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Performance Evaluation of Finger Print Identification

Seema saini[#1], Amanpreet Kaur *[2]

[#1]M.Tech Scholar, Department of CSE
GIMET, Amritsar, Punjab, India
*[2] AP, Department of CSE
GIMET, Amritsar, Punjab, India
[1]sainiseema706@yahoo.com, batthamanpreet@gmail.com

Abstract

Human fingerprints are reliable characteristics for personnel identification as it is unique and persistence. Fingerprints are the most popular and studied biometrics features. Their stability and uniqueness make the fingerprint identification system extremely reliable and useful for security applications. In this paper we evaluate the performance of Fingerprint Verification system based on minutiae feature extraction.

Keywords— ***Fingerprint Recognition, Minutiae, Gabor Filters, Biometric.***

I. Introduction

Fingerprint recognition or palm print identification is the process of comparing questioned and known friction skin ridge impressions from fingers or palms or even toes to determine if the impressions are from the same finger or palm. The flexibility of friction ridge skin means that no two finger or palm prints are ever exactly alike (never identical in every detail), even two impressions recorded immediately after each other.

Fingerprint identification (also referred to as individualization) occurs when an expert (or an expert computer system operating under threshold scoring rules) determines that two friction ridge impressions originated from the same finger or palm (or toe, sole) to the exclusion of all others. This section provides a basic introduction to fingerprint recognition systems and their main parts, including a brief description of the most widely used techniques and algorithm. The fingerprint is formed in third and fourth month of fatal development and unique with epidermal ridges, furrows and patterns. Distinctiveness and persistence are the highly desirable qualities of fingerprint. Factors such as Skin condition, finger pressure and noise Detroit the quality of fingerprint images. The presence of noise gives an image a mottled, grainy, textured or snowy appearance [1, 2]. The images of fingerprint are mistaken during

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Volume 2, Issue 4, July 2015

termination; hence it is necessary to investigate the images of fingerprint by using suitable filters.

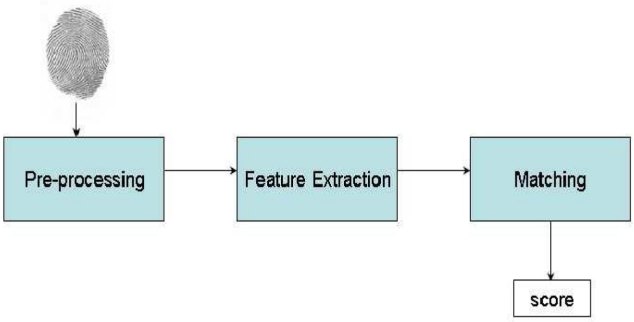

Figure.1: Fingerprint verification system module

The main modules of a fingerprint verification system are:

- Fingerprint sensing, in which the fingerprint of an individual is acquired by a fingerprint scanner to produce a raw digital representation;
- Pre-processing, in which the input fingerprint is enhanced and adapted to simplify the task of feature extraction;
- Feature extraction, in which the fingerprint is further processed to generate discriminative properties, also called feature vectors; and
  - Matching, in which the feature vector of the input fingerprint is compared against one or more existing templates. The templates of approved users of the biometric system, also called clients, are usually stored in a database. Clients can claim an identity and their fingerprints can be checked against stored fingerprints.

II. Architecture of Fingerprint Identification

The basic building block or architecture of the finger print system is shown in figure 2.

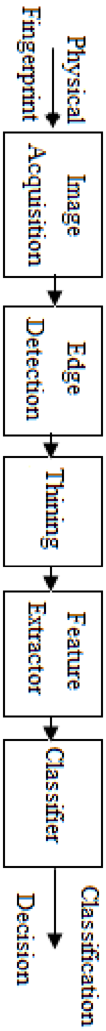

Fig. 2: Architecture of Fingerprint Recognition

A. Image Acquisition

A number of methods are used to acquire fingerprints. Among them, the inked impression method remains the most popular one. Inkless fingerprint scanners are also present eliminating the intermediate digitization process. Fingerprint quality is very important since it affects directly the minutiae extraction algorithm. Two types of degradation usually affect fingerprint images: 1) the ridge lines are not strictly continuous since they sometimes include small breaks (gaps); 2) parallel ridge lines are not always well separated due to the presence of cluttering noise.

