and Finger Vein Approach for an Efficient Personal Authentication-Survey

[1]N S Priya, [2] A Lenin Fred

[1]Research Scholar, Manonmaniam Sundaranar University, Tirunelveli.

[2] Professor, Department of Computer Science and Engineering, Mar Ephraem College of Engineering.

1. Abstract: Authentication is one of the efficient protection mechanisms and it play a significant role in safeguard the persons. Different authentication techniques are available in the society. But biometric devices provide better authentication among all techniques. The survey presents the better authentication techniques available till now.

2. INTRODUCTION

In the present era of e-commerce more and more services are being offered over the electronic devices and internet. These include banking, credit card facility, e-shopping, etc. To ensure proper use of these facilities only by the authorized or genuine users and avoid any misuse by the unauthorized or imposter users, some person authentication scheme is embedded into these services [1]. Currently, person authentication is done mostly using one or more of the following means: text passwords, personal identification numbers, barcodes and identity cards. The merit of these schemes is that they do not change their value with respect to time and also unaffected by the environment in which they are used. The main demerit of them is that they can be easily misused or forgotten. Also, with time more and more services are being offered over the electronic devices and internet. Hence it becomes unmanageable to keep track of the authentication secrets for different services. The alternative that provides relief from all these demerits is the use of biometric features for person authentication [2].

Biometric is an automated authentication technique for identifying or verifying an individual based on one's physiological or behavioral characteristics [3] Currently, ten different biometric indicators are either widely used or are under intensive evaluation, including face, facial thermo gram, fingerprint, hand geometry, ear, hand vein, iris, retinal pattern, signature, and voice print. All these biometric indicators have their own advantages and disadvantages in terms of the accuracy, user acceptance, and applicability [4] .It is the requirements of an application domain which determine the choice of a specific biometric indicator. In order to enable a biometric system to operate effectively in different applications and environments, a multimodal biometric system [5] which makes a personal identification based on multiple physiological or behavioral characteristics is preferred. Multi-biometric techniques are capable of diminishing several of the constraints of uni-biometric methods, as the diverse biometric sources generally compensate for the inborn constraints of the supplementary sources [6]. The significant objective of multi-biometrics is to scale up the accuracy of detection over a specific technique by synthesizing the outcomes of several traits, sensors or algorithms. In multi-modal biometrics, selection of true modality is a demanding task in the identification of a person.

There are many kinds of combinations of biometric traits, the typical combination: face and iris [7, 8], face and fingerprint [9], voice and face and fingerprint [10], face and gait [11], finger vein and finger geometry [12], palm and palm vein [13]. Person authentication based on speech and face features, is one of the first multimodal biometric system [14]. Moreover, Multimodal system using face and fingerprint features are then proposed [15]. The use of clustering algorithms for the fusion of decisions from speech and face modalities are explored [16]. A practical multimodal system using face, voice and lip movement is then developed [17]. Further, many of the methods are used to authenticate the person based on the biometrics. General strategies for combining multiple classifiers have been suggested in [18] and [19]. The simple sum rule is sufficient to obtain a significant improvement in the matching performance of a multimodal biometric system [24]. They also suggest a technique to incorporate user-specific weights to further improve the system performance [20]. Fusion strategies at the decision level include majority voting [25], behavior knowledge space method [21], weighted voting based on the Dempster-Shafer theory of evidence [22], AND/OR rules [23], etc.

3. RELATED WORKS

Many of the researchers have explained the biometric based person authentication. Among them some of the research papers explained in this section; Puneet Gupta and Phalguni [26] have explained an efficient multi-modal authentication system which makes use of palm-dorsa vein pattern. There were four levels of fusion in the system and such as multi-algorithm fusion, data fusion, feature fusion and score fusion. Multi-algorithm fusion was applied to extract genuine vein patterns from a vein image by using various vein extraction algorithms. All false vein patterns were eliminated from the extracted patterns through data fusion. Three types of features were obtained from each extracted vein pattern and they were shape features, minutiae and features obtained from hand boundary shape. Third level of fusion was at feature level to fuse minutiae and shape features.

Moreover, Jialiang Peng *et al.* [27] have explained the finger multimodal biometric authentication that combines finger vein, fingerprint, finger shape and finger knuckle print features of a single human finger. The multimodal biometrics provides score-level fusion approach based on triangular norm with four finger biometric traits, instead of two or three ones combined in the previous approaches. The experimental evaluations and analysis were conducted on a merged multimodal biometrics database. The results show that the score-level fusion approach using triangular norm obtains a larger distance between genuine and imposter score distribution as well as achieves lower error rates. Moreover, the comparison results suggest that the score level fusion of finger biometrics using triangular norm outperforms the state-of-the-art approaches.

Similarly, Amioy Kumar *et al.* [28] have explained the Biometric authentication using finger nail plates. The very convenient and efficient method by acquiring low resolution images of nail plate surface which was the outermost part of the nail unit. The contour and texture characteristics of nail plates from three fingers were represented by the appearance and shape based feature descriptors. The paper presents two ways of integrating the nail-plate features from three fingers: (1) score level rules for fusion of matching scores and (2) the classifier based fusion of matching scores by employing decision tree and support vector machines. The experimental results from 180 users and a total of 2700 nail plate images validate the contributions from this paper.

