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Verifying Human Identities Using Major and Minor Finger Knuckle Pattern

Shubhada Sonawane[1], Prof. Ganesh Dhanokar[2]

Student, Computer Science and Engineering, G.H.Raisoni Institute of Engineering and Management, Jalgaon, India [1]

Assistant Professor, Computer Science and Engineering, G.H.Raisoni Institute of Engineering and Management, Jalgaon, India[2]

Abstract: This paper investigates a new approach for personal authentication using fingerback surface imaging. The texture pattern produced by the finger knuckle bending is highly unique and makes the surface a distinctive biometric identifier. The finger geometry features can be simultaneously acquired from the same image at the same time and integrated to further improve the user-identification accuracy of such a system. The fingerback surface images from each user are normalized to minimize the scale, translation, and rotational variations in the knuckle images. This paper details the development of such an approach using peg-free imaging. The experimental results from the proposed approach are promising and confirm the usefulness of such an approach for personal authentication.

Keywords: Finger Biometric, Finger Knuckle Methodology, Pattern Recognition, Finger-vein Identification.

I. INTRODUCTION

Personal authentication is a common concern to both industries and academic research due to its numerous applications. Biometrics can be used to distinguish between individuals based on their inherent physical and behavioural characteristics and hence can serve as an ideal solution to this problem. In the past three decades, many biometric characteristics have been investigated, including fingerprint, face, iris, retina, palm-print, hand geometry, voice, gait and signature, etc [1].

Recently, it has been noticed that the textures in the outer finger surface has the potential to do personal authentication. Woodward et al. [2] used the 3D range image of the hand to calculate the curvature surface representation of the index, middle, and ring fingers for similarity comparison. In [3], Ravikanth et al. applied the subspace analysis methods to the finger-back surface images for feature extraction and person classification. The above works made a good effort to validate the uniqueness of biometric features in the outer finger surface; however, they did not provide a practical solution to establishing an efficient system using the outer finger surface features. In addition, the method [2] mainly exploits the 3D shape information of finger back surface but does not fully use the texture information; while the subspace analysis methods used in [3] may not be able to effectively extract the distinctive line and junction features in finger back surface. In palmprint recognition, the features used for matching are the principal lines and wrinkles. Actually, the outer surfaces of finger joints have even more obvious line features than the palm surface, while they have much smaller area than the palm surface. This motivates us to propose a new biometric technique the finger-knuckle print (FKP), which refers to the image of the outer surface of the finger phalangeal joint.
Using ten fingers and two iris images unique identification of ~1.2 billion populations is ambitious project.

Among the many authentication systems that have been proposed and implemented, finger knuckle biometrics is emerging as the full proof method of automated personal identification. Similar to fingerprint, these dermal patterns are formed at birth and they will not change throughout the life of a person. These line features are reliable and they can serve as unique personal identifier. Moreover, these line textures are clearly visible on the hand's upper surface and they can be captured using relatively inexpensive low-resolution device.
Accurate identification of finger knuckle patterns can be beneficial for several applications involving forensic and convert identification of suspects. There are several classes of forensic images in which the finger knuckle patterns are the only piece of evidence available to identify the suspects. There are some examples like kidnapping, sexual/physical assault where the cameras are unable to track the face/finger print of the suspect, in that case the finger knuckle pattern is the only or major source of information available to scientifically ascertain the identity of individuals.
In this paper, an FKP recognition system, including the specifically designed FKP data acquisition device and the FKP feature extraction and pattern matching flowchart, will be developed. The segmentation and extraction demonstrate that the proposed FKP authentication system can verify the personal identity in real time with a high recognition rate .In the rest of this paper, Section 2 introduces the knuckle matching methodology. Section 3 describes the literature survey. Section 4 describes need of this system. Section 5 reports the proposed work. Finally, conclusions are presented in Section 6.