ISSN: 2348 9510
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B. Edge Detection

An edge is the boundary between two regions with relatively distinct gray level properties. The idea underlying most edge-detection techniques is on the computation of a local derivative operator such as 'Roberts', 'Prewitt' or 'Sobel' operators. In practice, the set of pixels obtained from the edge detection algorithm seldom characterizes a boundary completely because of noise, breaks in the boundary and other effects that introduce spurious intensity discontinuities.

C. Thinning

An important approach to representing the structural shape of a plane region is to reduce it to a graph. This reduction may be accomplished by obtaining the skeleton of the region via thinning (also called skeleton zing) algorithm. The thinning algorithm while deleting unwanted edge points should not:

- Remove end points.
- Break connectedness
- Cause excessive erosion of the region

D. Feature Extraction

Extraction of appropriate features is one of the most important tasks for a recognition system. A multilayer perception (MLP) of three layers is trained to detect the minutiae in the thinned fingerprint image of size 300x300. The first layer of the network has nine neurons associated with the components of the input vector. The hidden layer has five neurons and the output layer has one neuron. The network is trained to output a "1" when the input window in centred on a minutiae and a "0" when it is not.

E. Classifier

After scanning the entire fingerprint image, the resulting output is a binary image revealing the location of minutiae. In order to prevent any falsely reported output and select "significant" minutiae, two more rules are added to enhance the robustness of the algorithm:

- At those potential minutiae detected points, we re-examine them by increasing the window size by 5x5 and scanning the output image.
- If two or more minutiae are to close together (few pixels away) we ignore all of them.

To insure translation, rotation and scale-invariance, the following operations will be performed: After extracting the location of the minutiae for the prototype fingerprint images, the calculated distances will be stored in the database along with the ID or name of the person to whom each fingerprint belongs [3]. The last phase is the verification phase where testing fingerprint image:

- Is inputted to the system
- Minutiae are extracted
- Minutiae matching: comparing the distances extracted minutiae to the one stored in the database
- Identify the person
- State the results obtained (i.e.: recognition rate).

III. Finger Print Classification

The analysis of fingerprints for matching purposes generally requires the comparison of several features of the print pattern. These include patterns, which are aggregate characteristics of ridges, and minutia points, which are unique features found within the patterns. It is also necessary to know the structure and properties of human skin in order to successfully employ some of the imaging technologies. The three basic patterns of fingerprint ridges are the arch, loop, and whorl.

- An arch is a pattern where the ridges enter from one side of the finger, rise in the centre forming an arc, and then exit the other side of the finger.
- The loop is a pattern where the ridges enter from one side of a finger, form a curve, and end to exit from the same side they enter.
- In the whorl pattern, ridges form circularly around a central point on the finger.

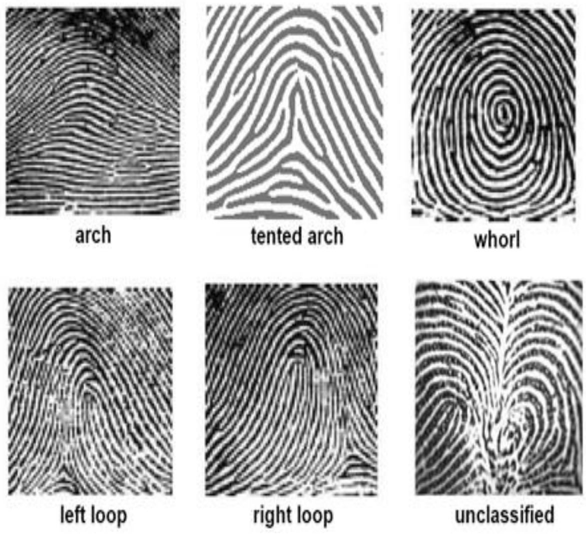

Fig. 3: Classes of fingerprint

Galton-Henry classification system accounts for more than 120 fingerprint classes. The five most common classes are [4]:

- Arch: ridges enter from one side, rise to form a small bump, and then go down and to the opposite side. No loops or delta points are present.
- Tented Arch: similar to the arch except that at least one ridge has high curvature, thus one core and one delta points.
- Left loop: one or more ridges enter from one side, curve back, and go out the same side they entered. Core and delta are present.
- Right loop: same as the left loop, but different direction.
- Whorl: contains at least one ridge that makes a complete 360 degree path around the centre of the fingerprint. Two loops (same as one whole) and two deltas can be found.

