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PCA AND CENSUS TRANSFORM BASED FINGERPRINT RECOGNITION WITH HIGH ACCEPTANCE RATIO

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ABSTRACT: Biometric techniques of authentication have been well known for the personal identification and have been in the great demand. Biometric method identifies persons by their physiological or behavioral characteristics such as fingerprint, face, retina, etc. Fingerprint recognition is one of the most used techniques among them. Fingerprint matching means matching of two fingerprints with fingerprint feature like ridge, minutia and other features of two fingerprint images. Fingerprint matching based on minutia pairings are use some time. But this technique is not very efficient for recognizing the low quality fingerprints. To overcome this problem, some researchers suggest the correlation technique which provides better result. Uses of correlation based methods are increasing today in the field of biometrics as it provides better results. The objective of this paper is to analyze the fingerprint verification techniques by extracting the features of fingerprints and enhance the fingerprint using image processing techniques to improve the matching percentage. The proposed method based on the PCA and census transform (CT) for fingerprint identification. In this method all the features of the fingerprint is enhance and used for the matching. CT is used for fingerprint feature extraction and PCA is used for fingerprint matching. For show the effectiveness also compared the results with the existing methods available in the literature and calculate the all the parameters like Acceptance Ratio (AR), Rejection Ratio (RR), False Matching Ratio (FMR), and False Non Matching Ratio (FMNR).

Keywords: Fingerprint Recognition (FR), Principal Component Analysis (PCA), Census Transform (CT), Acceptance Ratio (AR), Rejection Ratio (RR), False Matching Ratio (FMR), False Non Matching Ratio (FMNR).

I. INTRODUCTION

In daily life touch things every day: a coffee cup, a car door, a computer keyboard. Each time people do, it is likely that people leave behind their unique signature—fingerprints. No two people have exactly same fingerprints. Even identical twins, with identical DNA, have various fingerprints. This uniqueness allows fingerprints to be used in all sorts of ways, including for background checks, biometric security, mass disaster identification, & of course, in criminal situations. Human fingerprint recognition is one of most well-known biometrics, & it is by far most used biometric solution for authentication on computerized systems. Reasons for human fingerprint recognition being so popular are ease of acquisition, established use & acceptance when compared to other biometrics. Presently, fingerprints being a biometric feature are most widely used for commercial purpose in offices and various departments for personal identification. A fingerprint pattern contains structures like loops, bridge, bifurcations and characterized by set of ridgelines that often flow in parallel, but intersect and terminate at some points. The uniqueness is determined by the local ridge characteristic and their relationships. However, most automatic systems for fingerprint matching are based on minutiae matching. Further, in the acquired fingerprints from crime locations or during any biometric image acquisition process, brightness consistency in corresponding regions cannot be assured. Therefore, in most approaches there is a difficulty in distinguishing between patterns of various structures at the alternate boundaries inside a fingerprint. This causes erroneous match score and the performance of the matcher degrades. In this paper proposed a new correlation based model which is tolerant to such brightness inconsistency and also fast as it requires minimal pre-processing steps with respect to existing approaches.

II. METHDOLOGY

PROPOSED WORK FLOW

The proposed design has four major parts

- Database & Fingerprint Acquisition
- Pre-Processing
- Feature Extraction
- Fingerprint Matching

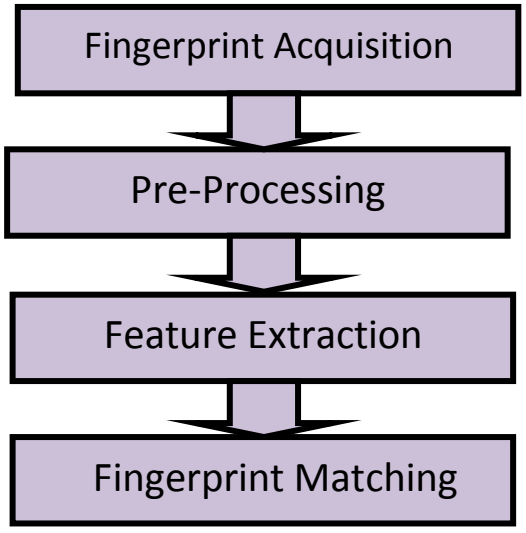

Figure 1: dataflow for system design

Database & Fingerprint Acquisition: In this work FVC2004 DB3 fingerprint standard database has been used, and Fingerprint Acquisition can be done by fingerprint sensors.

