FINGERPRINT MATCHING USING HYBRID SHAPE AND ORIENTATION DESCRIPTOR -AN IMPROVEMENT IN EER

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ABSTRACT

Fingerprint recognition is a promising factor for the Biometric Identification and authentication process. Fingerprints are broadly used for personal identification due to its feasibility, distinctiveness, permanence, accuracy and acceptability. This paper proposes a way to improve the Equal Error Rate (EER) in fingerprint matching techniques in the domain of hybrid shape and orientation descriptor. This type of fingerprint matching domain is popular due to capability of filtering false and strange minutiae pairings. EER is calculated by using FMR and FNMR to check the performance of proposed technique.

KEYWORDS

Fingerprint, Minutiae, Feature Extraction, Shape Descriptor, Orientation Descriptor, EER

1. INTRODUCTION

In an increasingly digitized world the reliable personal identification has become an important human computer interface activity. Fingerprints are gaining popularity because it is distinct for every person and one need not to remember them like password. Apart of it, Fingerprints are always with a person and one need not to carry like cards.

Fingerprint is a pattern of ridges, furrows and minutiae, which are extracted using inked impression on a paper or sensors. A good quality fingerprint contains 25 to 80 minutiae depending on sensor resolution and finger placement on the sensor [1]. The purpose of ridges is to give the fingers a firmer grasp and to avoid slippage. These ridges allow the fingers to grasp and pick up objects [2]. In a fingerprint image, the ridges appear as dark lines while the valleys are the light areas between the ridges. Minutiae points are the locations where a ridge becomes discontinuous. A ridge can either come to the end, or can split into two ridges, which is called as Bifurcation. The two minutiae types i.e. terminations and bifurcations are of more interest for matching of fingerprints.

II. IMPROVING EER OF FINGERPRINT MATCHING USING HYBRID SHAPE AND ORIENTATION DESCRIPTOR

We propose minutiae based matching technique for fingerprint comparison. This technique improves the EER of fingerprint matching using hybrid shape and orientation descriptor described in [6]. The proposed algorithm is:

Algorithm:

Step 1: We have a database of fingerprints. In this database, 8 impressions of each fingerprint are stored with noticeable differences in region overlap, orientation, image quality.
Step 2: Now we have a fingerprint which has to be matched with the database fingerprints. If this test fingerprint image is in color then it has to be converted it into gray scale image.
Step 3: Convert the gray-scale image to binary image, by using:

$$I(x,y) = \begin{cases} 1 & if\ I(x,y) \geq t \\ 0 & otherwise \end{cases}$$

Where *t* is the threshold

Step 4: Next step is image improvement. For this, following functions are performed:

- ridgesegment() operation performs which returns normalized image.
- ridgeorient() estimates local orientation of ridges (not minutiae).
- ridgefreq() estimates the ridge frequency.
- ridgefilter() finally enhances the fingerprint image via oriented filters.

Watch carefully these operations are performed on ridges (not on minutiae).

Step 5: Then the analysis of this enhanced image is done so that features can be obtained.
Step 6: Now registration is done. It concerns the alignment and overlay of the template and test fingerprints so that corresponding regions of the fingerprints have minimal geometric distance to each other.
Step 7: Now the Orientation descriptor is used which describes the orientation of fingerprint.
Step 8: Now construct shape descriptor. In order to improve accuracy, the shape context includes contextual information, such as minutiae type (i.e., bifurcation and ridge endings) and minutiae angle.
Step 9: Each minutiae is stored in vector form which has 5 values [x, y, cn, Theta, Flag].
Where,

x & y = co-ordinates of a minutiae
Theta = orientation of that minutiae

cn = crossing number
Flag = 0 for permissible minutiae, 1 for non-permissible minutiae.

Step 10: Now transform minutiae (i.e. x, y, theta) according to i-th reference point.