Fingerprints in databases are non-uniformly distributed in these classes. Fingerprint classification techniques have been a research topic for more than 30 years. Many classification methods have been designed. However, most of them use the same set of features: ridge line flow, orientation image, singular points, and Gabor filter responses. Orientation image contain all necessary information to classify fingerprints in five broad classes listed above. Scientists have found that family members often share the same general fingerprint patterns, leading to the belief that these patterns are inherited.

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II. Minutia Extraction

The basic method of minutiae extraction is divided in to three part Pre-processing, Minutiae Extraction, Post processing. We divide three basic steps in to 7 modules which are given below

A) Step 1: Input-

In this step we take five finger prints of a person as input and process them.

B) Step 2: Binarization:

This transform the 8-bit Gray fingerprint image to a 1-bit image with 0- value for ridges and 1-value for furrows.

C) Step 3: Thinning:

Ridge thinning is to eliminate the redundant pixels of ridges till the ridges are just one pixel wide.

- To get a thinned image we find the location of middle black pixel at each stage of continuation of the curve.
- In each scan of the full fingerprint image, the algorithm marks down redundant pixels in each small image window (3x3).
- And finally removes all those marked pixels after several scans.

D) Step 4: Minutiae Connect:

This operation takes thinned image as input and produces refined skeleton image by converting small straight lines to curve to maximum possible extant.

E) Step 5: Minutiae Margin:

This increases the margin of endpoints by one pixel of curves of length at least three pixels.

F) Step 6: Minutiae point Extraction:

For extracting minutiae point we compute the number of one-value of every 3x3 window [4]:

- If the centroids is 1 and has only 1 one valued neighbor, then the central pixel is a termination.
- If the central is 1 and has 3 one-value neighbors, then the central pixel is a bifurcation.
- If the central is 1 and has 2 one-value neighbors, then the central pixel is a usual pixel.

G) Step 7: False Minutiae Removal

Procedure for removing false minutiae is given below:

- If the distance between one bifurcation and one termination is less than D and the two minutiae are in the same ridge. Remove both of them. Where D is the average inter-

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ridge width representing the average distance between two parallel neighboring ridges [5].

- If the distance between two bifurcations is less than D and they are in the same ridge, remove the two bifurcations.
- If two terminations are within a distance D and their directions are coincident with a small angle variation. And they suffice the condition that no any other termination is located between the two terminations. Then the two terminations are regarded as false minutia derived from a broken ridge and are removed.
- If two terminations are located in a short ridge with length less than D, remove the two terminations.
- If a branch point has at least two neighboring branch points, which are each no further away than maximum distance threshold value and these branch points are closely connected on common line segment than remove the branch points.

And last we do the minutiae matching. Two fingerprint images to be matched, any one minutia is chosen from each image, and then the similarity of the two ridges associated with the two referenced minutia points is calculated. If the similarity is larger than a threshold, each set of minutiae to a new coordination system is transformed, whose origin is at the referenced point and whose x-axis is coincident with the direction of the referenced point [6]. After we get two sets of transformed minutia points, we use the elastic match algorithm to count the matched minutia pairs by assuming two minutiae having nearly the same position and direction are identical.

IV. Pattern Matching Using Gabor Filters

The first step is the normalization, which results in a better contrast of the fingerprint image. After that, the fingerprint is segmented, which crops areas of the recorded image, which do not contain any relevant information. This is the end of the pre-processing. The last pre-processing step usually consists of a fingerprint enhancement. However, tests have shown that the subsequent reference point detection works on non-enhanced fingerprint images as well as on enhanced. Therefore, any further enhancement is not required for the subsequent processing steps. After that, the fingerprint image is filtered using a Gabor filter. Now, it is possible to create the feature map, which is used as the template. This template is matched in the subsequent matching step with templates of other fingerprints. The result of the matching is the matching score, which represents how good two fingerprints resemble each other. Most methods for fingerprint identification use minutiae as the fingerprint features [7, 8]. For small scale fingerprint recognition system, it would not be efficient to undergo all the preprocessing steps (edge detection, smoothing, thinning, etc.), instead Gabor filters will be used to extract

