

A Study on the Fingerprint Recognition Algorithm Using Enhancement Method of Fingerprint Ridge Structure

Yong-Hoon Jung*, Jeong-Serk Roh*, Sang-Burm Rhee**

*Dept of Electronics & Computer Engineering, Dankook University, Seoul Korea

**School of Electrical & Electronics & Computer Engineering, Dankook University, Seoul Korea

[E-mail : tomas37@hanmail.net](mailto:tomas37@hanmail.net)

ABSTRACT

The present of state is situation that is realized by necessity of maintenance of public security about great many information is real condition been increasing continually in knowledge info-age been situating in wide field of national defense, public peace, banking, politics, education etc. Also, loss or forgetfulness, and peculation by ID for individual information and number increase of password in Internet called that is sea of information is resulting various social problem. By alternative about these problem, including Biometrics, several authentication systems through sign(Signature), Smart Card, Watermarking technology are developed. Therefore, This paper shows that extract factor that efficiency can get into peculiar feature in physical features for good fingerprint recognition algorithm implementation with old study finding that take advantage of special quality of these fingerprint.

keyword: Biometrics, Watermarking, authentication, recognition

1. Introduction

The present of state is situation that is realized by necessity of maintenance of public security about great many information is real condition been increasing continually in knowledge info-age been situating in wide field of national defense, public peace, banking, politics, education etc. Also, loss or forgetfulness, and peculation by ID for individual information and number increase of password in Internet called that is sea of information is resulting various social problem. By alternative about these problem, including Biometrics, several authentication systems through sign(Signature), Smart Card, Watermarking technology are developed. Body region of voice, face, iris, fingerprint and footprint, artery etc. is used much in biometrics. If argue briefly about fingerprint of their special qualities, Immutability and a person played in old form immediately even

if is caught that F. Galton silver of end part of the 19th century has fingerprint of same form until die being born and injury occurred by external factor emphasized Individuality that have fingerprint of other form all, is evaluated to theory that persuasive power is in today.

This paper shows that extract factor that efficiency can get into peculiar feature in physical features for good fingerprint recognition algorithm implementation with old study finding that take advantage of special quality of these fingerprint.

2. Relation research

Various kinds conditions must satisfy to embody efficient fingerprint recognition system, but minute research is required about feature of fingerprint, and research of matching method that consider way and various environment that can acquire correctly fingerprint reflex must become backing.

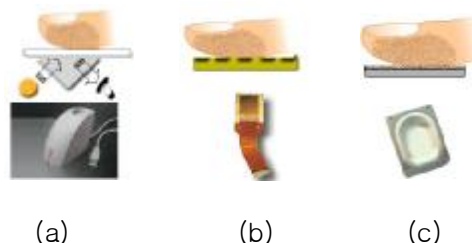
Beginning of modern fingerprint comparison skill goes back by 1684. Fingerprint in a person of Britain Royal Society's N. Gruw is different and found for the first time loop line, whorl, arch that have been separated. Also, early part British Edward Richard Henry way of the 20th century and fingerprint classification system of Germanic T. Roscher way are proposed, these way is used by way that select in English-speaking community countries of each America FBI etc.. and the our country National Police Agency. Reason that classifiable way of these fingerprint is important is because become important element that prove performance in fingerprint recognition system of big capacity of 1: N. Next, is same as following if recognize about features in fingerprint image. Generally, black line is ridge and white line expresses valley.

However, can change intentionally when change the other way according to input device and implementation algorithm. On knowledge info-age, information is weighing without that is limited to individual or some institution but, the boundary becomes vague day after day and it is nowadays actuality that quantity of information is being on the increase festinately. These environment made to be embossed greatly importance of maintenance of public security and rise interest about biometrics. Fingerprint recognition of biometrics field has been study but point to improve remains still. Specially, can do that side that is accuracy and speed enhancement is so.

This paper increases discernment ability of fingerprint image of existent fingerprint recognition system, and is doing by ultimate target that extract factor that can get into peculiar feature that can bring good result in many fingerprint image. Therefore, we propose extraction method of minutiae, reference point and direction information for performance elevation of fingerprint recognition system.

Finally, present part to improve as conclusion and hereafter subject. Right acquisition of fingerprint image is one of important factor that

dominate general performance of fingerprint recognition system. There is that representative input method is same as following, paper that see uses optical input device.



(a) optic-sensor (b) semi-conductor sensor, (c) contact emitting light sensor.

