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An Efficient Hybrid Method for Fingerprint Matching

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Abstract: Fingerprints are the most widely used for person identification and verification in the field of biometric system. We know that the fingerprints detection possess is mainly three types those are used in automatic fingerprint identification and verification: (i) Minutia (ii) Ridge and (iii) correlation. In this paper we create a method that has key points of all above three methods, is called hybrid method. This hybrid method work on the principal of score matching and determine the comparison between one-to-one matching. By this method, we improve speed of matching process between two fingerprints and classification of fingerprint pattern into different groups. It is very useful to overcome the problem of finding number of criminal in the crime.

Keywords: image processing minutia analysis, ridge analysis, correlation, pixel orientation.

I. INTRODUCTION

Fingerprint is one of the most mature biometric traits and considered legitimate proof of evidence in courts of law all over worldwide. Fingerprints are, therefore, used in forensic divisions worldwide for criminal investigations. More recently, an increasing number of civilian and commercial applications are either using or actively considering using fingerprint-based identification because of a better understanding of fingerprints as well as demonstrated matching performance than any other existing biometric approach. Modern fingerprint matching techniques were initiated in the late 16th century. Henry Fauld, in 1880, first scientifically suggested the individuality and uniqueness of fingerprints. At the same time, Herschel asserted that he had practiced fingerprint identification for about 20 years. This discovery established the foundation of modern fingerprint identification. In the late 19th century, Sir Francis Galton conducted an extensive study of fingerprints. He introduced the minutiae features for single fingerprint classification in 1888. The discovery of uniqueness of fingerprints caused an immediate decline in the prevalent use of anthropometric methods of identification and led to the adoption of fingerprints as a more efficient method of identification.

II. FINGERPRINT MATCHING

a. Correlation-based matching:-

Two fingerprint images are superimposed and the correlation between corresponding pixels is computed. Let T and I be the two fingerprint images, then sum of squared differences (SSD) between the intensities of the corresponding pixels –

$$SSD\ (T,I)=||T-I||^2=(T-I)^T(T-I)=||T||^2+||I||^2-2T^TI$$

need to minimize SSD, hence maximize the cross correlation term

$$CC\ (T,I)=T^TI$$

After correction for relative rotation and displacement, similarity between the two fingerprint images **T** and **I** can be measured as

$$S(T,I) = \max_{dx,dy,\square}\ CC\ (T,I^{dx,dy,\square})$$

b. Minutiae and Ridge -based matching:-

Minutiae are extracted from the two fingerprints and stored as sets of points in the two- dimensional plane and matching essentially consists of finding the alignment between the template and the input minutiae sets that results in the maximum number of minutiae pairings. We know that ridges are part of minutia feature.

III. PROPOSED WORK

1. Method Description

My proposed work is combination of key points of three most fingerprint matching techniques. It is very useful method to find matching score in two fingerprint images. The three key points is being defined below.

Minutia and Ridge

Minutiae are major features of a fingerprint, using which comparisons of one print with another can be made.

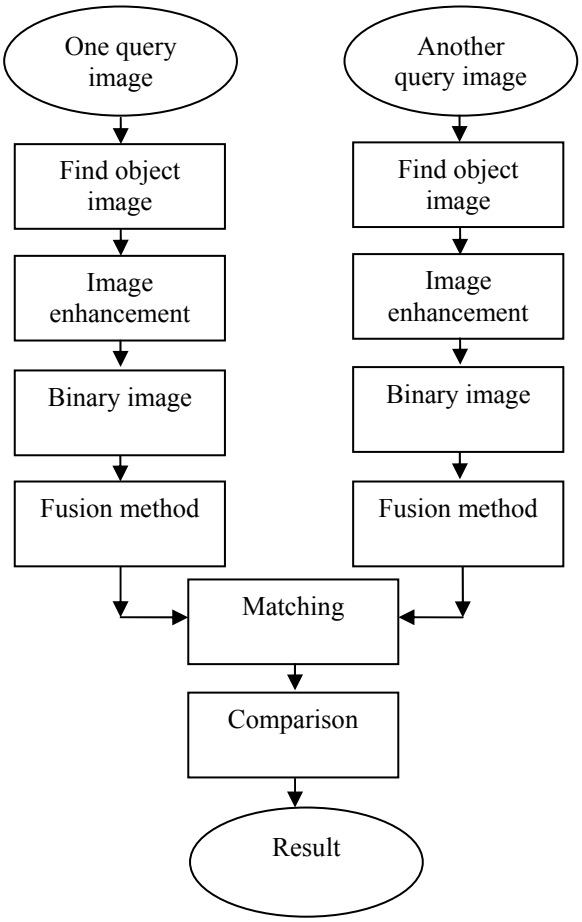
- Ridge ending - the abrupt end of a ridge.
- Ridge bifurcation - a single ridge that divides into two ridges
- Short ridge, or independent ridge - a ridge that commences, travels a short distance and then ends.
- Island - a single small ridge inside a short ridge or ridge ending that is not connected to all other ridges.
- Ridge enclosure - a single ridge that bifurcates and reunites shortly afterward to continue as a single ridge.
- Crossover or bridge - a short ridge that runs between two parallel ridges.
- Delta - a Y-shaped ridge meeting.
- Core - a U-turn in the ridge pattern.

