RETINA BASED BIOMETRIC RECOGNITION SYSTEM

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ABSTRACT:

In recent years biometric security has gained more importance because of the increased hacker's and cyber terrorism. So, retina biometric security has been one of the most reliable system. As every individual has different retinal pattern. The 4 major modules in the proposed system are, Retina fundus acquisition, Pre-processing, Detection of bifurcation points and Feature matching. In the pre-processing stage the blood vessels of retina are segmented and enhanced. And in this segmented image it detects bifurcation points using skeleton processing. Using this point of bifurcation, it checks the similarity between those points and referred image in database using similarity transformation. In proposed system the error rate is very low and the response is fast.

KEYWORDS:

Security; Biometrics; retinal recognition; Retina Based Biometric System;

1. INTRODUCTION:

In today's world, among various biometric modalities, iris, arguably, is one of the most reliable, universal, measurable, accurate and inimitable. From many years it has been told that each iris is different from other specially in anterior layer. Not only the iris of identical twins are different, but the iris of the same person are also different from each iris pattern. Although specific details of the appearance of an iris vary depending on the level and direction of illumination, it has been said that fundamental and important features of iris remain same for long time. Generally, covariates in iris recognition are image quality (i.e. noise, blur), Illumination (specular reflection), off angle, occlusion, and resolution. In past years, several attempts have been made to advance the iris recognition and address covariates. But, there can be potentially many other covariates in iris recognition which are not been identified.

The biometric recognition system is a pattern in which the system checks the originality of a person using biometric measures. There are mainly two different types of authentication: - Verification (checking the validity of a given identity) and Identification (checking if a given pattern is associated with any of the enrolled identities stored in the database). The retina is an internal protected organ of the body. The human retina includes of blood vessels that it has unique pattern and this pattern do not change through the individual's life. So, it is impossible to fake this pattern. And this retinal based security system is run by tracking an image of a human retina blood vessel network and different this with previously scanned pattern of same person. The uniqueness and stability of retina guarantees a strong biometric authentication. Also, it is less vulnerable to spot thievery.

The fundamental application for retinal pattern identification till date has been for physical access entry for high-security provision such as military installations, nuclear facilities, sophisticated laboratories, etc. And also used in access control systems at high-security provisions. There are many benefits of retina biometry: - it has a low happening of false positives, also offers very low (almost 0%) error rates, as no two individuals have a same retinal pattern it is well founded and it can provide quick results that is a person can be identified very quickly.

2. LITRATURE SURVEY:

John Daugman proposed a "How Iris Recognition Works" in the year 2004, Algorithms developed by the author for identifying persons by their patterns of iris have now been tested in many laboratories and field, Producing no mismatches in several million comparison tests. The recognition principle is the failure of a test of statistical independence on iris phase structure encoded by multi-scale quadrature wavelets. The combinational complexity of this phase information across different persons spans about 249 degrees of freedom and generates discrimination entropy of about 3.2 b mm2 over the iris, enables immediate conclusion about personal identity with very high confidence. The high confidence levels are major as authorize large databases to be searched fully (one-to-many "identification mode") without making wrong matches, in spite of so many attempts. Biometric systems that are shortage of this property can get through one-to-one ("verification") or few comparisons.

K. McGinn, S. Tari recommended a "Identity verification using iris images-Performance of human examiners" in the year 2013, we are clueless of any earlier systematic investigation of how well human examiners perform at identity verification using the same type of images as obtained for automated iris recognition. This paper handout experiment results in which tester consider a set of iris images to conclude if they are (a) both the images are of same eye of one person, or (b) if it is two different eye images, with two different individuals with same gender, ethnicity and approximate age. Results say that novice testers can willingly pull off accuracy exceeding 90% and can exceed 96% when they consider their decision as "sure". Results also say that testers may be able to enhance their accuracy with experience.

