IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 3, No 2, May 2013
ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
www.IJCSI.org

A New approach for Finger-Print Identification

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Abstract

The choice of an object representation is crucial for the effective performance of cognitive tasks such as fingerprint image (FPI) recognition, this is because how robustly and efficiently Recognition tasks can be performed depends on the choice of the feature representation. This paper introduces radon transform coefficients as an effective and efficient FPI representation. The radon represent FPI with sets of weighted coefficients that are specially chosen to reflect the properties of the represent FPI.The radon transformer parameters are chosen according to a specific discrete scheme that is based on the discrete Multiwvelet transform. In this paper, we describe a new method to identify fingerprint by combining an extreme classifying method, SVM, and radon transformer-based technique. This approach is a learning method whose identifying time is so fast while training time is acceptable.

Keywords: Fingerprint identification, FPI , support vector machine, and radon transformers.

1. Introduction

Controlling the access to any computer network or secure areas requires a reliable personal recognition infrastructure [1]. Conventional methods of recognizing the identity of a person by using passwords or cards are not altogether reliable, because they can be forgotten or stolen. Biometric technology, which is based on physical or behavioral features of human body such as face, fingerprints, hand shape, eyes signature (iris or retinal) and voice, has now been considered as an alternative to existing systems in a great deal of application domains. Such application domains include private networks, entrance management for specified areas, and airport security checking system [2].

Most popular fingerprint identification systems first extract all minutiae points and then match them with the templates saved in a database to find the most correlative template. After that they will base on matching score and threshold to conclude about that fingerprint. This approach has some difficulties:

- It is very difficult to extract minutiae points in a noise fingerprint image. But this problem is very popular in practice (Fig. 1).
- The scale, translation and rotation of fingerprint will make difficulties for matching step (Figure. 1).
- Aligning minutiae points is an obligated step in this system. But the number of extracted minutiae of each fingerprint is not equal and consistent. This makes computational time in matching step so expensive.
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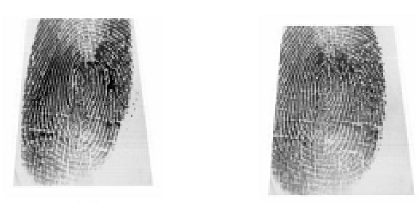

(A) (b)

Fig 1. Deux mauvaises qualités de l'image images d'empreintes digitales d'un même doigt

To pass these limitations, we propose a method to Identify fingerprint basing on using an extreme Classifying method, support vector machine, and radon transformer-based technique.

- With radon transformer-based technique, the feature of a fingerprint will be a combination of global flow of ridge and valley structure and the local ridge characteristics in a fingerprint which called Finger Code.

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- To identify a fingerprint from a pool of registered fingerprints, we just extract its Finger Code and use MLP to classify. The classification will be executed quickly by using one versus one technique [3].

2. Description of Our System

Our system constitutes of three necessary part (show fig. 2):

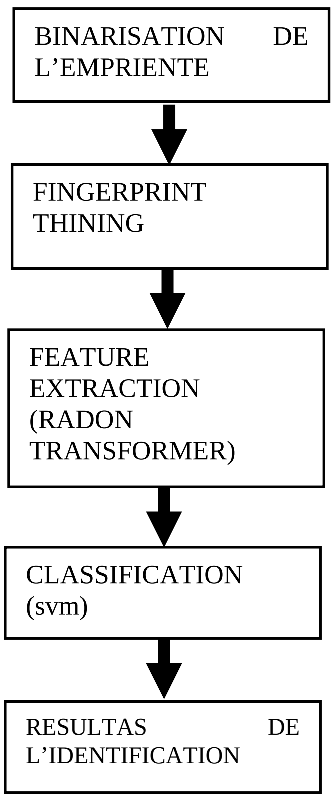

Fig 2. The process of finger print identification

3. Radon Transform and Its Properties

3.1 Définition

The Radon transform represents an image as a Collection of projections along various directions. It is widely used in areas ranging from seismology to computer vision. The Radon transform of an image f(x;y),denoted as (x;y),is defined as its line integral along a line inclined at an angle y from the y-axis and at a distance s from the origin [4] as shown in Fig. 4.