II. KNUCKLE MATCHING METHODOLOGY

Figure 1 represents work flow diagram for proposed Knuckle Surface Identification.

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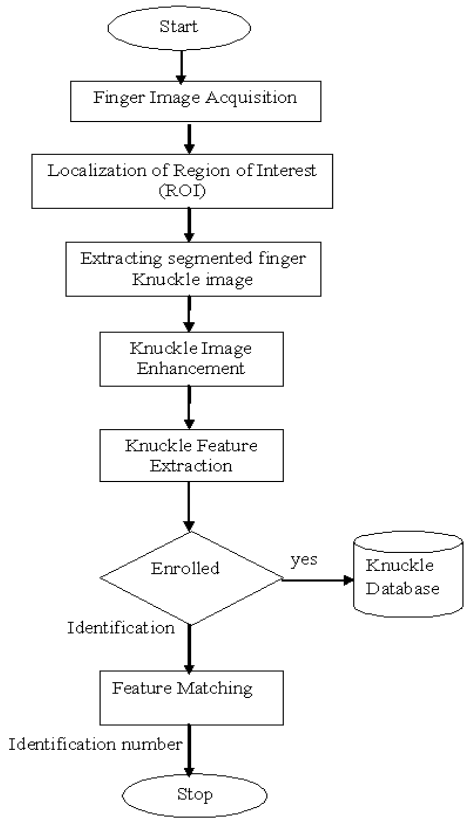

Figure 1. Flowchart for proposed research work

A. Finger image acquisition
The backside of finger is to be acquired using digital camera.

B. Localization of Region of Interest (ROI)
Each of these images requires localization of region of interest for the feature extraction. The region of interest is the region having maximum knuckle creases. It is necessary to construct a local coordinate system for each FKP image. With such a coordinate system, an ROI can be cropped from the original image for reliable feature extraction and matching.

C. Extracting Segmented Finger Knuckle Image
The Region of Interest is to be automatically extracted using the edge detection based approach. This gives segmented finger knuckle image.

D. Knuckle Image Enhancement
The finger surface is highly curved and results in uneven reflection which also generates shadow. The knuckle images therefore have low contrast and uneven illuminations. These undesirable effects are to be reduced using image enhancement techniques.

E. Knuckle Feature Extraction
The enhanced knuckle image mainly consists of curved lines and creases. Knuckle curved lines and creases are to be detected. Knuckle features are then extracted.

F. Database Establishment
In order to evaluate the proposed FKP identification an FKP database is to be established by collecting finger back images of various users.

G. Feature Matching
Algorithms are to be employed for the matching of two knuckle features.

III.LITERATURE SURVEY

The use of finger knuckle print as biometric identifier has generated increasingly interest in the literature. Woodard and Flynn successfully demonstrated the use of 3D finger dorsal images for personal identification. This work essentially exploits local curvature patterns on the 3D finger surface and quantifies them into various shape indexes for the matching.

A. Kumar, senior member, IEEE, [4] this paper has successfully investigated the likelihood of employing minor finger knuckle images for the identification. The coarse-to-fine segmentation strategy developed in this paper has been quite self-made because it has been able to achieve higher matching accuracy. The experimental results illustrated during this paper, on the info of 503 subjects, can achieve promising performance (EER of 6.29% and 12.6% under two protocols) from contactless minor finger knuckle images. The experimental results according during this paper conjointly recommend that the synchronous use of major and minor finger knuckle images will help to considerably improve the performance which will not be attainable by victimization either minor or major finger knuckle images alone.

B. Kumar and C. Ravikanth [7] details an online system using the hand dorsal surface images which can minor finger knuckle images for the identification. The coarse-to-fine segmentation strategy developed in this paper has been quite self-made because it has been able to achieve higher matching accuracy. The experimental results illustrated during this paper, on the info of 503 subjects, can achieve promising performance (EER of 6.29% and 12.6% under two protocols) from contactless minor finger knuckle images. The experimental results according during this paper conjointly recommend that the synchronous use of major and minor finger knuckle images will help to considerably improve the performance which will not be attainable by victimization either minor or major finger knuckle images alone.