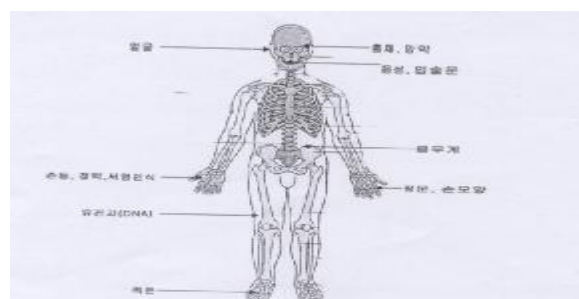
2.1 Overview of Biometrics Technology

Biometrics Technology is skill that take advantage of unique feature of human's immutability, and analyze feature via device computerized characteristics.

body part utilized in biometrics is physical features and fingerprints, retina, iris, face, hand, voice, body smell, DNA etc. Biometrics is means that the perfectest authentication that other people can not take the place of me is.

Identification card or key, card, authentication means such as personal code number etc.. can get into reproduction, loss, forgetfulness, exposure, peccation, transformation etc., but biometrics supplies perfect method that can not take the place of what by a dimension high authentication means.

The following [Fig. 1] show component part for biometrics.



[Fig. 1] Component element for biometrics

It is objects that thing had marked [figure 1] is studying in biometrics technology.

We explain about fingerprint recognition skill that believability and constancy of biometrics technology studied the highest fingerprint recognition skill, and study in paper that see after explain shortly about biometrics methodologies such as retina(retina), iris(iris), vein(vein), face(face) cognition in this paper.

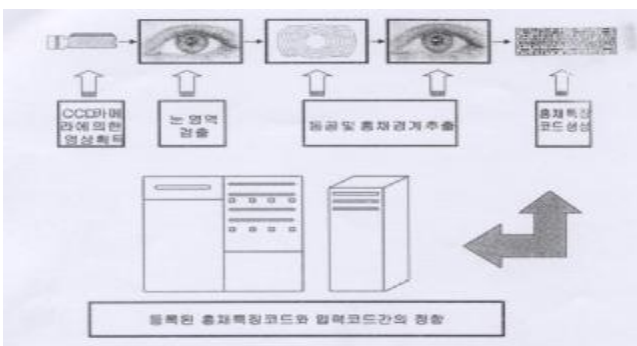
1) retina and iris

retina recognition is using composition of capillary situated on user's eyeball back in each and every person with human's fingerprint differ, to read this retina pattern by using to be having special quality that do not change for all life. Also, user for successful retina pattern search must take off glasses.

Although satisfy highly maintenance of public security department this retina pattern search skill discontent and awe of use cause and is cost-ineffective to use.

On the other hand, there is rejection symptom that must open and stare eye about 5 seconds setting focus of eye. also, iris recognition can speak as skill that applications by many field are expected because there is no shortcoming such as retina recognition. furthermore, iris recognition takes advantage of picture acquired in natural state. But, retina and iris are shortcoming that price is expensive at system development.

Following [Fig. 2] expressed about recognition process and feature code creation in iris recognition.



[Fig. 2] Edge extraction and recognition procedure in

iris recognition system

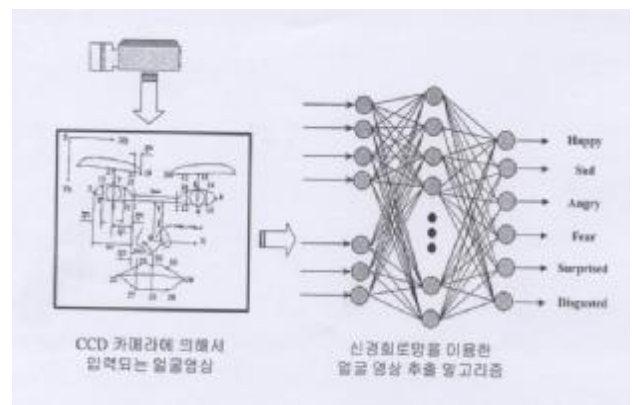
2) face recognition

The research about face recognition for a long time such as psychology, neuroscience, engineering field in wide field go. Face recognition has been divided by recognition which use still image and recognition which use animation, and it is become much researches in image processing department and pattern recognition, computer vision, field of neural net etc..

Face recognition system is used in many application fields such as company or security system of emigration and immigration of airport, management system in ATM of bank.

First of all, face recognition is begun by extracting face-area in acquired image. The face recognition techniques must consider trait of character that expression is changed according to user's emotion and situation. also, it is sensitive in surroundings lighting and there are many items to improve up to now.

It appeared about face recognition which use artificial intelligence method in [Fig. 3].



