IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 8, August 2016

Score Level Integration of Fingerprint and Hand Geometry Biometrics

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Abstract: In the age of information technology biometric identification is the heart of computer implementation. Biometric is a physical or biological attribute that can be measured. Biometric identification accepts or rejects the person's identity, based on his/her physiological or behavior characteristics. Multimodal biometric identification system is more power full, more accurate, less noisy data than the single biometric model. In unimodal such as face, finger, iris, retina all are decade according to time pass or some changes may be applied therefore multimodal is given better performance. In this work we use fingerprint, hand geometry used as multibiometric and find good result with high accuracy using quantile normalization fusion of hand geometry and fingerprint biometrics.

Keywords: Fingerprint, Biometrics, Quantile Normalization, Hand geometry.

1. INTRODUCTION

Technology that is advancing at a remarkably fast speed controls the today's world we live in. Most of these technology developments are meant to make lives simple and safer. With the availability of very large-scale computer networks and the increasing concern for identifying theft cases, the use of appropriate personal identification security systems has become of most importance. The desired personal identification systems should have the ability to point out an individual with at most accuracy, rapidly, reliability, without invading any privacy rights, in a most cost effective way, user friendly and which can manage to cope up with the changing technology developments. Biometrics systems generally form one of the latest technologies that have found to be used in many areas of people's daily lives. Biometrics can be explained as a process of measuring an individual's physiological or behavioral characteristics by determining or verifying their identity. On the other hand, biometrics acts as a barrier between an individual's personal data and the unauthorized use of that data. A biometric device works by creating a digital template, whereby a database compares this template with an already existing template.

With the increasing frauds in today's world security is a big issue. So to increase the security we need to automate various identification systems. For that biometrics emerged as a new technology. Biometrics emerged as an automated identification system based on person's biological traits. Two types of traits are used- physiological and behavioral [1]. Physiological characteristics relate to the shape of the body and includes- fingerprint, face recognition, hand geometry, iris recognition, palm recognition, etc. Behavioral characteristics relate to the behavior of the person and it includes - signature recognition, keystroke dynamics and voice recognition. Biometrics has replaced traditional identification system in many applications like immigration and border security, ATMs, government IDs, etc. A good biometric system must be following qualities- universality, permanence, uniqueness, collectability, circumvention, performance.

Technology must be for every common person, similar is the cases with biometrics. It should reach each and every person. each biometric has its own negative and positive accept and the selection of the biometric should not relay on its matching performance but it should also see whether there is a need of biometrics system for the application or not. In this sequence we talk about accuracy, biometric technology itself is based on accurately validating a person's true identity. Without accuracy the idea of biometrics itself will be baseless.

Secondly biometric system must be reliable in every sense be it performance accuracy or speed. The work flow of biometric system should be continuous. It should not be interrupted in any case even when authorized persons access the system while blocking others.

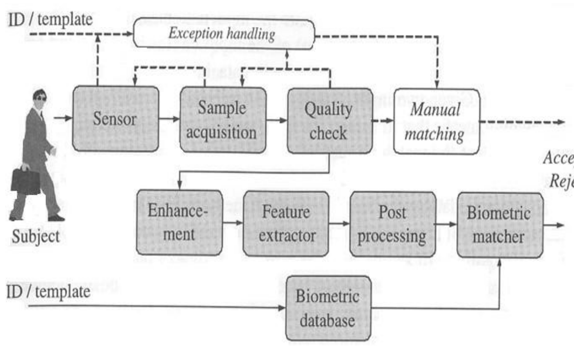

Figure 1 Biometric Recognition System

A multi model biometric system have some important modules in research areas: i) sensor module – which

IJARCCE

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captures the trait in the form of raw biometric [12] data, ii) feature extraction modules- which process the data to extract a feature set that is a compact representation of the trait, matching module- which employs a classifier to compare the extract feature set with the stored temples to generate the matching scores, decision module- which uses the matching score to either determine an identity or validate a claimed identity, system database module which uses database pattern using pattern matching technique, as shown in figure 1.1.