B. Kumar and C. Ravikanth [7] details an online system using the hand dorsal surface images which can simultaneously exploit the finger knuckle patterns from the multiple fingers and also their geometrical shape characteristics. Better results were found out with different fusion of basic techniques as Principal Component Analysis (PCA), Linear Discriminate Analysis (LDA) and Independent Component Analysis (ICA). This method overcome problem due to finger rings and black background. Previous method used black background problem of using dark background is that the finger surface can be dark, so they used white background which requires simple pre-processing as compared. The

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disadvantage of this method is the speed of working is less as it uses scanner for imaging.

A. Kumar, [4] in this paper they work on a new approach to enhance the performance of finger vein identification System. The projected system at the same time acquires the finger vein and low resolution finger print images and combines these two evidences employing a novel score level combination strategy. The utility of low resolution fingerprint pictures non inheritable from a digital camera is examined to establish the matching performance from such pictures. They developed and investigated two new score level combos, i.e., holistic and nonlinear fusion, and relatively assess them with additional well-liked score level fusion approaches to establish their effectiveness in their projected system. They presented the information of 6,264 pictures from 156 subjects illustrate vital improvement within the performance, each from the authentication and recognition experiments.

S. Aoyama, K. Ito, and T. Aoki, [9] in this paper they work on FKP recognition based on Band Limited Phase Only Correlation (BLPOC). POC is an imaging matching technique using the phase components in 2D DCT of given images. BLPOC is a modified version of POC which is dedicated to evaluate similarity between images, in order to handle the non-linear deformation of FKP images. Most of POC based biometric recognition algorithms cannot handle the nonlinear deformation of pictures, since the part info obtained from the whole image is used. So as to handle the nonlinear deformation of FKP pictures, the planned algorithmic program employs native block matching exploitation BLPOC, since the nonlinear deformation is around diagrammatically by the minute translational displacement between native image blocks. The Region of Interest (ROI) is extracted from the FKP image within the pre-processing. The translational displacement between the 2 ROI pictures is calculable victimization BLPOC and also the two images area unit aligned consistent with the calculable displacement. Then, the common region of the two images is extracted. If the world magnitude relation of the common region between the ROI pictures is below the edge, the BLPOC operate between the ROI images is calculated. Otherwise, the BLPOC operate between the common regions is calculated. Finally, the average BLPOC function is calculated from all the corresponding point pairs regardless of the reliability of correspondence.

Kam Yeun Cheng, Ajay Kumar,[6]This paper details the development of a smart phone based online system to automatically identify a person by using their finger knuckle image. The key objective is to exploit user-friendly biometric, with least privacy concern, to enhance security of the data in smart phone. The developed system application can operate on any smart phones which use android OS and contain an embedded camera (with at least 2MP resolution). This paper uses 1D log-Gabor filter to extract the finger knuckle templates which are matched using Hamming distance. The limitation with this system is that for accurate finger knuckle detection, the acquire image background should be largely uniform as the background noise would influence the auto finger detect capability. This paper has also developed a new smart phone based finger knuckle image database of 561 finger knuckle images of 187 different fingers from 109 users, in real imaging environment.

IV. NEED OF FINGER KNUCKLE PRINT

There are many different types of Biometrics, these are, IRIS Identification, Retinal Identification, Face Recognition, Voice Recognition, Fingerprint, Hand/Finger Geometry, Signature verification, Keystroke Dynamics, and other esoteric biometrics. Hand-based biometrics, such as fingerprint and hand geometry, is the most prevalent biometric system in the marketplace.
However, fingerprint suffers from a major drawback, which is its proneness to anti-security threats, such as the reproduction of fingerprints left on surfaces to deceive the system. On the other hand, the hand geometry features are not descriptive enough for identification when the number of users grows larger. Problem related to other identifiers are as human voice and signature can be copied, duplicates are available so face recognition will not be foolproof identifier.