Manisha Sam Sunder recommended a "Iris Image Retrieval Based on Macro-features" in the year 2010, most iris recognition systems use the global and local texture data of iris in order to identify individuals. In this work, we look over the use of macro-features that are visible on the anterior surface of RGB images of the iris for matching and retrieval. These macro-features touch to structures such as moles, freckles, nevi, melanoma, etc. and this might not be there in all iris images. Given an image of a macro feature, the aim is to decide if it can be used to successfully reclama the related iris from the database. To direct this issue, we use characteristic draw out by the Scale-Invariant Feature Transform (SIFT) to represent and match macro-features. Experiments using a subset of 770 distinct iris from the Miles Research Iris Database suggest the possibility of using macro features for iris characterization and retrieval.

J. De Mira and J. Mayer proposed a "Image feature extraction for application of biometric identification of iris-A morphological approach" in the year 2003, this paper give out a new perspective on basis of morphological operations for application of biometric identification of individuals by analysis and segmentation of the iris. Algorithms drew on morphological operators are developed to split up the iris region from the eye image and also to spotlight the chosen iris patterns. The draw out characteristics are used to represent and distinguish the iris. In order to properly draw out the patterns, and an algorithm is suggested to produce skeletons with distinctive paths among nodes and end-points. The representation acquired by the morphological processing is kept for identification purposes. To represent the order of the morphological approach some outcomes are presented. The proposed system was acquired to present low complication execution and less storage needs.

F. Shen proposed a "A visually accountable iris recognition system with crypt features" in the year 2014, one important hurdle for the use of current virus recognition techniques in law enforcement areas such as forensics is that the iris features used by these techniques are not accountable to human eyes. This thesis proposes an iris recognition technique that identifies a human's eye based on the crypt, a visible feature on the iris. The main cause is to support the law enforcement applications that needs human common sense in the process. The crypt is a visible feature that is relatively stable and easy for human eyes to rely on for iris recognition tasks. To confirm the human-in-the-loop system plan, we have conducted two human-subject test to access human perception of crypt features. The results support the applicability of using crypt features for semi-automatic iris recognition.

3. PROPOSED WORK:

The proposed system is Retina based personal identification system using skeletonization and similarity transformation. The system outcome contains four modules via, retina fundus acquisition, Pre-processing, Detection bifurcation points and Feature matching

Fundus acquisition: The devices used to acquire images of the retina were called fundus cameras, which uses low power infrared light to enhance blood vessel pattern of the retina. Once the retinal image is acquired, the blood vessels are spot through further processing. Then shape the compounded network of blood vessels dfferentiating features are drawn out and stored in templates, which are later used in the matching process.

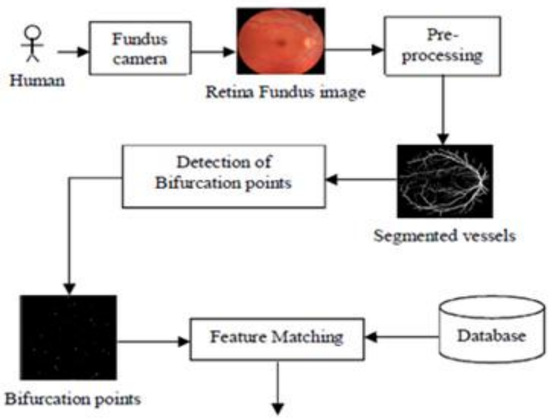

Fig 1: System Architecture

Pre-processing: In this pre-processing stage, it carry out blood vessels segmentation and enhancement that helps to extract the retinal blood vessel pattern from fundus image. For this first of all we extract the green channel of the fundus image, because it provides highest contrast. The figure shows the pre-processing of funds image. This has five stages: resolution hierarchy creation, hessian vesselness extraction, back sampling, Hysteresis threshold and image fusion.