Pre-Processing: Census Transform is been used for pre-processing. Pre processing is the method which is used before matching.

Feature Extraction: The output of census transform contains features of fingerprint. This is called feature extraction.

Fingerprint Matching: It is done with the help of PCA method. PCA is used for fingerprint matching.

PROPOSED MODEL

In the proposed model, initially, a database is to be formed consisting of fingerprint images from various source and the desired portions like ridges, central loops, whorls and arch, patterns are extracted from the sample images. However, compression algorithms can be employed to minimize the space complexity as it is required to store huge number of fingerprint images for reference purpose during fingerprint matching. In our approach we align and extract the input images to a desired dimension such that they are in accordance with the database image dimension. As the proposed method is a subset of correlation based template matching method the alignment and region selection plays a vital part in matching and thus care should be taken to properly calibrate the input image based on the region of interest. The flowchart describing the matching process is given in Fig.2.

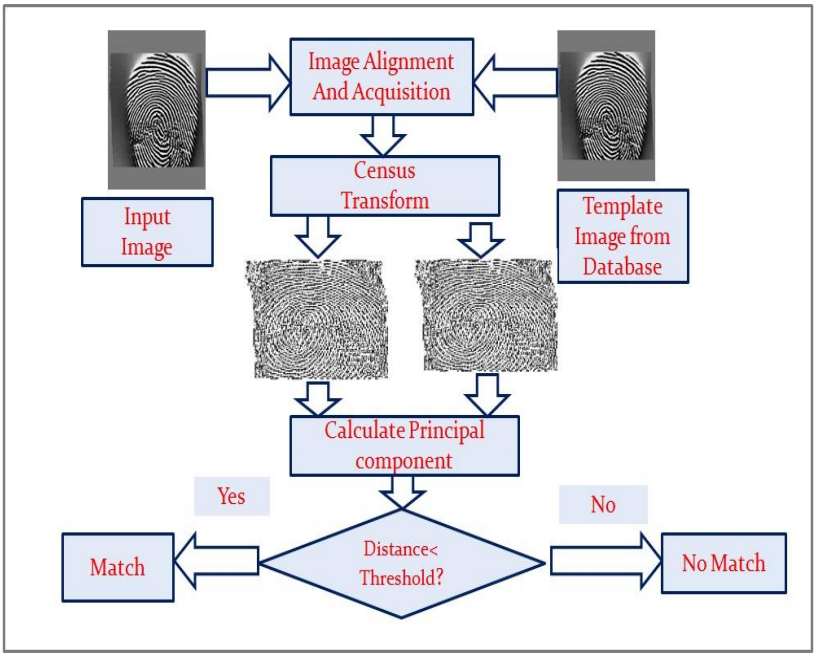

Figure 2: proposed model for fingerprint matching

III. SIMULATION RESULT

The proposed method is applied on the DB3 fingerprint database images which are available in the public domain. The DB3 database contains 8 impressions each of 10 distinct fingers. Therefore we have total 80 fingerprints in the database. Table 1 provides the matching percentage of fingerprints from the database, where the percentage of matching of the proposed approach is compared with hamming score based approaches as depicted in [1]. For brevity of space, here we have depicted our results by considering the first two sets of fingerprints containing 8 different prints of the fingers.

