FC-QIA: Fingerprint-Classification based Quick Identification Algorithm

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Abstract: *Fingerprint is one of the most important biometric techniques for identification and authentication, which may also reduce the complexity (cost / time) of searching data in large database. Over the past several years various methods have been proposed for fingerprint identification, on the same way, this paper propose a new efficient method for fingerprint identification based on ridge and valley pattern of fingers and corresponding result shows that proposed scheme is several times faster than previous scheme.*

Keywords: *Fingerprint identification, fingerprint classification, biometric authentication, fingerprint verification, Henry's scheme.*

I. Introduction

Fingerprint may use as low cost specific biometrics technique for user identification and verification as a best method in terms of availability and feasibility. It also provides higher security and convenience. Fingerprint classification criteria based on their geometric properties like delta and core may also be used to make system efficient fast data sources. Very first, scientist named *Galton* classifies the fingerprint, after Galton other scientist *Henry* added two or more number of classes in the scheme of Galton. Fingerprint identification system takes long time when fingerprint templates

are stored in database randomly. For improving the identification speed Henry stored the fingerprint templates into particular order. For fingerprint identification purpose in future, input fingerprint data compared with the stored fingerprint database and the response time depends on number of comparisons. Response time decreased with reducing the number of comparisons. Henry fingerprint classification system classifies the fingers in a systematic way: loop, Whorl, Arch. Loop and Arch further divided into two subclasses: left loop, right loop and plain arch tented arch. Methods for automatic fingerprint classification system divided into four main categories: i) approaches based or singular points, ii) structure based, iii) frequency based, iv) Mathematical model method. One Hybrid classification method for fingerprint classification that combines two methods like: approaches based or singular points and mathematical model method. Some of the hybrid methods not tested for large databases because of their bad performance. [1, 2, 3, 4]

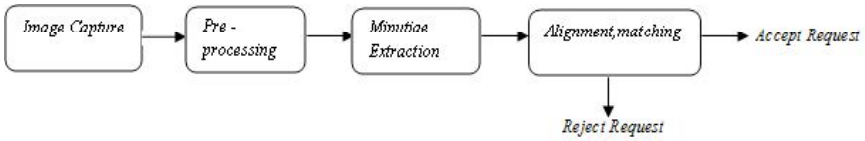


Figure 1: Fingerprint Identification System

Finger 1 shows commonly used traditional fingerprint identification system. In the 1st step image capturing, device capture image, in 2nd step, pre-processing, the main aim of pre-processing make image more suitable for the next step and compress the image data. In the 3rd step, extract the features of the image that are important for identification. For minutiae extraction a special algorithm used named *"Ridge Following Algorithm".* In final 4th step, alignment and matching algorithms are used for identification. If input fingerprint is matched with the previously stored database, system accept request otherwise user's request is rejected. [8]

II. Previous Work

For fingerprint identification AFIS (Automated Fingerprint Identification System) is used which need to be compare of the input fingerprint to the

whole fingerprint database. This technique is more complex for some applications. Several previous scientists make large number of methods for fingerprint classification and identification. For reducing the number of comparisons and response time, a new scheme is produced by the scientist Francis Galton and Edward Henry. This scheme is used with existing AFIS database and also used for the systems that required compatibility with human classifications. In this scheme classify the fingerprint data based on finger's features like number of cores and number of deltas. [3, 4]

Henry fingerprint classification system permits for logical classification of fingerprints of both hands and fingerprint records grouped based on fingerprint pattern types. Henry classification system decreases the effort necessary for search the fingerprint data from the large database. In the Henry fingerprint classification system each finger assign the number based on their occurring of fingers in the hand. The right thumb assign the number = 1 and end with the left little finger (pinky), its number = 10. In this system each finger assigned the numerical values to all fingers in both hands. Fingers without whorl pattern like arch or loop pattern provides the value = 0 (zero) and with whorl assign the value = 1. According to the Henry fingerprint classification system assigned finger number, finger values and pattern type of finger shown in the table 1. [5, 6, 7, 11]

	Left Hand					Right Hand				
Name	L Pinky	L Ring	L Middle	L Index	L Thumb	R Thumb	R Index	R Middle	R Ring	R Pinky
Number	10	9	8	7	6	5	4	3	2	1
Value(if whorl)	1	1	2	2	4	4	8	8	16	16
Pattern type	Arch	Loop	Whorl	Loop	Arch	Loop	Whorl	Arch	Arch	Loop
Finger Value	0	0	2	0	0	0	8	0	0	0

Table 1: Henry Fingerprint Classification Scheme [7]