In Decision (Matching) the final component of a biometric system is the decision or matching component. Decision component compares a query biometric template with the stored template of claimed person and assign them a similarity score. That score is used for make decisions about the matching or not of the templates. In Verification Systems if the similarity scores are greater than a fixed threshold the system decides that templates belong to the same person. In Identification System the database templates are compared query template and higher similarity score templates are selected to decide if some person was identified on database.

2. LITERATURE REVIEW

Biometrics is referred to the study of identifying individuals with the aid of two aspects namely, physical or behavioural traits. As an important biometrics characteristic, fingerprint or finger knuckle print has been receiving significant attention with its high merits, like user friendliness, accuracy and cost factor. Anyhow, there arises certain improvement for designing a multimodal system in the aspects of matching score, error rate and genuine acceptance rate.

Fingerprint matching scheme using Ridge Count (RC) [1] method used a breadth first search to maximize the rate of accuracy and the biometric recognition system. However, uni-modal fingerprint biometric systems only conducted individual recognition system based on a specific source of biometric information. Fuzzy Binary Decision Tree FBDT) [2] used hand knuckle as a feature for biometric verification system with the aid of Ant Colony optimization to differentiate between two classes, genuine and imposter. But, the match score on low quality small foreground area biometric images remained unaddressed. Online Finger-Knuckle-Print Verification (OFKPV) [3] introduced a new biometric authentication system using local convex direction map to increase the recognition rate. But, the process involved during verification resulted in higher affine transformations.

Joan Fabregas et.al.[11] have investigated how the biometric system based on hand geometry is affected by image resolution. Researchers have reduced resolution from initial 120dpi up to 24dpi. The experiments are performed by using two databases, one underhand database and other is overhand database and capture 10 different images of 85 people and 15 features have been extracted which define hand geometry. For identification two classifiers are used- SVM and Neural networks. At the end they conclude that without any loss of recognition rate, resolution can be reduced to 72dpi.

Bahareh. Agile, et.al., [4] has used only four finger geometry for personal identification/verification. They proposed the method which is insensitive to rotation of the hand so that images can be captured by desk scanner where users can freely place his hand and pegs are not required. They extract 24 features from 4 fingers and have used Euclidean and absolute distance as a classifier. The proposed method has been applied on 500 pictures of 50 users and shows 99.81% accuracy in identification and EER is 0.1743% using the absolute distance classifier.

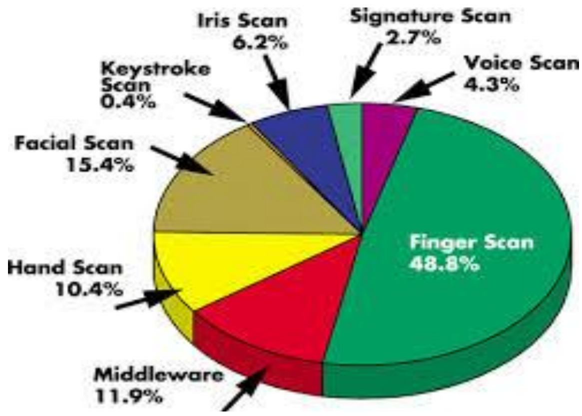

Figure 2 market size of different biometric technology

Keeping in view the hygiene of individuals some researchers proposed contactless hand geometry system in which a person is not expected to touch any surface which is good for individual hygiene. Jing-Ming Guo et.al. [6] have designed contact free system of hand geometry using a commercial webcam and infrared devices for illumination. Using infrared devices, it is possible to employ the system in dark and real environment. After capturing the image and preprocessing the image 34 hand's features have been extracted using 13 important points of hand for further recognition. For recognition libSVM framework is employed and obtained the result of false accept ratio (FAR) 1.85%, which is acceptable to uniquely identify the individual.

Fingerprint Database: (BSSR1) Biometrics Score Set-Release 1, is score set of raw output, from face recognition and fingerprint recognition. This release includes the true multimodal score data which is similarity scores, when compared of faces and fingerprint data of the same people. The data is also intended to allow a group to investigate and test a range of statistical problems in the relation to biometrics. Generally, the data are studied at score level fusion based multimodal, multi-algo, multi-sampling and repeated sample data fusion biometrics. It is used in testing of confidence level and assessed if it exists or not in biometrics.

