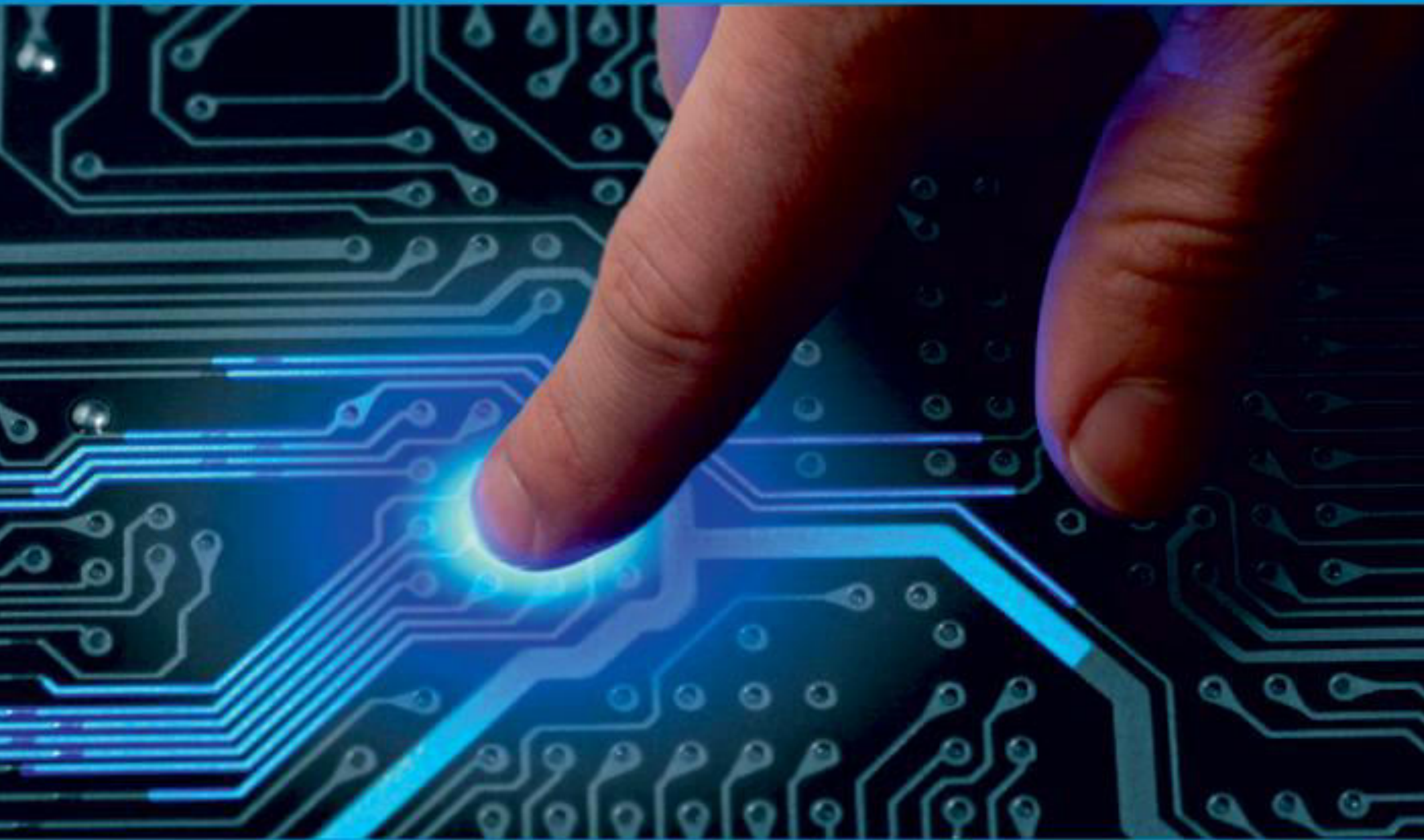
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 4, April 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

N: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 4, April 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1104098 |

