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Increasing Accuracy of Age and Gender Detection by Fingerprint Analysis Using DCT and DWT

Akanchha Gour [1,] Dharmendra Roy[2]

M.Tech, Dept. of Computer Science & Engineering (Software Engineering), Rungta College of Engineering & Technology, Bhilai (C.G.), India[1]

Reader, Dept. of Computer Science & Engineering ,Rungta College of Engineering & Technology, Bhilai (C.G.), India[2]

ABSTRACT:-Although fingerprint is the one of the oldest, mature and most reliable soft biometrics and also acceptable as the evidence in the court of law in all over the world. There are various number of methodology are presented in past for the identification of person from fingerprint but relatively very few number of attempt has been done in the field of age and gender identification with the help of fingerprint .In this paper we are going to propose a method which will be identify age and gender with the help fingerprint image. For our work we are taking 100 number of fingerprint image of different age which include both male and female fingerprint. In our system we are using Discrete Cosine Transforms (DCT) and Discrete Wavelet Transforms (DWT) for the purpose of extraction of different feature from fingerprint image and for the classification we are using K-Nearest Neighbor (KNN) method as classifier and after the analysis we got overall result with 90% of accuracy for our system.

KEYWORDS: Discrete Wavelet Transformation, Discrete Cosine Transformation, Fingerprints, K-Nearest Neighbor.

I. INTRODUCTION

In the field of forensic science gender and age detection is one of the important task which can minimize the search list of suspect. In the today technology there are several other biometrics and physical feature of person are used for the age and gender identification such as teeth, bone etc. these are the physical characteristics which can be use to determine age of person while various methodologies has been used to identify the gender using different biometrics traits such as face, gait, iris, hand shape, speech and fingerprint. Fingerprint has been used as a biometric for the gender and age identification because of its unique nature and do not change throughout the life of an individual. [1] A Fingerprint is the representation of the epidermis of a finger; it consists of a pattern of interleaved ridges and valleys. [3] A sample image of fingerprint is shown in figure 1. Whereas the black line denote the ridge while the distance between two black line is representation of valley

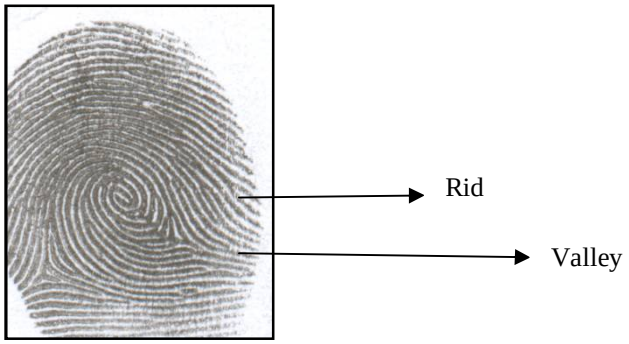

Fig1:-Sample of Fingerprint image.

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Fingerprint posses several characteristics which make it unique such as-

A. Unique:-it is unique such that two sibling or twins who have same DNA structure can be differentiate by their fingerprint.
B. Remain Same:-it does not change throughout the life of a person.
C. Classified: - Fingerprint patterns can be classified, and those classifications then used to narrow the range of suspects.[2]

The main aim this paper is o represent a method which will be able to detect age and gender of persons from their fingerprints. Age and gender detection system from the fingerprint is constitutes of digital image of fingerprint &then some transformation technique will be applied on this fingerprint image. To develop algorithm for this purpose we are going to use MATLAB programming language. In our work we are going to use Discrete Cosine Transforms (DCT) and Discrete Wavelet Transforms (DWT).In our system first the digital image of fingerprint will goes for preprocessing step where the quality of image will be improve after that this improved fingerprint image will be goes for feature extraction step where we will use DCT and DWT method. After this we will compare this feature with the database. Here we will use KNN method as the classifier and will decide the age and gender of the fingerprint. The rest of this paper is organized as follow: A brief discussion various methods to detect age and gender by using fingerprint is presented in section 2. Proposed system is discussed in section 3.Experiment result is given in section 4. Conclusion and future scope is discussed in section 5.

II. RELATED WORK

In the past there are various studies and research has been proposed to identify a person from their fingerprint but at the same time there are very few attempt has been done to classify age and gender from the fingerprint. In this section we are going to discuss various studies regarding age and gender classification from fingerprint.