The release consists of three sets, which are explained below:

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Set 1 is comprised for face and fingerprint of 517 individuals. Two right index fingerprint, two left score and two scores from comparison of front face.

Number of subjects 517
No. of fingerprint systems 1
No. of face systems 2
No. of face images from which scores were obtained 2 per subject
No. of fingerprint images from which scores were obtained 2 per subject
No. of scores 2*517*517
No. of similarity files 2068
Suggested use in fusion studies face and finger fusion

Set 2 is comprised of fingerprint from one system and run in different environment of 6000 individuals.

Number of subjects 6000
No. of fingerprint systems 1
No. of face systems 0
No. of face images from which scores were obtained 0
No. of fingerprint images from which scores were obtained 4(2 left, 2 right) per subject
No. of scores 2*6000*6000
No. of similarity files 12000
Suggested use in fusion studies two finger fusion

Set 3 consists of scores from two face run on 3000 individuals.

Number of subjects 3000
No. of fingerprint systems 0
No. of face systems 2
No. of face images from which scores were obtained 2
No. of fingerprint images from which scores were obtained 0
No. of scores 2*3000*3000
No. of similarity files 12000.

3. HAND GEOMETRY

Hand geometry is based upon measurement of the physical geometry feature of human hand. There measurement is further used to create template. Such template helps to compare against new hand reading by the user. The hand geometry of the human hands contains pattern of ridges and image much like the length, curve etc. Human hand geometry also contains additional distinctive features such as principal lines and wrinkles that can. It is easy to be captured even with a lower resolution scanner. One can easily understand how accurate these devices are by knowing that they take over 90 measurements of the length, width, thickness, and surface area of a person's hand and fingers. But there is a problem faced as it covers large area and the people suffering from arthritis, missing finger, or large hands might find it difficult to enroll.

4. FINGERPRINT

In the early phase of industrial development man development, a way to identify culprits by their fingerprints. The same technique evolved and now is used in the open market to identify the right person from the wrong. Now it is automatically done by machines and computers. by keeping in mind the universal pattern of Arch's, loops, whorls shape of the ridges. Once a fingerprint is captured by the device and the input has been made to the system then the next time and every other time Fingerprint recognition system is very accurate and stable, correct fingerprint recognition takes place. Some of the disadvantages of this method are that the sensor may get dirty and can give false result due to the presence of the residual of previous user. Database and template making may vary depending on the skin conditions of the different users. However, it has been observed that, a biometric system that assimilates information at an earlier stage of processing is expected to provide more accurate results than the systems that integrate information at a later stage, because of the availability of richer information.

Figure 3 Finger Image used for Biometric Trait

The state-of-the-art of fingerprints based identification methods with advantages, disadvantages, and key features comparison. Traditionally, tokens such as physical key, personal ID cards, and passwords were used to identify a person. The limitations of these automatic tokens are: Tokens can be easily stolen or lost; Password can be guessed or forgotten. Thus, the necessity of a powerful means for identifying a person called biometric personal identification system came into existence. A number of finger print based biometric systems have been developed by researchers for identifying an individual. These systems use fingerprint, thumbprint, palm print, finger veins, and hand geometry based features for identity verification [96]. The features of palm print image include principle lines, wrinkles, ridges, minutia points, singular points and texture. A low-resolution palm print image with less than 100 dpi (dots per inch) can be used to obtain principle lines and wrinkles. A high-resolution palm print image with at least 400 dpi can be used to obtain minutiae points, ridges and singular points.

5. QUANTILE NORMALIZATION

The goal of the quantile method is to make the distribution of probe intensities for each array in a set of arrays the same. The method is motivated by the idea that a quantile–quantile plot that the distribution of two data vectors is the