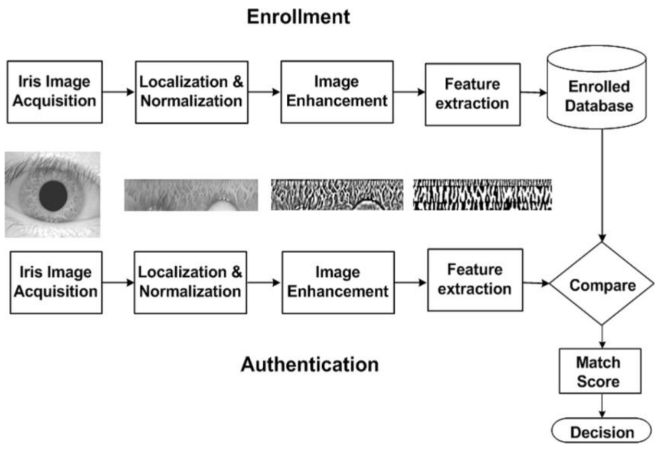

Fig 2: System authentication process

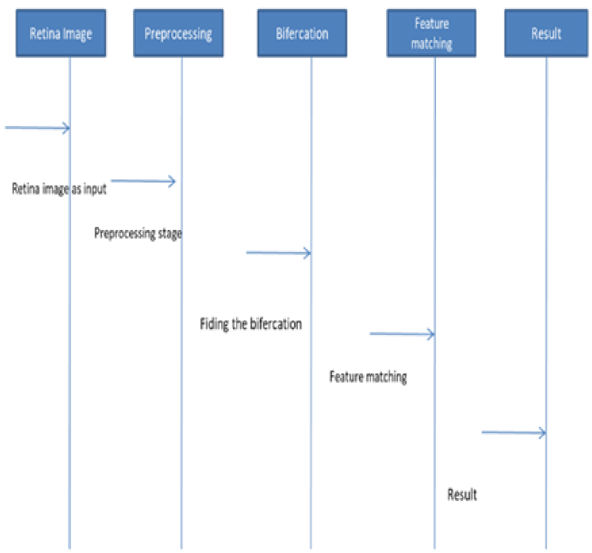

Fig 2: Sequence Diagram

Detection of bifurcation points: Bifurcation are the most reliable and abundant feature in fundus images. The retinal bifurcation points are different for every other person; thus, they are used for solid process of identification of person. In this paper, it detects bifurcation points with the help of Skeletonization process.

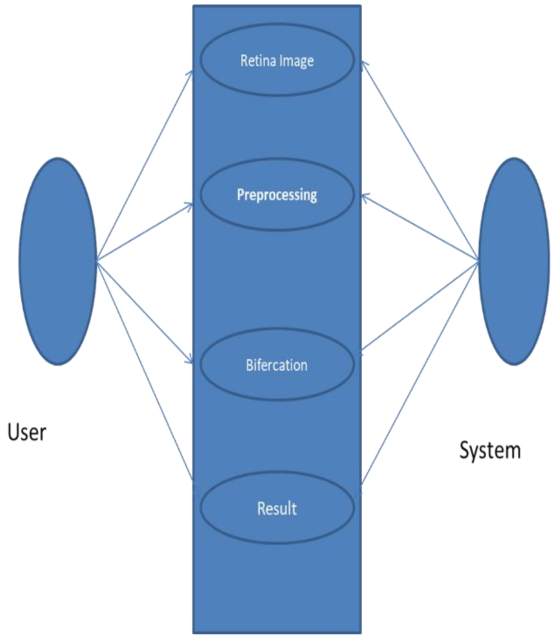

Fig 3: Use Case Diagram

Feature matching: In the matching stage, the reference pattern, p, which is stored in database for the claimed identity is compared to the pattern extracted, p', during the previous stage. Due to the eye movement during the image acquisition stage, it is necessary to align β with α in order to be matched. The movement of the eye in the image acquisition process leads to translation in both axes. So, for same individual, the number of bifurcation points of both patters p and p' are different. So, it is necessary to transform the candidate pattern in order to get a pattern similar to the reference one.

According to this process a pixel in image will be removed if satisfies 2 conditions.