Finger Vein Recognition Matching Techniques

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ABSTRACT: Finger-vein recognition, enlisting the uniqueness of living recognition, is a high security biometric authentication technology. In modern era, finger-vein recognition technology has become increasingly popular. Basically, the finger-vein recognition process involves finger-vein image acquisition, feature extraction and recognition. The recognition algorithm is the key research issue in that the accuracy and recognition performance of finger vein recognition system mainly depends on this matching algorithm. In this paper, a systematic and detailed review is presented for the recent development of most advanced matching techniques/algorithms utilized in finger vein recognition to overcome the weaknesses of the previous methods in order to develop a more powerful and robust finger vein-based identification or verification system. The paper presents the most recent research developments of the key matching techniques available for finger vein recognition and provides details for methods being reviewed along with their error rates. In addition, a performance comparison has been made among various recently developed matching techniques in which the recognition performances of various matching methods were compared. These compared methods are robust to noise, image deformations and finger misalignment. Recognition rate of almost all the reviewed finger vein matching algorithms is close to 100%. Recent advancements in matching techniques of finger vein recognition have resulted in increased accuracy and reliability and reduced cost. The key advantages of this technology are high degree of privacy and anti-spoofing capabilities. The research should emphasize more on creating and utilizing novel machine learning solutions to challenging finger vein problems which can significantly influence the recognition performance of a finger vein recognition system and to achieve a high accuracy and recognition rate of the finger vein recognition in near future.

I. INTRODUCTION

Rapid developments of science and information technology lead to a major security issue that needs an immediate solution. Due to the growing demand of user-friendly and stringent personal identification, biometric authentication has become a booming research area for decades. The design of efficient biometric authentication systems is nowadays a challenging and pertinent task for both the scientific and the industrial communities. Conventional approaches such as keys, passwords, and PIN numbers carry the risks of being stolen, forged, lost, or forgotten [1]. Hence, it gives rise to an efficient technique of identity recognition against digital impersonation based on biological features. Biometric recognition is proved more reliable and secure than the traditional hedges against identity theft such as passwords and PINs. It utilizes inherent physiological features and behavioral characteristics of an individual. Examples of physiological features are face, fingerprint, iris, vein, etc. Some examples of behavioral characteristics are like handwriting, voice, signature, etc. [2].

However, these conventional biometric techniques have their limitations regarding performance, accuracy and convenience. Hand-based biometrics commonly include fingerprint recognition, finger knuckle print recognition, and palm print recognition. However, all of these are vulnerable to forgery since the features are external to human bodies. Out of these biometric techniques, finger vein biometric has drawn much attention and gaining popularity. The finger vein recognition system is more efficient and reliable and can solve many difficulties faced by conventional biometrics techniques. From the security and convenience point of view, the finger-vein is a promising biometric pattern as the vein pattern is defined as the vast network of blood vessels underneath the skin of a particular part of a human body. Veins features are unique, robust, stable and largely hidden patterns. In addition, vein patterns are not easily observed, damaged, or changed. Unlike facial features or fingerprints, though, it's much more difficult to forge finger vein patterns, or even distort them in attempts to fool a biometric security system. Additionally, individuals can't photograph finger veins and, unlike fingerprints, they can't be left on surfaces. Compared with other biometric traits, the finger-vein is more advantageous because of these advantages as listed: a) Internal characteristic i.e., it is hard to copy or forge finger vein, and very little external factor can damage finger vein. b) The non-invasive and contactless capture of finger-veins are more convenient and hygienic for the user, and thus, it is more acceptable. c) Living body identification i.e., only vein in living finger can be captured [3]. Because of its uniqueness, stability, high accuracy,

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response timing and high resistance to criminal tampering, vein pattern offers a more reliable trait for a secure biometric authentication system. Regardless of advantages, there are some challenges that need to be overcome to achieve high accuracy and recognition performance. The main challenges are poor lighting, recognition rate and misalignment [4].