Table 1 PERCENTAGE MATCH SCORES COMPARISON

Finger	Hamming Score based percent Match (101_1)	PCA based present Match (101-1)	Finger	Hamming Score based percent match (102_1)	PCA based present Match (102-1)
101_1	100%	100%	102_1	100%	100%
101_2	56.36%	90.02%	102_2	52.63%	70.12%
101_3	44.51%	65.73%	102_3	42.31%	98.274%
101_4	46.31%	75.31%	102_4	41.47%	60.61%
101_5	34.71%	79.32%	102_5	35.03%	64.73%
101_6	34.8%	65.5%	102_6	34.93%	36.67%
101_7	34.34%	57.04%	102_7	33.78%	66.93%
101_8	35.19%	27.79%	102_8	34.62%	40.39%

In order to calculate the False Match Rate (FMR) and False Non Match Rate (FNMR) of DB3 database we have calculated the Acceptance Ratio (A.R.) and Rejection ratio (R.R.) of the whole database based on match scores as depicted in Table I. N.M. Chaudhari and B.V. Pwar in [9] have considered threshold for match as 30%. Souvik Kundu, Baidyanath Ray [1] have considered threshold for match 35%. In this proposed method threshold is considered 55%. But the result is more than 55% show the effectiveness of proposed work.

PARAMETERS

In this proposed work four parameters are calculated and analysis. These parameters are given below-

ACCEPTANCE RATIO (AR): Acceptance Ratio is called AR. In term of fingerprint matching acceptance ratio is calculated by total matched fingerprint is divided by the total attempts and total is multiplied by the 100.

AR= 100*(total Matched / total attempt)

REJECTION RATIO (RR): Rejection Ratio is called RR. In terms of fingerprint matching rejection ratio is calculated by the total non matched fingerprint is divided by the total attempts and total is multiplied by the 100.

RR= 100*(total Non Matched / total attempt)

Table II below depicts the comparative data of A.R. and R.R. of DB3 database between existing and the proposed method.

TABLE II ACCEPTANCE RATIO (A.R.) AND REJECTION RATIO (R.R)

	Hamming score based method		Proposed work	
Finger	Hamming Score Based A.R.	Hamming Score Based R.R.	PCA based A.R.	PCA based R.R.
101_1	62.5	37.5	87.5	12.5

102_1	62.5	37.5	75	25
103_1	62.5	37.5	87.5	12.5
104_1	50	50	100	0
105_1	50	50	100	0
106_1	87.5	12.5	100	0
107_1	87.5	12.5	100	0
108_1	37.5	62.5	87.5	12.5

Figure 3 below depicts the comparative results of A.R. and R.R in graphical form.

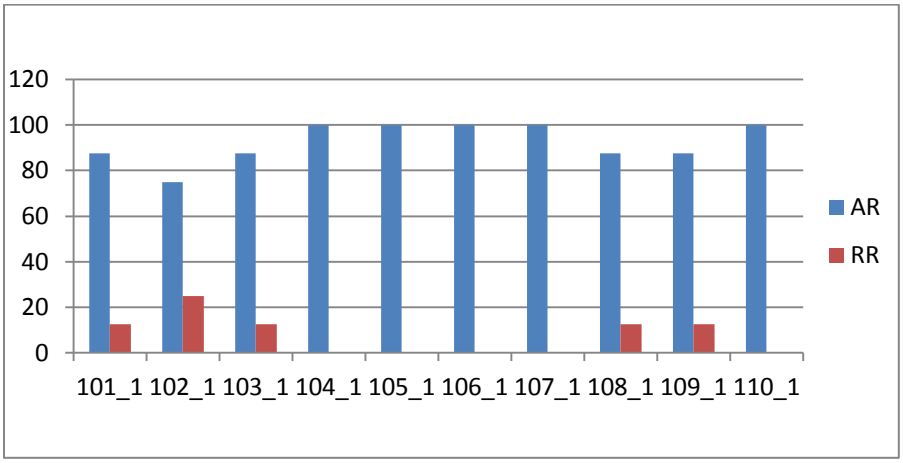

Figure 3: Acceptance Ratio and Rejection Ratio

FALSE MATCHIMG RATIO: False matching ratio is called false acceptance ratio. False acceptance rate also called FAR. In terms of fingerprint matching false matching ratio is calculated by the total matched or total accept fingerprint divided by the total overall attempts of database.