Condition I:

For pixel I (i, j),

1. The number of pixels connected must be equal to 1.

2. It should have at least 2 near pixels and at the latest 6.

3. The pixels in location (i,j+1), (i-1,j) and (i+1,j) should be white

4. The pixels in location (i-1,j), (i+1,j) and (i,j-1) should be white.

Condition II:

1. The number of pixels connected must be equal to 1.

2. It should have at least 2 near pixels and at the latest 6.

3. The pixels in location (i-1,j), (i+1,j) and (i,j-1) should be white.

4. The pixels in location (i,j+1), (i-1,j) and (i+1,j) should be white.

```
%fprintf ('CS5240 -- SIFT: Match image: Computing frames and descriptors.\n');

[frames1, descr1, gss1, dogss1] = do_sift (I1, 'Verbosity', 1, 'NumOctaves', 4, 'Threshold', 0.1/3/2); %0.04/3/2

[frames2, descr2, gss2, dogss2] = do_sift (I2, 'Verbosity', 1, 'NumOctaves', 4, 'Threshold', 0.1/3/2);

fprintf ('Computing matches.\n');

descr1 = descr1';

descr2 = descr2';

tic ;

Matches=do_match (I1, descr1, frames1', I2, descr2, frames2');

fprintf ('Matched in %.3f s\n', toc);

lambda0 = 0.0609;

X = [ones (size (maturities)) (1-exp (-lambda0*maturities)). / (lambda0*maturities)...

    ((1-exp (-lambda0*maturities)). / (lambda0*maturities)-exp (-lambda0*maturities))]

Beta = zeros (size (yields, 1), 3);

Residuals = zeros (size (yields, 1), numel (maturities));

For i = 1: size (yields, 1)

 Olsfit = fitlm(X, yields (i, :)', 'Intercept', false) ;

 Beta (i, :) = olsfit.Coefficients.Estimate';

 Residuals (i, :) = olsfit.Residuals. Raw';
```

MLDIVIDE ALGORITHM:

The mldivide operator employs different solvers to handle different kinds of coefficient matrices. The various cases are diagnosed automatically by examining the coefficient matrix.

The versatility of mldivide in sloving linear systems from its ability to take advantage of symmetries in the problem by dispatching to an appropriate slover. This approach aims to minimize computation time.

The MATLAB mldivide functions prints a warning if A is badly scaled, nearly singular, or rank deficient. The distributed array mldivide is unable to check for this condition, if A is an M-by-N matrix with N>M, for distributed arrays. Mldivide computes a solution that minimize norm(X).

4. RESULTS AND DISCUSSION:

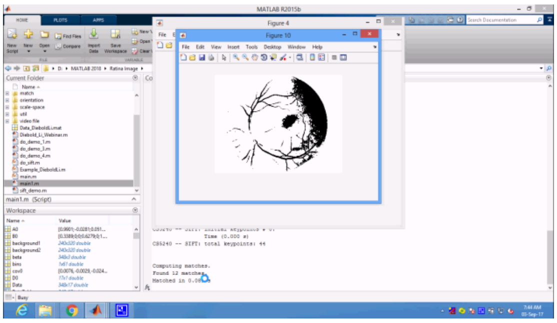

Fig 4.1: Main screen of the application

The above screen shot is the main screen which will be opened once the application is executed.

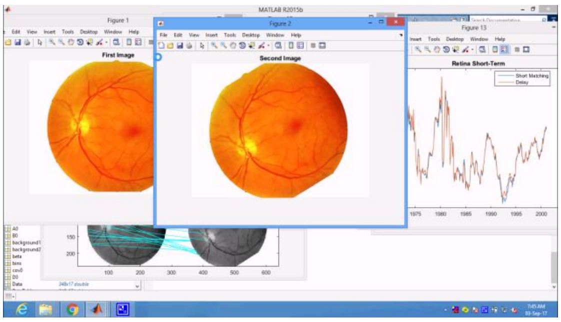

Fig 4.2: Fundus acquisition stage

The above snapshot gives the 2 images, one is the main images which are compared with the second images, both images graph and other feature is extracted once the pre-processing is carried out. There is a high accuracy of finding the matching of the images.