[Fig. 3] Face recognition using artificial intelligence method

2.2 The history of fingerprints

Great Britain and most of Europe accepted the Galton-Henry system, with the exception of France, Belgium, and Egypt, who used an amalgam of the two systems. France also held on to anthropometry for the first half of the 20th

century. Also, Edward Henry finished his system of identification and retrieval of fingerprints in 1896, to great success. The following year the Indian government made fingerprinting the official means of keeping track of criminals. In 1901, Henry becomes the head of Scotland Yard's Criminal Investigation Division. The four basic divisions that Henry creates are: Arches, Loops, Whorls, and Composites. Every fingerprint will fall into one of these four groups, narrowing down potential matches.

And from this point on, progress is swift, with the notable exceptions of France, Belgium and Egypt, all of whom will continue to use both the Bertillon method and fingerprinting. The New York Civil Service begins testing fingerprinting in 1902. In March, 1903 the New York State Prison system begins fingerprinting criminals and in 1904 the federal prison at Leavenworth begins to do so. (as a direct result of the Will/William West case). The US Army begins using them in 1905, and the Navy in 1906. The Marines lag behind a bit, beginning fingerprinting in 1907. In 1908, P.A. Flak of the Library Bureau Company in Chicago, designed the basic form still in use today an 8-inch square of medium weight cardboard, with the fingerprints on it in printer's ink. Printer's ink is preferred because it rarely smudges and dries quickly.

After eight years of testing, the FBI created a computerized Criminal Fingerprint File in 1980. In 1983 the FBI created the National Crime Information Center, to allow for the dissemination of information about criminals between the federal and local governments. As part of this, the FBI standardized the methods of fingerprint classification, eradicating local differences in classification, and making national retrieval easier. Fingerprinting and identification are still key to solving criminal cases, despite the technological advances that are making DNA testing more reliable and easy to obtain. It is possible that they may one day become obsolete, as new methods supersede them, but for the foreseeable future, the ends of the fingers will continue to point the way.

3. considerations item

Environmental factor of temperature, humidity, dust etc. in location becomes important variable that select sensor called ordinarily by optic or semi-conductor sensor. After acquisition of such fingerprint image consists rightly, taking into account condition of kind of fingerprint, preprocessing step are become different in authentication/recognition system implementation. Next step selects that fit in

purpose that preprocessing process intends by oneself among matching algorithm of short filterbank base relatively with minutiae base that minute preprocessing process is required. FAR(False Acceptance Ratio and FRR(False Rejection Ratio) etc. are used in criterion and hereafter performance assessment to decide these process.

Following [Fig. 4] show fingerprint classification that based on the Henry Classification System.



[Fig. 4] Five pattern of fingerprints

The Arch pattern is made up of ridges lying one above the other in a general arching formation.

The loop pattern consists of one or more free recurving ridges and one delta. In order to distinguish between ulnar and radial loops you must: first, know from which hand the loop pattern comes from and second, place your hand palm side down over top of the impression and determine if the recurving ridges originate from the little finger side or the thumb side. If the ridges flow in from the little finger side this would be an 'ulnar' loop. If the ridges flow in from the thumb side this would be a 'radial' loop. Next, whorl pattern consists of one or more free recurving ridges and two points of delta. When the line of the fingerprint disc is placed on the two points of delta, it will bisect at least one of the ridges belonging to the core group.

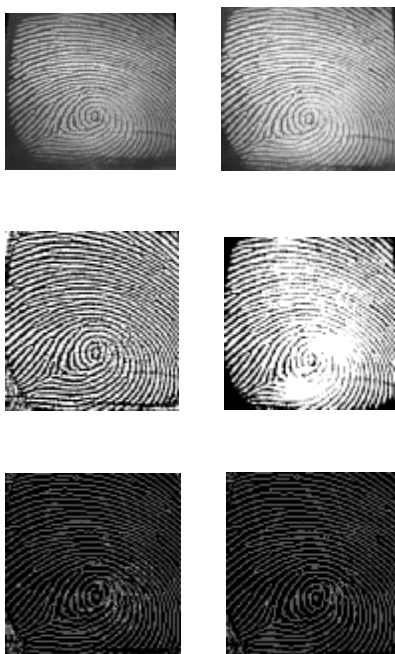
4. Preprocessing for image enhancement

Achieve minutiae of fingerprint used in matching that can speak that is coda of fingerprint recognition system after acquire image of

fingerprint considering various environment, preprocess process that extraction of factor that get into feature of direction information etc.. makes to be easy. This process can talk that equalization, binarization, thinning are representative example. If difference are not big foreground of input fingerprint and background in this paper, did not receive big effect in recognition result even if it omits equalization process. Next, binarization brought result that block binarization is good.

The next process is ready to extract reference point in fingerprint Image if thinning and noise rejection filtering.

Following [Fig. 5] show that preprocessing procedure and image enhancement in fingerprint recognition system.