Palm print and finger print can be simultaneous extracted from the palm side which can give better performance improvement, but size of finger knuckle is very small as compared to palm print and offers more attractive alternative as it requires less processing as compared to palm print. These biometric identifier systems can cause problem in children and adults.
Many concepts are proposed to explore an alternative way to utilize the major knuckle print for human identification. This biometric system implementation is contactless and peg-free and free from factors like tiredness etc. which causes problem in other biometric identifiers. But in some humans the major knuckle pattern of finger can be occluded by hair and there are some cases where only the minor knuckle portions are visible in forensic images. By considering this problem, now need to utilize the major and minor portions simultaneously.

V. PROPOSED SYSTEM

The use of finger knuckle images for the biometric identification has generated increasingly interest in the literature. The unidirectional bending of fingers is primarily responsible for generating skin pattern alterations on the finger dorsal surface joining the four phalanx bones. The minor knuckle patterns of finger are formed on the surface joining distal phalanx and middle phalanx bones and can also be quite distinctive for biometric identification. We proposed this project to examine biometric identification capability for humans using such minor knuckle of finger images and will apply an effective algorithm for the automated segmentation of region of interest, image normalization, enhancement and robust matching to accommodate inherent image variations.

We proposed to investigate the possibility of using minor knuckle patterns of finger for human identification. This idea aims to develop a completely automated scheme to simultaneously segment minor and major knuckle images of finger from contactless finger dorsal images. We can achieve significant improvement in performance by using combination of simultaneously acquired minor knuckle pattern of finger and major knuckle pattern of finger image, which is not possible by using major knuckle images of finger alone.

A. Image segmentation and Normalization**:**
Accurate personal identification using finger knuckle patterns will require accurate segmentation of ROI (region of interest) images. The segmentation approach should be able to generate normalized and fixed size ROI images from the finger dorsal images of persons under different age group. In absence of any fixation pegs or the finger docking frame, the acquired finger dorsal images illustrate fingers with varying poses, locations and scale changes. In addition with this the different length, width of fingers, finger-nails, skin color and location of distal inter phalangeal points, poses severe challenges to exploit any anatomical characteristics of fingers for robust minor finger knuckle segmentation. Each of the acquired images is firstly subjected to binarization using thresholding. The resulting images are cleaned (denoised) by automatically removing the isolated regions/pixels so that the longest object representing finger is only retained. The binarized finger shape is used to estimate the location of finger-tip from the convex hull of the images. The location of finger-tip is utilized to eliminate the background image above the finger-tip. The orientation of fingers is then estimated from this binarized image using the methods of moment. Then coarse segmentation is done in which segments a small portion of acquired finger images that can include finger knuckle region major part of finger nail.

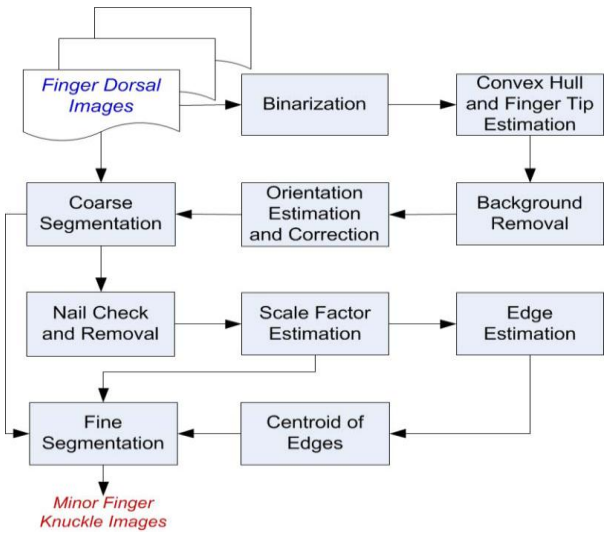

Fig.2: Block Diagram of Proposed System

Such segmentation strategy requires some assumptions for the maximum ratio of nail length to the finger length and assumption that the major finger knuckle region is located somewhere in the middle of the acquired finger dorsal image. Then nail check and removal steps are done with resulting image which consist of segmenting the image and locating the bonding box region for smaller parts and removing them. The width of the resulting image is computed and used to estimate the scale factor for the scale normalization. The edge detection of resulting image is used to locate the center of minor finger knuckle image.