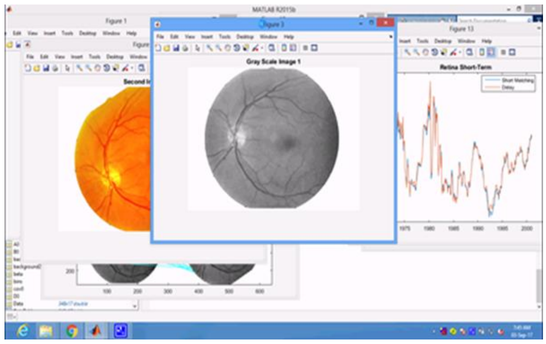

Fig 4.3: Pre-processing stage

The above screenshot gives the gray scale of the image 1 which is done at the time of pre-processing step, once this step is done, the pre-processing of the image2 also carried out.

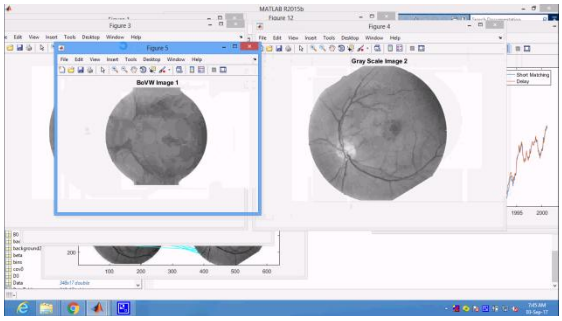

Fig 4.4: converting of gray scale image into black and white format

The gray scale image is now converted into the black and white format for the exact feature extraction after the pre-processing step is done.

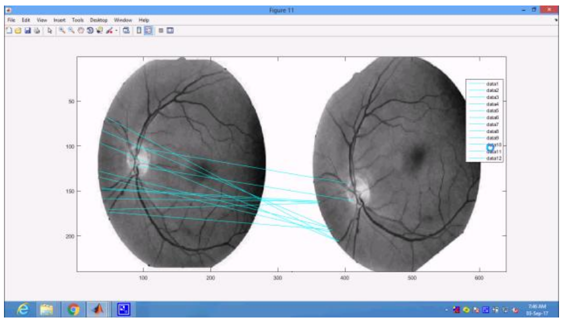

Fig 4.5: Feature matching stage

The above screenshot is giving the 2 images which we are matching here, the two retina images after the processing and segmentation, now the feature extraction process is initiated which will make the process to finalise the matching step.

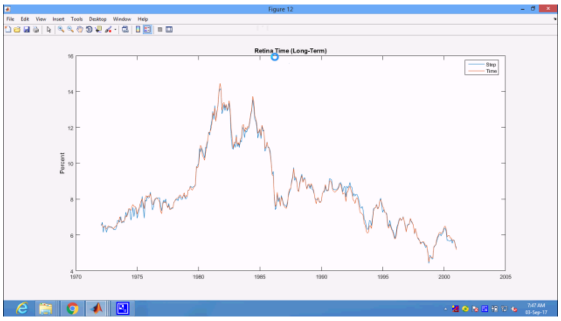

Fig 4.6: Retina long term graph

The above graph is the final graph representation of the both the graph, from the graph one can understand the matching functionality of the 2 images. The above graph is the retina time i.e. long-term graph is shown.

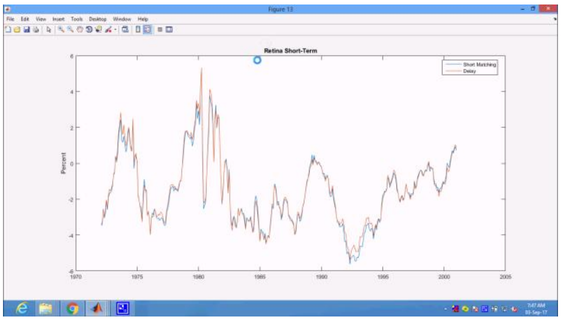

Fig 4.7: Retina short term graph

The above graph is another type of the graph of the 2 retina images. This is called as retina short term graph and short matching and delay is calculated here. The process involves this step after the pre-processing and feature extraction is done.