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ISSN (Print) 2319 5940

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same if the plot is a straight diagonal line and not the same if it is other than a diagonal line. This concept is extended to n dimensions so that if all n data vectors have the same distribution, then plotting the quantiles in n dimensions gives a straight line along the line given by the unit vector _ √1n , . . . , √1n. This suggests we could make a set of data have the same distribution if we project the points of our n dimensional quantile plot onto the diagonal.Let **q**k = (qk1, . . . , qkn) for k = 1, . . . , p be the vector of the kth quantiles for all n arrays **q**k = (qk1, . . . , qkn) and d= _ √1n , . . . , √1n be the unit diagonal. This implies that we can give each array the same distribution by taking the mean quantile and substituting it as the value of the data item in the original dataset. Though biometric systems have been successfully deployed in a number of real-world applications, biometrics is not yet a fully solved problem. The three main factors that contribute to the complexity of biometric system design are accuracy (FAR, GAR and rank-1 identification rate), scalability (size of the database) and usability (ease of use, security and privacy). To reliably compare data from multiple chips one needs to minimize non biological differences that may exist. One process that helps is to normalize within a set of chips. We will propose a method that can quickly normalize within a set of chips without choosing either a baseline chip to which all chips are normalized or working in a pairwise manner. The method will deal reliably with nonlinearities.

6. RESULTS

In statistics, quantile normalization is a technique for making two distributions identical in statistical properties. To quantile normalize a test distribution to a reference distribution of the same length, sort the test distribution and sort the reference distribution. The highest entry in the test distribution then takes the value of the highest entry in the reference distribution, the next highest entry in the reference distribution, and so on, until the test distribution is a perturbation of the reference distribution. To quantile normalize two or more distributions to each other, without a reference distribution, sort as before, then set to the average (usually, arithmetic mean) of the distributions. So the highest value in all cases becomes the mean of the highest values, the second highest value becomes the mean of the second highest values, and so on. Generally, a reference distribution will be one of the standard statistical distributions such as the Gaussian distribution or the Poisson distribution. The reference distribution can be generated randomly or from taking regular samples from the cumulative distribution function of the distribution.

However, any reference distribution can be used. Fusion of matching score of fingerprint and hand geometry, we have calculated the FAR, GAR, Min Threshold and Max Threshold values, FAR is False Acceptance Rate, GAR is Genuine Acceptance Rate.A match score is termed as genuine or authentic score if it indicates the similarity between two mate samples. AR is defined as the fraction of genuine scores that exceed the thresholdη.

The input values are of hand geometry score, fingerprint geometry score and normalized score values of fingerprint and hand geometry matching scores is shown in table 4.1, table 4.2, table 4.3, table 4.4 and table 4.5.

Table 1Matching Score for Hand Geometry

0.748489	0.126027	0.14286	0.133894	0.136077	0.056536
0.284369	0.4532	0.11544	0.120545	0.126082	0.11544
0.12332	0.302226	0.709533	0.120446	0.137779	0.092934
0.128678	0.105075	0.311746	0.895789	0.116451	0.200758
0.139579	0.135559	0.114484	0.16433	1	0.114484
0	0.32689	0.092934	0.120446	0.137779	0.650549

Table 2 Matching Score for Fingerprint

76.898	26.423	27.788	27.061	27.238	20.788
39.263	52.953	25.564	25.978	26.427	25.564
26.203	40.711	73.739	25.97	27.376	23.739
26.638	24.724	41.483	88.843	25.646	32.483
27.522	27.196	25.487	29.529	97.293	25.487
16.203	42.711	23.739	25.97	27.376	68.956

Table 3 Normalized Fingerprint Score for Fingerprint

84	5	5	4	8	21
7	57	4	8	11	11
7	7	81	4	6	32
5	6	5	65	6	11
5	10	7	5	158	9
6	11	7	8	23	98

IJARCCE

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ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
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Table 4 Normalized Fingerprint Score for Hand Geometry

0.519481	0.006494	0.006494	0	0.025974	0.11039
0.019481	0.344156	0	0.025974	0.045455	0.045455
0.019481	0.019481	0.5	0	0.012987	0.181818
0.006494	0.012987	0.006494	0.396104	0.012987	0.045455
0.006494	0.038961	0.019481	0.006494	1	0.032468
0.012987	0.045455	0.019481	0.025974	0.123377	0.61039

Table 5: Fused Score

0.388826	0.000818	0.000928	0	0.003534	0.006241
0.00554	0.155971	0	0.003131	0.005731	0.005247
0.002402	0.005888	0.354766	0	0.001789	0.016897
0.000836	0.001365	0.002024	0.354825	0.001512	0.009125
0.000906	0.005282	0.00223	0.001067	1	0.003717
0	0.014859	0.00181	0.003128	0.016999	0.397088