Human identification using combination of minor and major finger knuckle pattern images can be used to achieve improvement of the performance. The accurate result cannot be obtained only by using major finger knuckle images.

Uniqueness and stability of knuckle pattern is over period of 6 years.

VI. CONCLUSION

This paper proposes contactless, cost effective and user friendly finger knuckle surface based biometric identifier for personal identification. Unlike most previous work, this approach uses single knuckle print image and it need not require collecting large amount of knuckle images. It is efficient approach as it requires less computation and processing time. The proposed method improves security and improved efficiency in comparison traditionally used biometric identification.

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REFERENCES

[1] D. Zhang, Automated Biometrics: Technologies and Systems Kluwer Academic, 2000.
[2] D.L. Woodard and P.J. Flynn, “Finger surface as a biometric
[3] Identifier”, CVIU, vol. 100, pp. 357–384, 2005.
[4] C. Ravikanth and A. Kumar, “Biometric Authentication using
[5] Finger-Back Surface”, CVPR’07, pp. 1-6, 2007.
[6] Ajay Kumar, “Importance of being unique from finger dorsal patterns: Exploring minor finger knuckle patterns in verifying human identities” IEEE Trans. Inf. Forensics Security, vol.9, no.8, pp.98-110, Aug2014.
[7] B. V. K. V. Kumar, M. Savvides, K. Venkataramani, and C. Xie, Spatial frequency domain image processing for biometric recognition, in Proc. ICIP 2002, Rochester, NY, USA, pp. 5356.
[8] Kam Yuen Cheng, Ajay Kumar, ―Contactless Finger Knuckle Identification using Smartphones‖, Hong Kong Polytechnic University**,** Hung Hom, Kowloon, Hong Kong.
[9] Kumar and C. Ravikanth, ―Personal authentication using finger knuckle surface,‖ IEEE Trans. Inf. Forensics Security, vol. 4, no. 1, pp. 98–110, Mar. 2009..
[10] Kumar and Y. Zhou, ―Human identification using finger images,‖ IEEE Trans. Image Process., vol. 21, no. 4, pp. 2228–2244, Apr. 2012.
[11] S. Aoyama, K. Ito, and T. Aoki, ―Finger-knuckle-print recognition using BLPOC-based local block matching,‖ in Proc. ACPR, Nov. 2011, pp. 525–529.
[12] L. Zhang, L. Zhang, D. Zhang, and H. Zhu, ―Online finger-knuckle-print verification for personal authentication,‖ Pattern Recognit., vol. 43, no. 7, pp. 2560–2571, Jul. 2010.

[13] Kumar, "Incorporating cohort information for reliable palm-print authentication," in Proc. 6th ICVGIP, Bhubaneswar, India, Dec. 2008, pp. 583–590.
[14] Zhang L., Zhang David, Zhu H, "Online finger knuckle- print verification for personal authentication,", Pattern Recognition, 2010, vol. 43,no. 7, pp. 2560-2571.

BIOGRAPHIES

Ms. Shubhada Sonawane, received degree BE in computer engineering in 2011 and now pursuing ME in computer science and Engineering from GHRIEM, Jalgaon.

Prof. Ganesh Dhanokar, received degree BE in Information Technology, ME in Computer Science and Engineering. Now he is working as Assistant Professor of Computer Engineering Department, GHRIEM, Jalgaon.

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