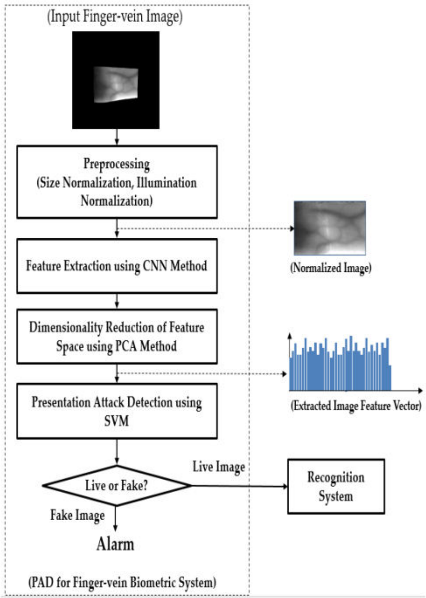

Fig 1: finger vein recognition system

A typical finger vein recognition system consists of four main stages which comprises image acquisition, image preprocessing, feature extraction, and matching. Matching is the most important stage in finger vein recognition. After features are extracted from the vein image, the matching stage measures the similarity or dissimilarity between the features of input finger vein image and the previously enrolled ones in the database [5]. The main objective of this study is to analyze the most recent matching/classification techniques applied in finger vein recognition. It is observed that finger vein recognition is a challenging task because of low image contrast, uneven-illumination and temperature variations. Finger vein identification systems are also vulnerable to spoof attacks. However, accuracy of the personal verification system is the most serious issue to consider. Therefore, fast, reliable and more efficient matching techniques are still required for FVR. The main challenge in biometric system is to enhance the recognition performance in terms of both accuracy and efficiency [6]. An acceptable level of recognition performance has not yet been achieved. In this paper, the most advanced matching techniques and algorithms utilized in finger vein recognition will be reviewed.

II. LITERATURE REVIEW

The most recent research advancements in the matching techniques and algorithms applied in the finger vein recognition are reviewed in order to overcome the weaknesses of the previous methods to develop a more robust, efficient, highly accurate and powerful finger vein-based identification or verification system. Template matching is performed between a processed input image and a stored template image in this phase. Thus, closer the normalized distance between the processed image and template image proves that two feature vectors are more related [10]. Some matching algorithms (e.g. the mismatch ratio) are sensitive to the image translation and rotation, meanwhile, the distribution information of the vein vessel network is neglected. The mismatch ratio is used to quantify the differences of two patterns.

Sujani G[11] et al., makes the use of SIFT algorithm as a matching technique of finger vein recognition. A sift algorithm is used to detect the number of key points for each of the image of finger-vein and calculate the total number of key points for all the 6 fingers of the person i.e., index, middle and ring finger of both hands. It has been found that the finger will provide maximum number robust feature of points for the matching algorithm. The centre reference of each and every sub-region is the points which matches for the features selected. Fingers are compared with the highest number of sift points which leads to a result that the index finger is best suited to give more precise results.

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Another method of Matching of Finger-Vein patterns is introduced by Chenguang Liu which is based on integrating random forest regression with a vein pattern matching technique which is robust to finger misalignment [13]. In this paper, the author has developed a vein pattern matching method to calculate the matching score. Instead of matching the two patterns directly, which may suffer from finger misalignment, the image size of one of the two patterns is extended and the other one is slided on the extended pattern. At each step of sliding, a matching score is calculated according to the likelihood function and the best score among all matches is selected as the matching score of the two vein patterns.

Q Chen, L Yang[14] et al. highlighted the problem of the image deformation and proposed a deformable finger vein recognition framework consisting of the improved vein PCA-SIFT feature and bidirectional deformable spatial pyramid matching (B-DSPM). In bidirectional matching of two images, the pixel correspondences from the first image to the second one, and these from the second image to the first one are both given by DSPM. Based on two kinds of correspondences, two matching scores are computed, and the minor one is used in recognition. So, this method is efficient to overcome all kinds of image deformations. In [15], author has proposed an integration matching strategy in which, the vein backbone is used in vein network calibration to overcome large-scale finger displacements. The similarity of two calibrated vein networks is measured by the proposed elastic matching and further recomputed by integrating the overlap degree of corresponding vein backbones. Elastic matching is robust against small-scale vein deformation.