Ravi Wadhwa, Maninder Kaur, Dr. K.V.P. Singh presented their study in august 2013 where they are going to determine age and gender from fingerprint. For their work they were used RVA and DCT Coefficients to extract fingerprint image feature. In their work they observer that by generating more data of female and male they were able to generalized to differentiate the gender based on finger print. They also observed that the age groups show a constant variation from one age group to net age group. [1]

Emanuela Marasco , Luca Lugini, Bojan Cukic givena method in 2015 [10] to estimate age and gender from fingerprints. To capture the image property they were used Local Binary Pattern (LBP) and the Local Phase Quantization (LPQ) operators and used KNN as classifier. For their data set they collect 494 Sample fingerprints at West Virginia University and after their work they obtain result with accuracy of 89.1% for age and 88.7% for gender. [9]

A. S. Falohun , O. D. Fenwa , F. A. Ajala presented their work in February 2016 where they are going to detect Age and Gender from fingerprint. In their work for gender classification they use Back Propagation Neural Network while for age classification they used Discrete Wavelet Transforms and Principal Component Analysis together. In their work they observed and found that females have it on the higher side in RTVTR and the males are favoured with a higher Ridge Count [8]

E.O.Omidiora , O.Ojo , N.A.Yekini , T.O.Tubi in 2012 presented their work where they are using Ridge Count and Ridge Thickness To Valley Thickness to determine age and gender from fingerprint and after observation they found that The females have a higher ridge thickness to valley thickness ratio than the males and the males have a slightly higher ridge count than the females. [7]

III. PROPOSED SYSTEM

Aim of this paper is to create a system which will be able to detect gender and age of person by their fingerprint image. For this we will first take the digital image of fingerprint and we will perform preprocessing task on this digital image.

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After preprocessing feature extraction task will be perform where different feature of fingerprint image will be extracted with the help of Discrete Cosine Transforms (DCT) and Discrete Wavelet Transforms (DWT).After the extraction of feature classification and result generation will be perform by using KNN classifier. For the implementation of our project we are going to use MATLAB R2012a.Generlized block diagram of our system is shown in figure 2.

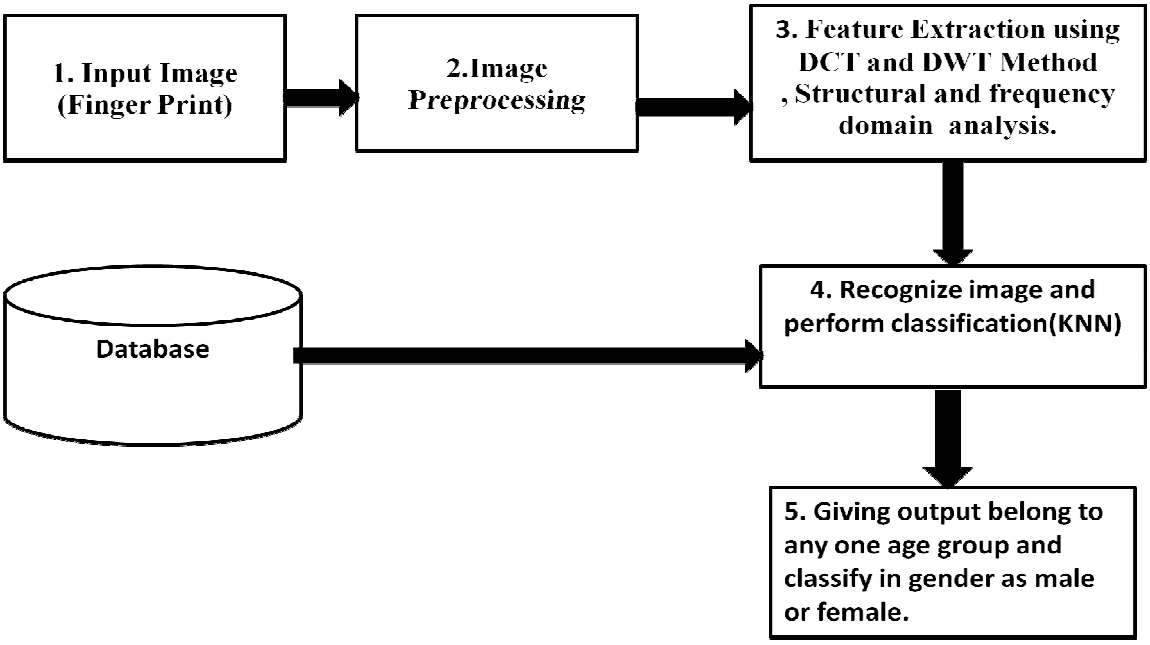

Fig2:-Generalized block diagram of our system

A. *Preprocessing*

Main aim of this step is to improve the visual appearance of the image and converting the fingerprint image into the format which will be suitable by the system to handle. Here task like binirization, decomposition and thinning etc will perform.