Suppose a 2-D function $f(x,y)$ (Fig. 4). Integrating along the line, whose normal vector is in θ direction, results in the $g(s,\theta)$ function which is the projection of the 2D function $f(x,y)$ on the axis s of θ direction. When s is zero, the g function has the value $g(0,\theta)$ which is obtained by the integration along the line passing the origin of (x,y) coordinate. The points on the line whose normal vector is in θ direction and passes the origin of (x,y) coordinate satisfy the equation:

$$\frac{y}{x} = \tan(\theta + \frac{\pi}{2}) = \frac{-\cos\theta}{\sin\theta} \Rightarrow x\cos\theta + y\sin\theta = 0 \qquad (1)$$

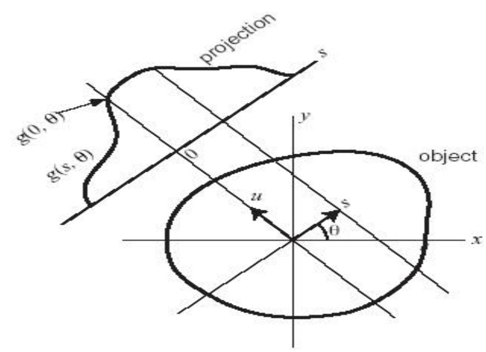

Fig 3. The Radon Transform computation.

The integration along the line whose normal vector is in θ direction and that passes the origin of (x,y)-coordinate means the integration of $f(x,y)$ only at the points satisfying the previous equation. With the help of the Dirac "function" δ, which is zero for every argument except to 0 and its integral is one, $g(0,\theta)$ is expressed as:

$$g(0,\theta) = \iint f(x,y)\cdot\delta(x\cos\theta + y\sin\theta)\,dxdy \qquad (2)$$

Similarly, the line with normal vector in θ direction and distance s from the origin is satisfying the following equation:

$$(x - s\cdot\cos\theta)\cdot\cos\theta + (y - s\cdot\sin\theta)\cdot\sin\theta = 0 \Rightarrow$$
$$x\cos\theta + y\sin\theta - s = 0 \qquad (3)$$

So the general equation of the Radon transformation is acquired [5]:

$$g(s,\theta) = \iint f(x,y)\cdot\delta(x\cos\theta + y\sin\theta - s)\,dxdy \qquad (4)$$

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The inverse of Radon transform is calculated by the following equation:

$$f(x,y) = \int_{-\pi/2}^{\pi/2} \rho \cdot R_\theta(s(x,y))\, d\theta \quad (5)$$

Where R_θ is the Radon transformation, ρ is a filter and

$$s(x,y) = x\cos\theta + y\sin\theta \quad (6)$$

3.2 Result of the feature extraction

The Radon transform represents an image as a collection of projections along various directions. It is widely used in areas ranging from seismology to computer vision. The Radon transform of an image f(x; y), denoted as (x; y); is defined as its line integral along a line inclined at an angle y from the y-axis and at a distance s from the origin [4] as shown in Fig. 5

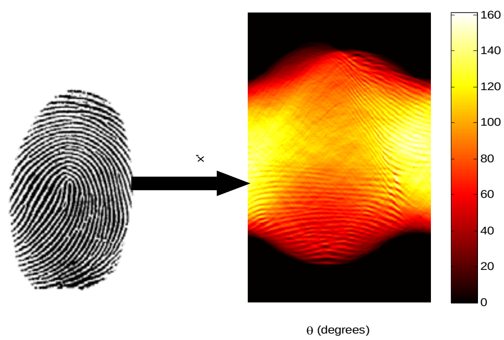

Fig 5. radon transformer of one of the finger print.

3.3 Enrolling module

The fingerprint of each finger will be captured fourtimes. With each fingerprint, we will extract fingercode and process this fingercode to create 4 other FingerCodes corresponding to rotating the original fingerprint image in 4 other directions {-450, -22.5°, 22.50, 450}. Then we will have twenty FingerCodes of the same new fingeprint for training system. All FingerCode will be passed in to train SVMs. We use one-versus-one SVM system, so we only need to create N extra SVMs when having a new (N+1) the class registered to the system and train these N SVMs to "supplement knowledge" for system.

4. Multiclassify using support vector machine

The problem of multi-class classification, especially for systems like SVM, does not present an easy solution. The standard method for N-class SVM is to construct N SVMs. The ith SVM will be trained with all of the examples in the ith class with positive labels, and all other examples with negative labels. We refer to SVMs trained in this way as l-v-r SVMs (short for one-versus-rest). The final output of the N 1 -v-r SVMs is the class that corresponds to the SVM with the highest output value. Unfortunately, there is no bound on the generalization error for the l-v-r SVM, and the training time of the standard method scales linearly with N.