Table shows the Henry fingerprint classification, Primary Grouping Ratio (PGR) calculates from this equation:

$$PGR = \frac{1+(sum\ of\ whorled,\ Even\ finger\ value)}{1+(sum\ of\ whorled,\ Odd\ finger\ value)}$$

$$PGR = \frac{1+(2+8)}{1+0} = \frac{11}{1} \qquad (from\ table\ 1)$$

Fingerprint data stored into database with their relative PGR value. If all the fingers of both hands contain whorl values, then PGR = 31:31, if any person does not contain whorl values then PGR = 1:1. The major drawbacks of this scheme are, first is, fingerprints of both hands are required and second, because of the storage of fingerprints of both the hands required large memory space. [9, 10]

III. Proposed Scheme

In previous scheme system stored the fingerprint records in a traditional pattern which is highly complex and less efficient. But in proposed scheme, fingerprint records classify and stored into the particular manner, based on ridge pattern of fingerprint like: whorl, loop and arch. Human finger formed by various types of patterns that are totally based on ridges and valleys. Loops use nearly 66%, whorl takes 30% and arch use the 4-10% of all fingerprints [8]. In proposed scheme, fingerprints are divided into six regions based on the number of deltas and cores are: whorl, left loop, right loop, plain arch, tented arch and twin loop.

Figure 2: Classification of fingerprints

IV. Fingerprint-Classification Based Quick Identification Algorithm (Fc-Qia): The Proposed Algorithm

Step 1: if (Nd=2&&Nc=1) || (Nd=2&&Nc=0)
then pt = whorl.
Step 2: else if (Nd = 2 && Nc = 2)
then pt = Twin Loop.
Step 3: else if (Nd = 1 && Nc = 1)
if DL = Right
then pt = left loop.
ifDL=left,
then pt = Right loop.
Step 4: else if (Nd = 0 && Nc = 0)
if Rp = vertical,
then pt = tented arch
if Rp = horizontal,
then pt = plain arch.
Step 5: else, one of the above condition is not satisfied, and then reject the input fingerprint.
Where: (number of delta = Nd, number of core = Nc, pattern= pt, ridge pattern= Rp, delta location = DL).

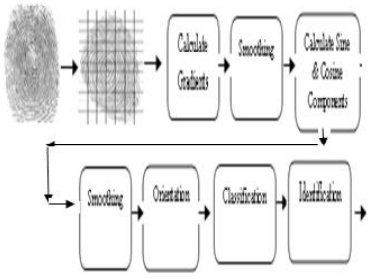
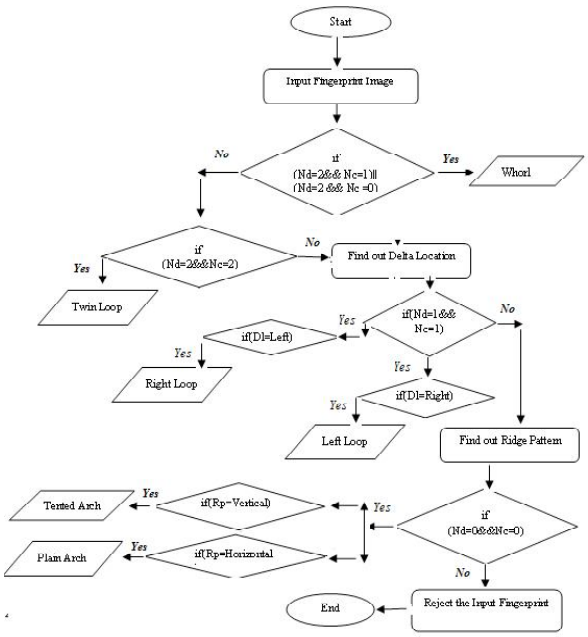


Figure 3: Fingerprint Identification Algorithm

V. Flow Chart of Algorithm



Flow Chart: Fingerprint Identification Process

VI. Implementation

In implementation, we use **MATAB** version **7.10** as an implementation platform. This work is mostly based on the Image Processing toolbox; it is main part of **MATLAB** tool and the work focused on designing a classification-based speedup fingerprint identification system that is highly expandable using the **MATLAB** environment, the main benefits of the **MATLAB** environments are: simplicity, code database, code libraries, PC operation, platform Export, User Interface etc. This implementation presents the experimental procedures used for fingerprint Identification. It also provides

the results obtained from the mathematical calculation and discusses the comparison of previous and proposed scheme.

VII. Experimental Results

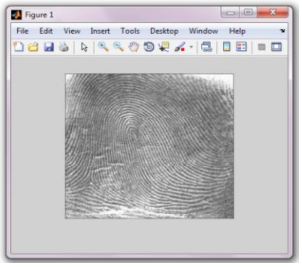


Figure 4: Original Fingerprint Image

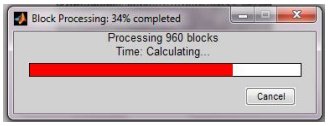


Figure 5: Block processing of the input image

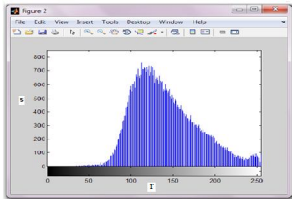


Figure 6: Histogram of the Original Image

Figure 4, shows the input image for processing that used in identification process. Figure 5 also shows the block processing of the input image. Figure 6, shows the histogram of the original image. Here r, is the input gray level and s, is the output gray level. Gray level means intensity of pixels. If image is noisy, so, for processing this image, we need noise free image for their operation, figure 7, shows the noise free image. For efficiently identification, we smooth the image, figure 8, shows resulting image after smoothing. Figure 9, also shows the blurred image due to motion.