In [29], Rohit M. Thanki and Komal have explained the multimodal biometric authentication system using digital watermarking and Compressive Sensing theory. In architecture, they were using compressive sensing theory for generation of measurement features of biometric template of individual and embed into another biometric template of same individual to generate multimodal biometric watermarked image. This watermarked version of biometric image was use for matching with enrolled biometric templates and if matching is not possible then extracts measurement biometric features from watermarked image and match with second enrolled data of individual. This paper also shows that how improved data storage capacity at system database and protection of multi biometric template over noisy communication channel.

Moreover, Daniela Sanchez and Patricia Melin [30] have explained the Optimization of modular granular neural networks (MNN) using hierarchical genetic algorithms for human recognition using the ear. This model was used in different areas of application, such as human recognition and time series prediction. Here, this method was tested for human recognition based on the ear biometric measure. A benchmark database of the ear biometric measure was used to illustrate the advantages of this model over existing approaches in the literature. Their method was consists in the optimization of the design parameters of a modular neural network, such as number of modules, percentage of data for the training phase, goal error, learning algorithm, number of hidden layers and their respective number of neurons. This method was also finds out the amount of and the specific data that was used for the training phase based on the complexity of the problem.

On the other hand Zengxi Huang *et al.* [31] have explained the robust face and ear based multimodal biometric system using Sparse Representation (SR), which integrates the face and ear at feature level, and it was effectively adjust the fusion rule based on reliability difference between the modalities. They first developed a Sparse Coding Error Ratio (SCER) to measure the reliability difference between face and ear query samples. Then, SCER was utilized to develop an adaptive feature weighting scheme for dynamically reducing the negative effect of the less reliable modality. In multimodal classification phase, SR-based classification techniques were employed, i.e., Sparse Representation based Classification (SRC) and Robust Sparse Coding (RSC). Finally, they derive a category of SR-based multimodal recognition methods, including Multimodal SRC with feature Weighting (MSRCW) and Multimodal RSC with feature Weighting (MRSCW).

4. MOTIVATION AND SOLUTION

The primary intention of my research is to design and develop an efficient multi-modal authentication system combining hand and finger veins. In biometrics, choosing of right modality is a challenging task for recognition of a person. Due to the advantage of widely accepted identification, signature and face-based biometric modality is selected as important modality as compared with other modalities. On the other hand, the aim of multi-biometrics is to improve quality of recognition over an individual method by combining the results of multiple features, sensors, or algorithms. A variety of approaches have been developed in recent years. In my paper, we have planned to do a multi-model approach combining hand and finger vein images. Overall, the proposed approach will be comprised into four steps: 1. Preprocessing, 2. Vein extraction, 3. Feature extraction and fusion, 4. Recognition phase. At first, the finger and hand images will be pre-processed to make it fit for further process. In the feature extraction step, the image processing techniques will be applied to extract the veins and the significant features like, position and texture will be extracted from the veins for multi-modal biometric recognition. The extracted features from both the images will be stored in the database.

In recognition phase, the test image (finger and hand vein) will be applied to extract vein feature vector. The extracted feature vector will be matched with the features in the database using feature weighted method. For experimental evaluation, the *CASIA vein image database* will be used to demonstrate that extracting vein features is possible to achieve better accuracy in multi-modal biometric recognition. The optimal weights are then used to person identification process when the test input is matched with the features stored in the database. The performance of the algorithm will be evaluated using FAR, FRR and accuracy.

5. CONCLUSION

This paper provides better idea about the authentication techniques such as hand and finger vein approach using biometric devices.

REFERENCES

[1] M.N.Eshwarappa and Mrityunjaya V. Latte, "Multimodal Biometric Person Authentication using Speech, Signature and Handwriting Features", International Journal of Advanced Computer Science and Applications, Special Issue on Artificial Intelligence, pp.77-86, 2011.

[2] A.K. Jain, A Ross and S. Prabhaker, "An introduction to biometric recognition", IEEE Transaction Circuits and Systems for Video Technology, vol. 14, no. 1, pp, 4-20, 2004.

[3] Michael P. Down and Richard J. Sands, "Biometrics: An Overview of the Technology, Challenges and Control Considerations", Information Systems Control Journal, Vol. 4, 2004.

[4] C. Nandini and C. N. RaviKumar, "Multimodal Biometric for Person Authentication by Fusion", TECHNIA International Journal of Computing Science and Communication Technologies, vol. 2, no. 1, 2009

[5] Anil Jain, Lin Hong and Yatin Kulkarni, "A multimodal Biometric system using Fingerprint, face and sppech", Proceedings of 2nd International Conference on Audio- and Video-based Biometric Person Authentication, pp. 182-187, 1999.

[6] Yadav, S. S., Gothwal, J. K., and Singh, R: Multimodal Biometric Authentication System: Challenges and Solutions, Global Journal of Computer Science and Technology, Vol. 11, No. 16, 2011, pp. 57-61

[7] Zhifang Wang, Qi Han, Xiamu Niu and Christoph Busch, "Feature-Level Fusion of Iris and Face for Personal Identification", In Proceedings of the 6th International Symposium on Neural Networks (ISNN 2009): Advances in Neural Networks - Part III, pp. 356–364, 2009.