Lin Y [16] et al. proposed a new matching method based on potential energy for finger-vein recognition. This method first extracts the finger vein skeleton feature, and then uses a weighted potential energy vector of skeleton image to represent the skeleton feature, and finally evaluate the similarity by calculating the Hausdorff distance of potential energy eigenvectors to classify. The smaller the value of this distance, the greater the probability of the two samples come from the same finger. This technique spends less time than the method based on template matching and obtain higher accuracy rate than the method based on minutiae matching. In [17], the author proposed a new matching algorithm which is based on the observation that regular deformation, which corresponds to a posture change, can only exist in genuine vein patterns. It incorporates optimized matching to generate pixel-based 2D displacements that correspond to deformations. The pixel-based displacements are obtained by considering the matching process as a pixel-based optimization process based on dense local features. The texture of uniformity extracted from the displacement fields is taken as the final matching score to discriminate between genuine and imposter matching. Regions of the same displacement values in genuine matching tend to be larger in terms of area covered than in imposter matching. This method has shown that deformation information is discriminative.

III. METHODS

The matching stage is of paramount importance as it can significantly influence the performance of a finger vein recognition system. Extensive feature dimensions can cause huge computation and the memory cost of the classifier. Thus, to make the finger vein recognition system more practical, the system should have a high recognition rate, high accuracy and high recognition speed. The matching has two types of error results to achieve high accuracy, which are false rejection rate (FRR) and false acceptance rate (FAR). False rejection rate claims a genuine pair as imposter, and the false acceptance claims an imposter pair as genuine. Hence, the system efficiency is computed by the equal error rate (EER) [10]. The EER is defined as the error rate when the false rejection rate (FRR) equals the false acceptance rate (FAR). The threshold is used to make a decision on the matching algorithm. If the threshold is reduced, FAR is increased and FRR is decreased, and vice-versa. Always, low FAR and high FRR would ensure that any unauthorized user will not be permitted to access [26]. The lower the EER, the higher the accuracy. Table 1 demonstrates the performance comparison of the recent research advancements in the matching techniques of the finger vein recognition system along with their Equal Error Rate (EER) or Recognition Rate (RR). From Table 1, we can observe clearly.

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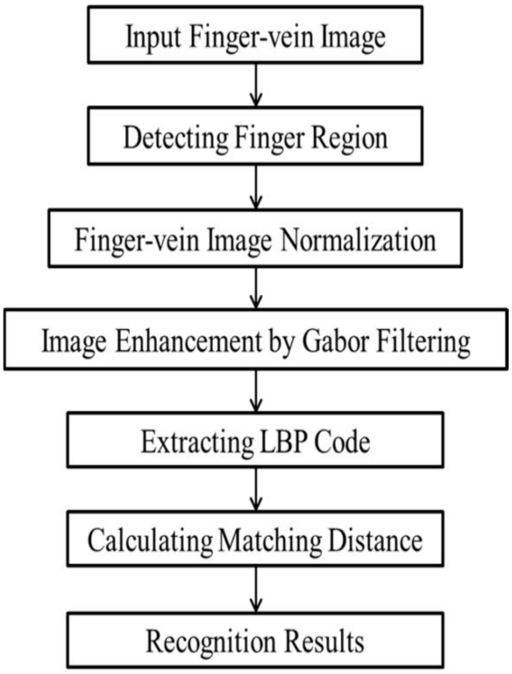

Fig 2: Work Flow

As discussed, most of the researchers worked on neural networks approach for finger-vein authentication and/or identification have followed traditional CNN model. Basically, a CNN model requires a huge dataset so as to learn from the training dataset. The finger-vein database used in the proposed work is SDUMLA-FV built by Shandong University [17], which has finger-vein images of just 106 individuals. Hence, the proposed work has been implemented based on transfer learning model [18]. The transfer learning is an approach where the model is pre-trained on a huge database of images and the knowledge gained by the model through those images is used for training another set of images. One of the major transfer learning models.