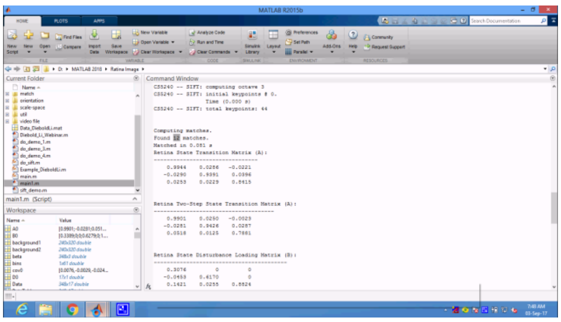

Fig 4.8: Final output of time taken

The above final result output gives the time taken for each type of the operation to be processed. And retina values of the 2 images which has been submitted for the sake of processing. This will give the number of matched in this case it is given as 12 and also the time taken for the matching process to be done.

5. CONCLUSION:

The proposed Retina based personal identification system using skeletonization and similarity transformation, is a simple and efficient system for identifying originality of people. The use of hessian based vessel segmentation technique helps to take out the ended retinal vessel tree from fundus image. Thus, we can take out almost all features. Skeletonization helps to establish the skeletal structure of retinal vessels. From the result of skeletonization, the pixel grouping method determine all bifurcation points in the image. These detected bifurcation points are used as features in matching stage. In the matching stage, the acquired pattern is matched with the reference one stored in database of the system. Here, the degree of similarity is measured using similarity metric. Thus the proposed system is able to produce an accurate result. Also it offers extremely low error rate. The system requires less computation time. It is a simple and efficient method for checking authentication of user.

6. REFERENCES:

[1] Robust Vessel Segmentation in Fundus Images, A. Budai, R. Bock, A. Maier, J. Hornegger, and G.Michelson. Hindawi Publishing Corporation International Journal of Biomedical Imaging Volume 2013, Article ID 154860, 11 pages http://dx.doi.org/10.1155/2013/154860

[2] A Combined Method to Detect Retinal Fundus Features V. Bevilacqua S. Cambo L. Cariello G. Mastronardi, Politecnico Di Bari (Italy)

[3] Retinal Verification Using a Feature Points-Based Biometric Pattern, M. Ortega, M. G. Penedo, J. Rouco, N. Barreira, and M. J. Carreira, Hindawi Publishing Corporation EURASIP Journal on Advances in Signal Processing Volume 2009, Article ID 235746, 13 pages DOI:10.1155/2009/235746.

[4] Alejandro F. Frangi, Wiro J.Niessen, et al. “Multiscale vessel enhancement filtering,” Medical Image Computing and computer-Assisted Intervention-MICCAI’98. 1998,1496:130:137.

[5] Digital image processing, third edition, Rafael C Gonzales and Richard E Woods.

[6] Retinal Fundus Biometric Analysis for Personal Identifications, Vitoantonio Bevilacqua, Lucia Cariello, Donatello Columbo, Domenico Daleno, Massimiliano Dellisanti Fabiano, Marco Giannini, Giuseppe Mastronardi, and Marcello Castellano, D.-S. Huang et al. (Eds.): ICIC 2008, LNAI 5227, pp. 1229–1237, 2008.

[7] Retinal Fundus Features Hybrid Detection based on a Genetic Algorithm, Vitoantonio Bevilacqua, Lucia Cariello, Simona Cambo, Domenico Daleno, Giuseppe Mastronardi, DEE Polytechnic of Bari, Via Orabona 4, 70125 Bari, Italy

[8] J. Daugman, "How iris recognition works," *IEEE Trans. Circuits Syst.Video Technol.*, vol. 14, no. 1, pp. 21–30, Jan. 2004.

[9] J. Daugman, "Probing the uniqueness and randomness of IrisCodes:Results from 200 billion iris pair comparisons," *Proc. IEEE*, vol. 94,no. 11, pp. 1927–1935, Nov. 2006.

[10] *Unique Identification Authority of India*. [Online]. Available:http://uidai.gov.in, accessed Nov. 1, 2015.

[11] K. R. Nobel, "The state of the art in algorithms, fast identificationsolutions and forensic applications," MorphoTrust USA,Billerica, MA, USA, Tech. Rep., Jan. 2013. [Online]. Available:http://www.planetbiometrics.com/article-details/i/1446/.