[8] Gan Junying, Gao Jianhu and Liu Junfeng, "Research on Face and Iris Feature Recognition Based on 2DDCT and Kernel Fisher Discriminate Analysis", In International Conference on Wavelet Analysis and Pattern Recognition, 2008.

[9] G. L. Marcialis and F. Roli, "Serial Fusion of Fingerprint and Face Matchers", In Lecture Notes in Computer Science, pp. 151-160, 2007.

[10] A.K. Jain, L. Hong and Y. Kulkarni, "A Multimodal Biometric System Using Fingerprint, Face, Speech", In Second International Conference on AVBPA, pp. 182–187, 1999.

[11] X. Zhou and B. Bhanu, "Integrating face and gait for human recognition at a distance in video", In IEEE Transaction Systems Man Cybernet, Part B: Cybernet, 2007.

[12] B.J. Kang, R. Park, "Multimodal biometric authentication based on the fusion of finger vein and finger geometry", journal of optical engineering, vol.48, no.9, 2009

[13] D Zhang, ZH Guo, GM Lu, L Zhang, YH Liu and WM Zuo "Online joint palm print and palm vein verification" In Expert System Application, vol. 38, no.3, pp.2621–2631, 2011.

[14] R. Bruneelli and D.Falavigna, "Person identification using multiple cues," IEEE Transaction PAMI, vol. 17, no.10, pp.955-966, 1995

[15] L. Hong and A.K. Jain, "Integrating faces and fingerprints for person identification", IEEE PAMI, vol. 20, no. 12, pp. 1295-1307, 1998

[16] V. Ghattis, A.G. Bors and I. Pitas, "Multimodal decision level fusion for person authentication," IEEE Trans. Systems, Man and Cybernatics, vol. 29, no. 6, pp, 674-680, 1999

[17] R. W. Frischholz and U. dieckmann, "Bioid: A multimodal biometric identification system," IEEE Computer Society, vol.33, pp. 64-68, 2000.

[18] T. K. Ho, J. J. Hull and S. N. Srihari, "Decision combination in multiple classifier systems", IEEE Transaction on Pattern Analysis and Machine Intelligence, vol. 16, pp. 66–75, 1994.

[19] J. Kittler, M. Hatef, R. P. Duin and J. G. Matas, "On combining classifiers", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 20, pp. 226–239, 1998.

[20] A. K. Jain and A. Ross, "Learning user-specific parameters in a multi biometric system," in Processing of the International Conference on Image Processing (ICIP), (Rochester, USA), pp. 57–60, 2002.

[21] L. Lam and C. Y. Suen, "Optimal combination of pattern classifiers", Pattern Recognition Letters, vol. 16, no. 9, pp. 945–954, 1995

[22] L. Xu, A. Krzyzak and C. Suen, "Methods of combining multiple classifiers and their applications to handwriting recognition", IEEE Trans. on Systems, Man and Cybernetics, vol. 22, no. 3, pp. 418–435, 1992.

[23] J. Daugman, "Combining multiple biometrics", The Computer Laboratory, Cambridge University

[24] A. Ross and A. K. Jain, "Information fusion in biometrics", Pattern Recognition Letters, vol. 24, pp. 2115–2125, 2003

[25] Y. Zuev and S. Ivanon, "The voting as a way to increase the decision reliability", in Foundations of Information/Decision Fusion with Applications to Engineering Problems, (Washington D.C., USA), pp. 206–210, 1996

[26] Puneet Gupta and Phalguni Gupta, "Multi-modal fusion of palm-dorsa vein pattern for accurate personal authentication", Journal of Knowledge-Based Systems, vol. 81, pp. 117-130, 2015

[27] Jialiang Peng, Ahmed A. Abd El-Latif, Qiong Li and Xiamu Niu, "Multimodal biometric authentication based on score level fusion of finger biometrics", International Journal for Light and Electron Optics, Vol. 125, no.23, pp.6891–6897, 2014.

[28] Amioy Kumar, Shruti Garg and M. Hanmandlu, "Biometric authentication using finger nail plates", Expert Systems with Applications, vol.41, no.2, pp.373-386, 2014

[29] Rohit M. Thanki and Komal R. Borisagar, "Novel Approach For Multimodal Biometric System Using Compressive Sensing Theory Based Watermarking", International Journal of Computer Science Engineering and Information Technology Research (IJCSEITR),Vol. 3, No. 4, pp. 81-90, 2013.

[30] Daniela Sanchez and Patricia Melin, "Optimization of modular granular neural networks using hierarchical genetic algorithms for human recognition using the ear" Engineering Applications of Artificial Intelligence, Vol.27,pp. 41-56,2014.

[31] Zengxi Huang, Yiguang Liu, Chunguang Li, Menglong Yang and Liping Chen, "A robust face and ear based multimodal biometric system using sparse representation", Pattern Recognition, vol. 46 pp. 2156–2168, 2013.