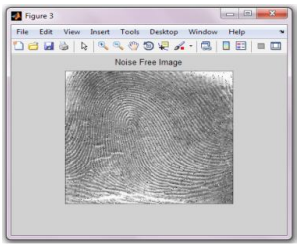


Figure 7: Noise free image

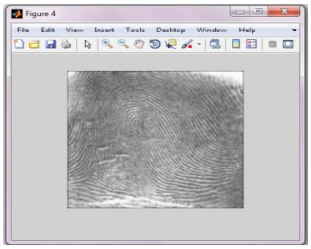


Figure 8: Image after Smoothing

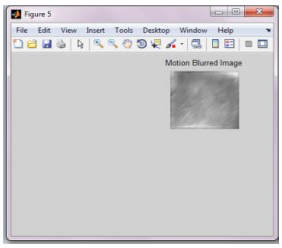


Figure 9: Motion Blurred Image

After finding out the type of the fingerprint of the input fingerprint like whorl, twin loop, left loop, right loop, plain arch or tented arch, I get an image.

After it, calculates the matching time of the previous scheme and proposed scheme. then we compare the speed of both schemes. Figure 10, shows the information about the image and figure 11, shows the magnitude of the result.

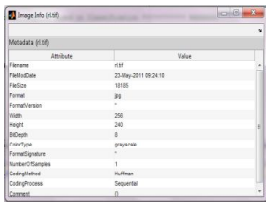


Figure 10: Image Information

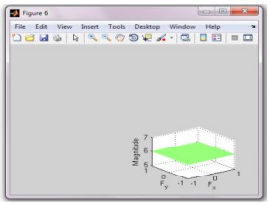


Figure 11: Magnitude of the Result

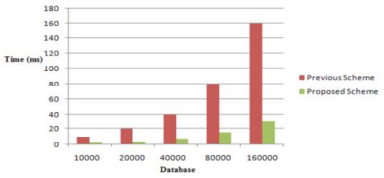


Figure 12: Performance evaluation of previous scheme and proposed scheme

VIII. Conclusion

In this paper, we proposed a classification algorithm for fingerprints based on ridge pattern and this algorithm leads a new scheme of bio-metric identification. It firstly examined the previous fingerprint classification scheme, proposed the new fast identification proposed scheme. After the experimental results it is finds that the proposed scheme is nearly 6.06 times faster than previous schemes. It is also concluded that the proposed scheme reduces the memory requirements, because we use only one hand used for identification not both.

References

[1] J.V.Kulkarni, J.R., S.N.Mail, H.K.Abhyankar, R.S. Holamble “A New Approach for Fingerprint Classification based on Minutiae Distribution” world academy of Science, Fingerprinting and technology, 15, 2006.

[2] X.Tan, Bir Bhanu, Y. Lin “fingerprint classification based on learned Features” IEEE Transactions on systems and cybernetics, vol. 35, no. , August 2005.

[3] S.C. Dass, Anil K. Jain “Fingerprint classification using orientation field flow Curves”

[4] Hanna Choi, S. Lee, D. Moon, Y. Chung, S.Pan "Secret Distribution for Secure Fingerprint Verification" International conference on Convergence and Hybrid Information Technology, IEEE, 2008.

[5] R. Cappelli, D.Maio, D. Maltoni, Loris Nanni "A two stage fingerprint classification system" 2007.

[6] Andrew Senior "A Combination Fingerprint Classifier" IEEE Transactions on pattern analysis and machine intelligence, vol. 23, no. 10, OCTOBER 2001.

[7] "The Henry Classification System" International Biometric Group, Research Consulting Integration, 2003.

[8] EECE 695C – Adaptive Filtering and Neural Networks "Fingerprint Identification – Project 2", 2009.

[9] Dr. H.B. Kekre, Dr. Tanuja Sarode, Rekha Vig "Fingerprint Identification using Sectorized Cepstrum Complex Plane" *International Journal of Computer Applications (0975 – 8887) Volume 8– No.1, October 2010.*

[10] Mary Lourde R and Dushyant Khosla "Fingerprint Identification in Biometric Security Systems" International Journal of Computer and Electrical Engineering, Vol. 2, No. 5, October, 2010.

[11] Atanu Chatterjee, Shuvankar Mandal, G. M. Atiqur Rahaman, and Abu Shamim Mohammad Arif "Fingerprint Identification and Verification System by Minutiae Extraction Using Artificial Neural Network" JCIT, 2010.