Step 11: Find the best matching using Euclidean distance between both transformed minutiae with the help of

$$r_{affine} = \sqrt{a_{1,x}^2 + a_{1,y}^2} < r_{max}$$

And computes the similarity score by using

$$sim(A,B) = \frac{n_{match}^2}{n_A n_B}$$

Step 12: It compares the test fingerprint to whole database and returns similarity score of all comparisons.
Step 13: Finally returns the matching fingerprint index which has similarity score > threshold value.

III. EXPERIMENTAL RESULTS AFTER IMPLEMENTATION

The experiment is implemented in MATLAB 7.10.0.499 by using FVC2002 DB1 Set B database. Fingerprint images were taken on optical scanner. Image size is 388x374, resolution is 500 dpi and format is .tif. A hybrid shape and orientation descriptor is used for matching the fingerprints. EER value is calculated by using FMR and FNMR.

Following figure shows the similarity between two fingerprints:

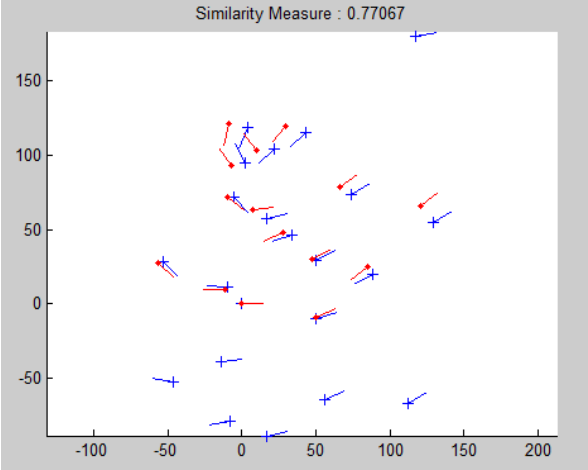

Fig. 2: Similarity measure between two fingerprints

Following graph shows the FMR, FNMR & EER of proposed technique:

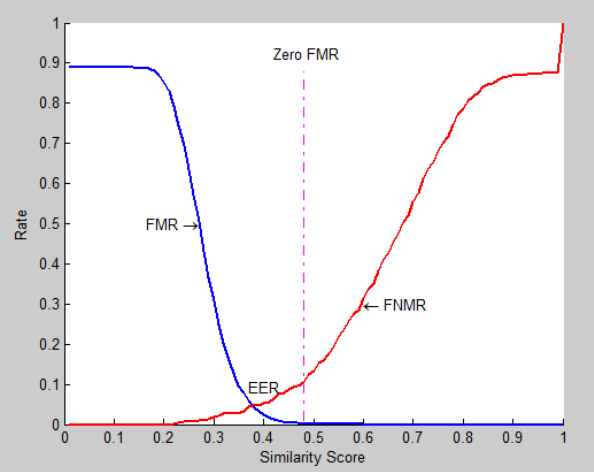

Fig. 3: FMR, FNMR & EER

In the graph, EER value of proposed technique is shown which is 0.37. Because of this value FMR and FNMR curves are intersecting.

Following table summarizes the performance of our proposed algorithm against numerous well-known algorithms on the FVC2002 database:

Table 1: Performance comparison of matching algorithms on FVC2002 Db1 Set B

We see that proposed technique improves the EER by minimizing its value.

Table 1: Performance comparison of matching algorithms on FVC2002 Db1 Set B

Matching Algorithm	EER
CBFS Chikkerur & Govindaraju [8]	1.50
TPS based Kwon et al. [9]	0.92
Meshgrid based Kwon et al. [10]	0.82
Hybrid Spiral based Shi & Govindaraju [11]	1.98
PA08 Maio et al.	0.98
Orientation based Joshua abrahm [6]	0.75
Proposed method	**0.37**

IV. CONCLUSION

We have obtained number of fingerprints from standard databases. In our proposed technique, the fingerprint image is improved using image-processing operations before obtaining features. This paper proposes a way to improve the Equal Error Rate (EER) in fingerprint matching techniques in the domain of hybrid shape and orientation descriptor. Experimental results show that the presented method has the better recognition accuracy compared with the previous recognition methods.

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