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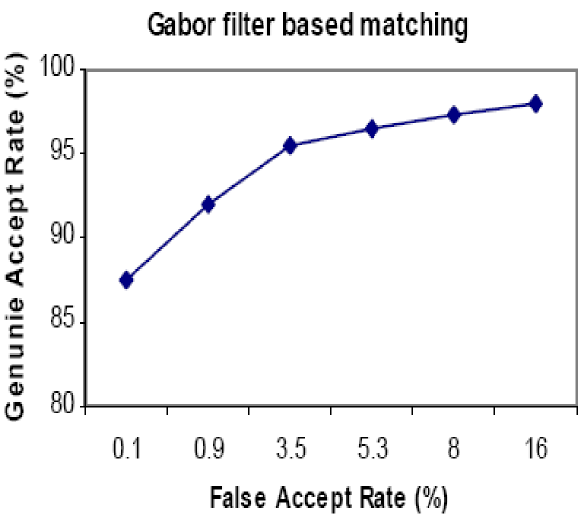
features directly from the gray level fingerprint. No pre processing stage is needed before extracting the features.

V. Performance Evaluation

Even if fingerprint recognition system is a matured biometric recognition it certainly makes wrong decisions. Some of the reasons are:

- Information limitation: for example due to poor quality finger print images.
- Representation limitation: i.e. features used to represent the fingerprint image.
- Invariance limitation: i.e. images of different fingerprint may look similar.

Fig. 4: Database of fingerprint



ISSN: 2348 9510
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Volume 2, Issue 4, July 2015

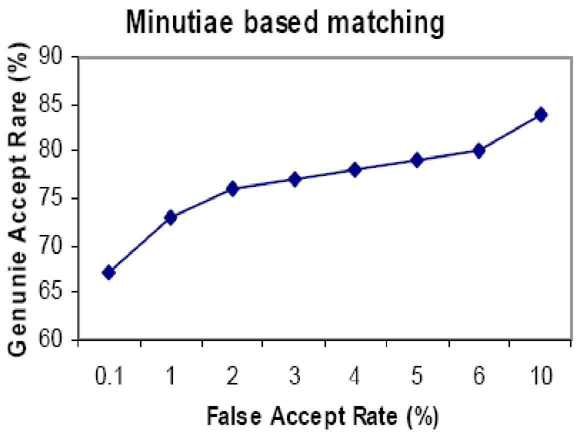

Fig. 5: Performance of the Gabor filter and minutiae matching.

VI. Conclusion

Image quality is related directly to the ultimate performance of automatic fingerprint authentication systems. Good quality fingerprint images need only minor pre-processing and enhancement for accurate feature detection algorithm. For small scale fingerprint recognition system, it would not be efficient to undergo all the pre-processing steps (edge detection, smoothing, thinning etc. as like of minutiae based technique), instead Gabor filters will be used to extract features directly from the gray level fingerprint. The Gabor filter method is widely accepted approach for the fingerprint matching. It is quite suitable for fingerprint matching. Eight Gabor filters are used to extract features from the template and input images. The primary advantage of our approach is improved translation and rotation invariance.

References

[1] Federal Bureau of Investigation, “The Science of Fingerprints: Classification and Uses”, US Government Printing office, Washington D.C., 2001.

[2] D. Maltino, D. Maio, A.K. Jain and S. Prabhakar,“A Handbook 0f Fingerprint Recognition”, Springer Press, 2003.

[3] B. Bhanu, M. Boshra, X. Tan, Logical templates for feature extraction in fingerprint images, Proceedings of the International Conference on Pattern Recognition (ICPR), Vol. III, Barcelona, Spain, September 2000, pp. 850–854.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 2, Issue 4, July 2015

[4] Manvjeet Kaur, Mukhwinder Singh, Akshay Girdhar, and Parvinder S. Sandhu, " Fingerprint Verification System using Minutiae Extraction Techn ique", Proceedings of World Academy of Science, Engineering and Technology vol. 36 , pp. 497-502, (2008).

[5] A.K. Jain, R. Bolle and S. Pankanti, Biometrics: Personal Identification in a Networked Society, Kluwer Academic Publishers, 2004.

[6] Roli Bansal, Priti Sehgal and Punam Bedi, "Minutiae Extraction from Fingerprint Images - a Review", IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 5, No 3, September 2011.

[7] D. Polemi, "Biometric Techniques: Review and Evaluation of Biometric Techniques for Identification and Authentication, Including an Appraisal of the Areas Where They are Most Applicable," Final Report, April 2000.

[8] Ching-Tang Hsieh and Chia-Shing Hu, "Humanoid Fingerprint Recognition Based on Fuzzy Neural Network", International Conference on Circuit, Systems, Signal and Telecommunications, pp. 85-90, (2007).