[12] P. E. Peterson *et al.*, "Latent prints: A perspective on the state of thescience," *Forensic Sci. Commun.*, vol. 11, no. 4, pp. 1–9, 2009.

[13] C. Champod, "Edmond Locard—Numerical standards and 'probable' identifications," *J. Forensic Identificat.*, vol. 45, no. 2, pp. 136–163,1995.

[14] K. McGinn, S. Tarin, and K. W. Bowyer, "Identity verification usingiris images: Performance of human examiners," in *Proc. IEEE 6th Int. Conf. Biometrics, Theory, Appl., Syst. (BTAS)*, Sessp./Oct. 2013,pp. 1–6.

[15] H. Proenca, "Iris recognition: On the segmentation of degraded imagesacquired in the visible wavelength," *IEEE Trans. Pattern Anal. Mach.Intell.*, vol. 32, no. 8, pp. 1502–1516, Aug. 2010.

[16] H. Proenca, S. Filipe, R. Santos, J. Oliveira, and L. A. Alexandre, "TheUBIRIS.v2: A database of visible wavelength iris images captured onthe-move and at-a-distance," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 32, no. 8, pp. 1529–1535, Aug. 2010.

[17] Z. Sun, L. Wang, and T. Tan, "Ordinal feature selection for iris andpalmprint recognition," *IEEE Trans. Image Process.*, vol. 23, no. 9, pp. 3922–3934, Sep. 2014.

[18] M. S. Sunder and A. Ross, "Iris image retrieval based onmacro-features," in *Proc. 20th Int. Conf. Pattern Recognit.*, 2010,pp. 1318–1321.

[19] J. De Mira and J. Mayer, "Image feature extraction for applicationof biometric identification of iris—A morphological approach,"in *Proc. Brazilian Symp. Comput.Graph. Image Process.*, 2003,pp. 391–398.

[20] F. Shen, "A visually interpretable iris recognition system with crypt features,"Ph.D. dissertation, Dept. Comput. Sci. Eng., Univ. Notre Dame,Notre Dame, IN, USA, 2014.

[21] F. Shen and P. J. Flynn, "Using crypts as iris minutiae," *Proc. SPIE*,vol. 8712, p. 87120B, May 2013.

[22] F. Shen and P. J. Flynn, "Iris matching by crypts and anti-crypts," in*Proc. IEEE Conf. Technol. Homeland Secur.*, Nov. 2012, pp. 208–213.

[23] F. Shen and P. J. Flynn, "Are iris crypts useful in identity recognition?"in *Proc. IEEE 6th Int. Conf. Biometrics, Theory, Appl., Syst.*,Sep./Oct. 2013, pp. 1–6.

[24] F. Shen and P. J. Flynn, "Iris crypts: Multi-scale detection and shapebasedmatching," in *Proc. IEEE Winter Conf. Appl. Comput. Vis.*,Mar. 2014, pp. 977–983.=

[25] J. Chen, C. W. Harvey, M. S. Alber, and D. Z. Chen, "A matchingmodel based on earth mover's distance for tracking Myxococcusxanthus,"in *Proc. Med. Image Comput. Comput.-Assist. Intervent.*, 2014,pp. 113–120.

[26] J. Chen, F. Shen, D. Z. Chen, and P. J. Flynn, "Iris recognition based onhuman-interpretable features," in *Proc. IEEE Int. Conf. Identity, Secur.Behavior Anal. (ISBA)*, Mar. 2015, pp. 1–6.

[27] P. J. Phillips, K. W. Bowyer, P. J. Flynn, X. Liu, and W. T. Scruggs, “Theiris challenge evaluation 2005,” in *Proc. 2nd IEEE Int. Conf. Biometrics,Theory, Appl., Syst.*, Sep./Oct. 2008, pp. 1–8.

[28] *CASIA Iris Image Database*. [Online]. Available: http://biometrics.idealtest.org/, accessed Nov. 14, 2015.

[29] Y. Rubner, C. Tomasi, and L. J. Guibas, “A metric for distributions withapplications to image databases,” in *Proc. IEEE 6th Int. Conf. Comput.Vis.*, Jan. 1998, pp. 59–66.