Another method for constructing N-class classifiers from SVMs is derived from previous research into combining two-class classifiers. Knerr [3] suggested constructing all possible two-class classifiers from training set of N classes; each classifier is trained on only two out of N classes. There would thus be K=N*(N-1)12 classifiers. When applied to SVMs, we refer to this as 1-v-1 SVMs (short for one-versus-one). In relation to this technique, P. Milanfar [6] suggested a Max Wins algorithm: each 1-v-1 classifier casts one Vote for its preferred class, and the final result is the class with the most votes.

5. Extracting Fingerprint Feature

In this approach, we use filter bank-based technique [1] to extract features vector of fingerprint, which called FingerCode. The five main steps in feature extraction algorithm are as follow:

- Locating the core point of fingerprint and region of interest for the fingerprint image.
- Tessellate the region of interest around the core point.
- Normalize all sectors of interest region, respectively.
- Filter the region of interest in eight different directions using a bank of Gabor filters [1].
- Compute the average absolute deviation from the mean (AAD) of gray values in individual sectors in filtered images to define the feature vector, FingerCode [8].

In this paper, we just present the determining corepoint step, the others are the same as those in Jain et al's method [1].

Fig 6. Corpoint detection of fingerprint

6. Experimental results

We have collected fingerprint images from 10 Different people using Microsoft Fingerprint Reader atthe resolution 500 dpi. Each person was requested to provide fingerprint images of 8 different fingers (left middle, left index, left thumb, right middle, right index and right thumb finger);. In total we have 10 fingerprint images of 80 classes.

We divide these fingerprint images into two groups for training and testing. For each finger, 6 images will were used as training data and the rest for testing. To get the interest region. Eighty features for each of the eight filtered images provide a total of 256 (32 x 8) features per fingerprint image.

Table 1: Experimental result

Extracting feature time	*Time to train one svm*	*Time to train 80 class svm*	*Identifiyng Time*
3.0410 Seconds	4.5 x10-3 Seconds	2.7220 Seconds	0.2540 Seconds

7. Discussion and Conclusion

The accuracy of the system can be improved if we use a threshold value when identifying object. We have tried to make a simple threshold like that [7]: when Identifying an object if the number of votes of winning Class is lower than (n-1), the system will reject, not Conclude about that class. Although the threshold is Very simple, the accuracy of system has been improved significantly: the equal error rate now is 6.2392% and reject rate is 3.9834%.

References

[1] Jain, A., L. Hong, S. Rankanti and R. Bolle, 1997. "An Identity Authentication system Using Fingerprint ", IEEE proceedings, 85(9): 1365- 1388.

[2] Antowiak, M and k. Chalasinska- Macukow, 2003. "Fingerprint Identification by Using Artificial Neural Network With Optical Wavelet preprocessing", Opto - Electronics Review, 11(4): 327- 337.

[3] S. Knerr, L. Personnaz, and G. Dreyfus. Single-layer learning revisited: A stepwise procedure for building and training a neural network. In Fogelman-Soulie and Herault, editors, Neurocomputing: Algorithms, Architectures and Applications, NATO ASI. Springer, 1990.

[4] M.P. Queluz, Authentication of digital images and video:generic models and a new contribution, Signal Processing:Image Communication 16 (5) (January 2001), 461–475.

[5] A. Asano, "Radon transformation and projection theorem", Topic 5, Lecture notes of subject Pattern information processing, 2002 Autumn Semester, http://kuva.mis.hiroshimau.ac.jp/~asano/Kougi/02a/PIP/.

[6] P. Milanfar, "A Model of the Effect of Image Motion in the Radon Transform Domain", IEEE Transactions on Image processing, vol. 8, no. 9, September 1999.

[7] Prabhakar, S., S. Pankanti and A.k Jain, 2003. "Biometrics Recognition: Security and Privacy Concerns",IEEE Security & Privacy Magazine,pp 33- 42.

[8] Kumar, N and A. Triparthi, 1993. "Feature Extraction from Multi spectral Digital Image Using Artificial Networks and Bayesian Classifier", Neural Computing and Applications, 3(4): 904- 907.

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A de wahha d e a received the B.Sc. and M.Sc. degrees in electronic engineering from the University of M'sila, M'sila, Algeria, in 2007 and 2010, respectively. From 2008 to day, He was a Tutor with the electronic engineering department, University of M'sila. Since 2011, he has a member at "Laboratoire de Génie Electrique" (LGE) at Université de M'sila.The main application domains of his interests are Computed Tomography (X-ray, PET, SPECT and eddy current imaging), image processing, Bayesian approaches and multiresolution analysis.