Table 6: Results

	FRR (%)	FAR (%)	GAR (%)
Hand geometry	5.87	8.67	94.14
Fingerprint	6.89	7.98	96.50
Hand + Fingerprint	7.38	8.76	98.98

7. CONCLUSION

Fusion of fingerprint and hand geometry systems at decision level was proposed. This platform is necessary if we have treat huge databases that contain hundreds of millions of users. The scores are normalize using quantile normalization. Each subsystem gives its individual decision, and then these decisions will be used by fuzzy logic which gives excellent accuracy. In the future we will use other methods to fuse the decisions and comparing them with fuzzy logic to determine who will present less computation time and highest accuracy.

REFERENCES

[1] Heeseung Choi, Kyoungtaek Choi, and Jaihie Kim, "Fingerprint Matching Incorporating Ridge Features With Minutiae," IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 6, NO. 2, JUNE 2011

[2] Amioy Kumar, Madasu Hanmandlu, H.M. Gupta, "Ant colonyoptimization based fuzzy binary decision tree for bimodal handknuckle verification system," Expert Systems with Applications, Elsevier journal, 2013

[3] Lin Zhang, LeiZhang., DavidZhang, HailongZhu., "Online fingerknuckle-print verification for personal authentication," Pattern Recognition, Elsevier journal., 2010[4] Sarat C. Dass," Assessing Fingerprint Individuality in Presence ofNoisy Minutiae", IEEE TRANSACTIONS ON INFORMATIONFORENSICS AND SECURITY, VOL. 5, NO. 1, MARCH 2010

[5] Shoichiro Aoyama, Koichi Ito, Takafumi Aoki," A finger-knuckle printrecognition algorithm using phase-based local blockmatching", Information Sciences, Elsevier, Aug 2013

[6] Tao Kong, Gongping Yang and Lu Yang," A hierarchicalclassification method for finger knuckle print recognition", EURASIP Journal on Advances in Signal Processing, Jan 2014

[7] Guangwei Gao, JianYang, JianjunQian, LinZhang," Integration ofmultiple orientation and texture information for finger-knuckleprintverification", Neurocomputing, Elsevier, Jan 2014

[8] A. Muthukumar And S. Kannan," K-Means Based MultimodalBiometric Authentication Using Fingerprint And Finger KnucklePrint With Feature Level Fusion", IJST, Transactions of ElectricalEngineering, Vol. 37, No. E2, pp 133-145, Dec 2013

[9] Esther Perumal and Shanmugalakshmi Ramachandran," AMultimodal Biometric System Based on Palmprint and FingerKnuckle Print Recognition Methods", IAJIT, Aug 2013

[10] Abdallah Meraoumia, Salim Chitroub and Ahmed Bouridane,"Fusion of Finger-Knuckle-Print and Palmprint for an EfficientMulti-Biometric System of Person Recognition", Proceedings onICC, IEEE, Nov 2011

[11] Vaibhav V. Dixit, Dr. Pradeep M. Patil," Person RecognitionBased on Knuckle Print Biometric Features Computed using RadonTransform", International Journal of Advanced Research inComputer Science and Software Engineering, Volume 4, Issue 3, March 2014

[12] Ola M Aly, Hoda M Onsi, Gouda I Salama, Tarek AMahmoud,"Multimodal Biometric System using Iris, Palmprint andFinger-Knuckle", International Journal of Computer Applications,Volume 57, No. 16, Nov 2012

[13] Ola M. Aly, Hoda M. Onsi, Gouda I. Salama, Tarek A. Mahmoud,"A Multimodal Biometric Recognition system using feature fusionbased on PSO", International Journal of Advanced Research inComputer and Communication Engineering Vol. 2, Issue 11,November 2013

[14] Li Lu and Jialiang Peng," Finger Multi-Biometric Cryptosystem using Feature-Level Fusion", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.7, No.3 (2014), pp.223-236

[15] Rima Belguechi, Estelle Cherrier, Mohamad El Abed and Christophe Rosenberger," Evaluation of Cancelable Biometric Systems: Application to Finger-Knuckle-Prints", IEEE, International Conference on Hand-based Biometrics, Nov 2011