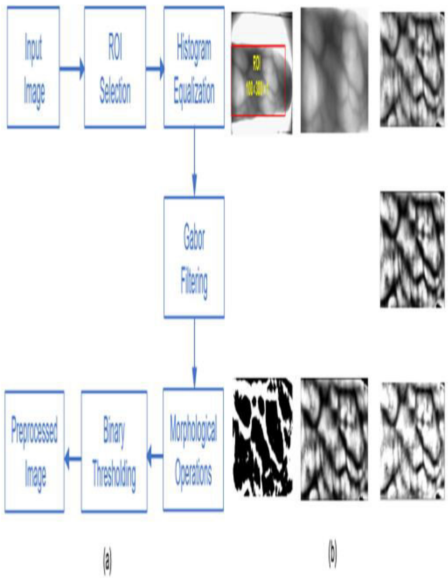

Fig 3: Image Analysis

One of the common problems faced in deep learning algorithms is overfitting. When the model performs very well on the training set but underperforms on the testing set, then such situation is known as overfitting. There are

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several regularization techniques [20] available that can perform well into different situations. One of the popularly used regularization technique in neural networks is dropout [21].

IV. RESULT ANALYSIS

Once the model has been built as discussed in the previous section, the model must be trained to learn the weights. To train a deep neural network, one must use an optimization algorithm. The proposed algorithm uses adaptive learning rate optimization algorithm viz. Adam [22]. It is an algorithm for first-order gradient-based optimization of stochastic objective functions, based on adaptive estimates of lower-order moments. An optimization technique generally requires a loss function to map an event or values of variables onto a real number representing the cost associated with the event. The loss function viz.

Dropout is a technique where randomly selected neurons are ignored during training. They are "dropped-out" randomly. For example, if the dropout rate is defined as 0.2, then 20% of the neurons in each layer are dropped during an epoch. The whole process is done during training. The dropout rate in the proposed work is 25%. Since, the dropout is done during training, one need to multiply the activation of each of the unit where dropout is applied by the factor of dropout during the prediction process, as a compensation.

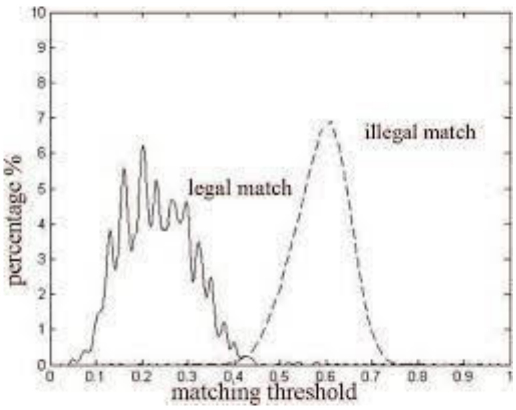

Fig 4: Finger Matching

we have presented a novel approach to authenticate an individual based on his/her finger-vein images. The deep learning technique of convolutional neural networks is applied along with transfer learning. The usage of transfer learning with ResNet–50 helped to achieve higher accuracy, as the learning is backed by the pre-trained model with millions of images from ImageNet database. We have used just one hidden layer with 250 neurons, and to have lower complexity, the dropout regularization is used. Appropriate optimization functions and loss functions are used to handle overfitting. As the algorithm resulted in 99.06% of accuracy in person authentication, we can conclude that the CNN model designed is found to be reasonably goodlassification problem. Here, we are dealing with 106 classes and hence the confusion matrix will be of order 106 * 106. As the representation of such a big matrix is almost impossible on a paper, it is not being included here. But, it is found that only one misclassification is resulted – the finger-vein image of person number 72 has been wrongly classified as person number 14. Thus, the proposed model has shown 99.06% of accuracy in authenticating the person

V. CONCLUSION

In today's society with the rapid growth in the field of computer and network technology, the identity verification is a critical key problem. Thus, the requirement for a better and more reliable approach for identity authentication becomes more significant. Since it is difficult to mislay, forge or share biometric identifiers, biometric recognition is more efficient and reliable than traditional passwords or PINs. Finger vein recognition technique has become the most preferred and novelist biometric method due to its low device constraint, low forgery risk, stability, aliveness detection and high anti counterfeit. A finger vein recognition consists of four main steps which include image acquisition, preprocessing, feature extraction, and matching. The matching technique is most crucial step of recognition to decide whether an input image is genuine or an imposter for one enrolled image, in which matching score is generated. A matching score measures the similarity between the enrolled template and the input image. This paper presents a detailed review on FVR matching algorithms. Matching stage plays a vital role as only this stage involves analysing the

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recognition performance which is the main criteria to measure the effectiveness of an algorithm. This paper presents the most recent research advancements in the recognition performance of FVR. Various matching algorithms reviewed in this paper have the potential to enhance the recognition performance in a broad sense.