[Fig. 5]Preprocessing for image enhancement

5. Extraction of direction and feature point in fingerprint image

We study extraction method of reference point and minutiae for efficient fingerprint recognition system. Also, we are going to present result image that show acquisition and preprocessing of fingerprint image and feature point.

Feature point in fingerprint image and direction information become important feature element of

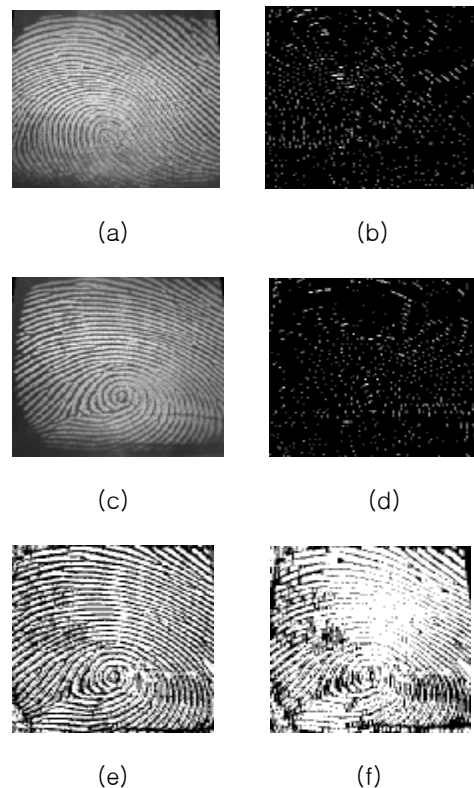
fingerprint that can heighten the recognition rate in fingerprint recognition system.

Central point of each form and number of delta that follow to Henry System are given with [Table 1].

<Table 1> Characteristics based on the Henry Classification System

Pattern	Core	Delta
R-loop	1	1
L-loop	1	1
Whorl	2	2
Arch	0	0
etc	0	1

Following [Fig. 6] show results of extraction of direction and feature point in fingerprint image.



[Fig. 6]Extraction of direction and feature point in fingerprint image

7. Conclusion and hereafter research

This paper displayed feature element extraction method in fingerprint image that can improve recognition performance by supplementing shortcoming of preprocessing methodology for

fingerprint image enhancement and fingerprint recognition system of existent minutiae base through direction information in fingerprint image. Result was satisfied on the whole, but there must be much researches about restoration problem for fingerprint image damaged and there must be researches about image acquisition method better than existent methodology too.

References

- [1] Jae Hyun Lee, Sung Joo Kim, Sang Bae Lee, "The stu., on the intelligent control of robot system using neural network," Preceedings of Asian Control Conference, vol.III, No.III, pp.67-70, 1997
- [2] Sung Joo Kim, Jae Hyun Lee, Sang Bae Lee, "The study on the Optimal control of Linear Track Cart Double Inverted Pendulum Using Neural Network," Preceedings of Asian Control Conference, vol.II, no.III, pp.15-18,1997
- [3] M. Minsky and S. Paper, Perceptrons, MIT press, 1969.
- [4] Y. Chan and F. Bastani, "ANN with T재 Dendrite Neurons and Weight Initialization," Proc, IJCNN, Baltimore, vol.III, pp.139-146, 1992
- [5] C. Koch and T. poggio, "Multiplying with Synapses and Neurons," in Single Neuron Computation, T. Mckenna, J. Davis, and S. F Zonnetzer, pp.3165-3455, 1992
- [6] <http://digitalplaza.co.kr/library/bio/lib-bio.htm>
- [7] F. Galton, Finger Prints, Macmillan, London, 1892.
- [8] E. R. Henry, Classification and Uses of Finger Prints, Routledge, London, 1900
- [9] Rafael C. Gonzalez and richard E. Woods, Digital Image Processing, Addison Wesley Longman, 1992.
- [10] T. Ch. Malleswara Rao, "Feature Extraction for Fingerprint Classification," Pattern Recognition, vol.8 pp.181-192, 1976
- [11] D. H. Ballard, "Generalized Hough transform to detect arvitrary patterns," IEEE Trans. Pattern Anal. Machine Intell., col,PAMI-3, no.2, pp.111-122, Feb. 1981.
- [12] Morris, R. and Thomson, K., "Password Security : A Case History," Comm ACM vol.22, no.11, 1979
- [13] H.C Lee and R.E. Gaensslen, Advances in Fingerprint Technology, Elsevier, 1991
- [14] R. Brunelli and D. Falavigna, "Personal Identification Using Multiple Cues," IEEE Trans. Pattern Analysis and Machine Intelligence, vol.17, no.10. pp.11-16 Nov., 1990.
- [15] Holems,-J.P., "Available hardware for automated entry control, ANS winter meeting, pp.11-16 Nov., 1990.