FMR= total accept / total attempts.

FALSE NON MATCHING RATIO: False non matching ratio is called the false rejection ratio. The false rejection rate is also called FRR. In terms of fingerprint matching false non matching ratio is calculated by the total non matched or total rejected fingerprint divided by the total overall attempts of database.

FNMR= total reject / total attempts

The FMR and FNMR of DB3 database is calculated and the result is compared with the existing data [1] as depicted in the Table III below.

TABLE III FMR AND FNMR FOR DB3 DATABASE

	Hamming score based method		**Proposed work**	
Finger	Hamming Score Based FMR	Hamming Score Based FNMR	PCA based FMR	PCA based FNMR
101_1	0.0625	0.0375	0.0875	0.0125
102_1	0.0625	0.0375	0.075	0.025
103_1	0.0625	0.0375	0.0875	0.0125
104_1	0.05	0.05	0.1	0
105_1	0.05	0.05	0.1	0
106_1	0.0875	0.0125	0.1	0
107_1	0.0875	0.0125	0.1	0
108_1	0.0375	0.0625	0.0875	0.0125

Figure 4 below depicts the comparative results of F.M.R. and F.N.M.R in graphical form**.**

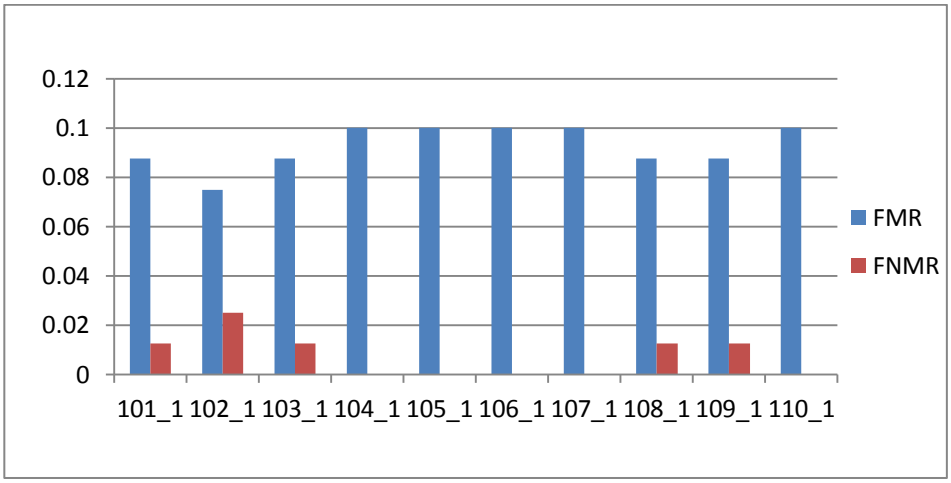

Figure 4: False Matching Ratio and False Non Matching Ratio

IV. CONCLUSION

In proposed work PCA and census transform (CT) is used for fingerprint matching. The combination of these two methods gives better result and better performance. The match score comparison; Acceptance Ratio (AR), Rejection Ratios (RR); False Matching Ratio (FMR) and False Non Matching Ratio (FNMR) for DB3 database is given in the table I, table II and table III respectively which depicts the effectiveness of the proposed method in fingerprint identification system. In this paper DB3 database is used for fingerprint recognition, which is available in public domain. In proposed work compare the original, accurate or full fingerprint of the person with the other fingerprints

of the same person but which is not proper, not good or not complete. Census transform is used for feature extraction of fingerprint. The Principal Component Analysis (PCA) method is used to calculate the principal component of the fingerprint images. Principal Components are the direction where most of the data is spread out. The Principal Component of any image is never changed if the image is reversed or rotate or damaged. Because of this reason PCA method give much accurate result. The hamming score based method used the threshold value 35% and other method which is minutia based recognition available in literature used the threshold value 30%. In proposed work use the threshold value more than 55% but the mostly result is greater than that. So this method is providing much better result as compare the other methods.

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