REFERENCES

[1] S. Gupta and L. Singh. 2017. A Study on New Biometric Approaches. IEEE International Conference on Computing and Communication Technologies for Smart Nation (IC3TSN): 306 – 310.

[2] T. Sabhanayagam. 2018. A Comprehensive Survey on Various Biometric Systems. International Journal of Applied Engineering Research, 13(5): 2276-2297.

[3] M. Jadhav and P. M. RavaleNerkar. 2015. Survey on Finger Vein Biometric Authentication System. IJCA Proceedings on National Conference on Emerging Trends in Advanced Communication Technologies NCETACT, 3: 14-17.

[4] RamaPrabha R. and V. K. David. 2015. Finger Vein Recognition Using Computational Intelligence Techniques. (IJCSIT) International Journal of Computer Science and Information Technologies, 6(4): 4024-4028.

[5] E. Ting, M.Z. Ibrahim. 2017. A Review of Finger Vein Recognition System. Journal of Telecommunication, Electronic and Computer Engineering, 10(1): 167-171.

[6] R. Dev and R. Khanam. 2017. Review on Finger Vein Feature Extraction Methods. IEEE International Conference on Computing, Communication and Automation (ICCCA): 1209-1213.

[7] K. Shaheed, H. Liu, G. Yang, I. Qureshi, J. Gou, Y. Yin. 2018. A Systematic Review of Finger Vein Recognition Techniques. Information, 9: 213.

[8] S. B. Kutemate and R. U. Shekokar. 2015. Secure and Reliable Human Identification Based on Finger-Vein Patterns. International Journal of Engineering Research & Technology (IJERT), 4(3): 978-980.

[9] L. Yang, G. Yang, Y. Yin, L. Zhou. 2014. A Survey of Finger Vein Recognition. Chinese Conference on Biometric Recognition, 8833: 234-243.

[10]K. A. Akintoye, M. S. M. Rahim and A. H. Abdullah. 2018. Challenges of Finger Vein Recognition System: A Theoretical Perspective. International Journal of Emerging Technology and Advanced Engineering, 8(2): 196-204.

[11]Sujani. G and S. Reddy. 2017. A Hierarchical finger selection method for finger vein recognition using SIFT. IEEE International Conference on Smart Technologies for Smart Nation.

[12]C. Chiu, T. Liu, W. Lu, W. Chen and J. Chou. 2018. A micro-control capture images technology for the finger vein recognition based on adaptive image segmentation. Microsystem Technologies, Springer, 24(10):4165–4178.

[13]C. Liu and Y. Kim. 2016. An efficient finger-vein extraction algorithm based on random forest regression with efficient local binary patterns. IEEE International Conference on Image Processing (ICIP).

[14]Q. Chen, L. Yang, G. Yang, Y. Yin and X. Meng. 2017. DFVR- Deformable finger vein recognition. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).

[15]L. Yang, G. Yang, Y. Yin. 2017. Finger Vein Recognition with Anatomy Structure Analysis. IEEE Transactions on Circuits and Systems for Video Technology, 28(8): 1892 - 1905.

[16]L. You, H. Li and J. Wang. 2015. Finger-vein Recognition Algorithm Based on Potential Energy Theory. IEEE 16th International Conference on Communication Technology (ICCT).

[17]X. Meng, X. Xi, G. Yang and Y. Yin. 2017. Finger vein recognition based on deformation information. Science China Information Sciences, Springer.

[18]H. Zheng, Q. Xu_, Y. Ye and W. Li. 2017. Effects of meteorological factors on finger vein recognition. IEEE International Conference on Identity, Security and Behavior Analysis (ISBA).

[19]L. Zhou, G. Yang, Y. Yin, L. Yang and K. Wang. 2016. Finger Vein Recognition Based on Stable and Discriminative Superpixels. International Journal of Pattern Recognition and Artificial Intelligence, 30(6).

[20]J. Li, Y. Hu, Y. Zhang and Z. Zhao. 2017. Finger-Vein Recognition Based on Improved Zernike Moment. Chinese Automation Congress (CAC), IEEE.

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