Correlation

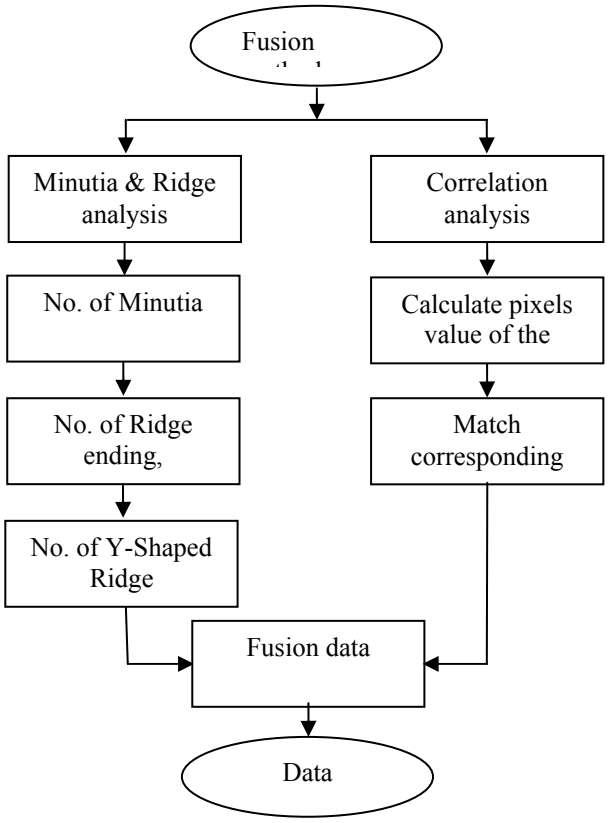
In this section we find the pixels value of the two fingerprint images then check what two fingerprint images are superimposed also we compute the correlation between corresponding pixels.

Flowchart of the methodology

a. Flowchart of the work



b. Fusion method



2. Algorithm of the methodology

Step1). Get two query images from the user.

Step2). Apply morphological operations for removing noise and small objects from fingerprint images.

Step3). After step2 we improve the image intensity for better analysis.

Step4). Now we apply a threshold value by graythresh function for binary image.

Step5). In this step we use fusion method and get the data.

a. Calculate all minutia points.
b. Calculate the total number of Ridge ending and Ridge bifurcation
c. Calculate the total number of Y- shape Ridge.
d. Determine the pixels value of the image with position.
e. Compute the correlation between two corresponding images pixel.
f. Finally fusion the all above data.

Step6). Fusion methods apply on two query fingerprint image for finding match on them. Also calculate matching score for comparison between proposed method and old method.

Step7). Show the result.

IV. EXPERIMENTAL RESULTS

We determine the matching score on the some fingerprint images is given in table 1 below.

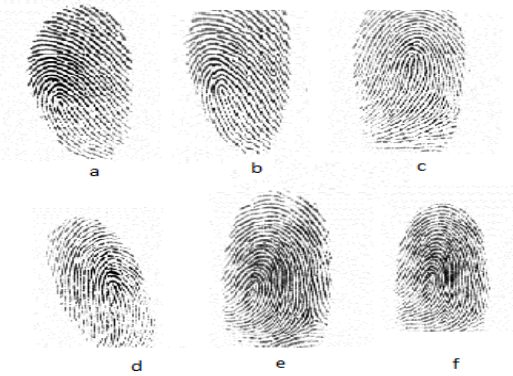


Fig. 1

Here, show the some fingerprint images like a,b,c,d,e and f in figure1 .

Images	Minutia Analysis	Coorelation Analysis	Proposed Work
(a, b)	57%	64%	66%
(a, c)	43%	49%	49%
(a, d)	58%	60%	61%
(a, e)	32%	34%	35%
(a, f)	37%	37%	39%
(a, a)	97%	100%	100%
(b, b)	98%	99%	100%
(c, c)	100%	100%	100%

Table 1

Table 1 show the matching score between two fingerprint images pair by three methods. We know that minutia and correlation methods are useful in normal condition but mostly it is not sufficient for hard matching because both have limitation like noise image, dull image, incomplete image etc. so we use hybrid method for better analysis of fingerprint images.

V. CONCLUSION

In this paper, we have developed a hybrid method that is very effectively work on fingerprint images. It selects a pair of two fingerprint images then find the matching score between them. It reduce the deficiency of existing methods like minutia, ridge and correlation. This hybrid method gives better result than all the other individual method. In future we add some other concept like 2D cross correlation, shape descriptor and moment invariants with this approach and get a very good result for fingerprint matching.

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