B. *Feature extraction by dwt*

After preprocessing task feature extraction task will be performed on this preprocessed fingerprint image .Wavelets have been used frequently in image processing and used for feature extraction, compression, face recognition, and image super-resolution. 2D- DWT decomposes an image into sub-bands that are localized in frequency and orientation. The decomposition of images into different frequency ranges permits the isolation of the frequency components introduced by “intrinsic deformations” or “extrinsic factors” into certain sub-bands. This process results in isolating small changes in an image mainly in high frequency sub-band images. [4]Thus, DWT is a suitable method to be used feature extraction. The 2-D wavelet decomposition of an image is results in four decomposed sub-band images referred to as low–low (LL), low–high (LH), high–low (HL), and high–high (HH). Each of these sub-bands represents different image properties. As most of the energy of images is in the low frequencies so decomposition is generally repeated only on the LL sub band.[5]For k level DWT, there are (3*k) + 1 sub-bands available. The energy of all the sub-bands is used as feature vectors individually which is called as sub-band energy vector (Ek). The level which gives optimal result is selected. The energy of each sub-band is calculated by using the equation (1). [5]

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$$E_K = 1/RC \sum_{i=1}^{R} \sum_{j=1}^{C} | X_k (i,j) |$$

…….……..…….. (1)

Where Xk (i,j) is the pixel value of the k th sub band and R, C is width and height of the sub-band respectively.

C. *Feature extraction by dct*

An image is transform from spatial domain into the frequency domain by the Discrete Cosine Transforms (DCT) to provide better approximation.DCT expresses a finite sequence of data points in terms of cosine function oscillating at different frequency. Very few cosine functions are needed to approximate an image, which means it has strong energy compaction property. DCT uses cosine function to separate images into parts of differing frequency to give a coefficient matrix which depends on the horizontal, diagonal and vertical frequencies.[6] Following formula shown in equation 2 can be used to calculate DCT coefficient

$$F(u,v) = \alpha(u)\alpha(v) \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} \cos\left[\frac{\pi u\ (2x+1)}{2N}\right] \cos\left[\frac{\pi v (2y+1)}{2M}\right] f(x,y)$$

$$\alpha(u)\alpha(v) = \begin{cases} \sqrt{\frac{1}{N}}\ for\ u,v \neq 0 \\ \sqrt{\frac{2}{N}}\ for\ u,v = 0 \end{cases}$$

...(2)

In our work first we will divide the each 256×256 image into 8×8 block after that we will determine RMS value of diagonal dct coefficients, in such a way we got 1024 number of feature for each 256×256 image. We can calculate the RMS value by the use of below equation 3.

$$dct_{rms} = \sqrt{\frac{\sum_{i=1}^{N} dct_i^2}{N}}$$

…….……..…….. (3)

IV. AGE AND GENDER CLASSIFICATION

For our system all digital image of fingerprint are taken from the www.unilorin.edu.ng website. For our system we have been used total 100 fingerprint images of different age which belongs to both male and female. In our system to train our database we have been used following algorithm.

A. *Training Algorithm for Age and Gender detection*

Input-: Fingerprint image of known class

Output-: Different feature of all fingerprint images in database.

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1. Calculate DCT coefficient of all digital image
2. Calculate RMS value of each diagonal DCT coefficient (by using 1)
3. Perform Fingerprint image decomposition by using DWT
4. Calculate various energy feature (E) (by using 3)
5. Combine the RMS value and Energy feature (E) for a particular fingerprint.
6. Insert all feature and known class of fingerprint into database
7. Repeat the above step for all fingerprint image which we taken for database

B. *Knn classification*

In our work for the classification purpose we used KNN classifier. The Knn is the method where we classify the input object based on the neighbor object whose class is known in advance. So this phenomenon can be used to train our dataset though no explicit training step is required [10]. For the classification we used following algorithm.

C. Algorithm for Classification

Input-: database of feature and fingerprint image
Output-: class (age and gender) of fingerprint

1. Calculate DCT coefficient of all digital image
2. Calculate RMS value of each diagonal DCT coefficient (using 1)
3. Perform Fingerprint image decomposition by using DWT
4. Calculate various energy feature (E) (using 3)
5. Combine the RMS value and Energy feature (E) for a particular fingerprint.
6. Apply KNN classifier and get the class (age and gender) of fingerprint.

V. EXPERIMENT RESULT

In our work we have been taken total 100 images of fingerprint which belongs to different age and belongs to both male and female. For the purpose of feature extraction we have been used RMS value of DCT coefficient and Energy value of DWT. For the classification purpose we used Knn method and after the classification we got the overall result with 90% of accuracy while for the age we obtain 92% accurate result and for the gender also we obtain 92% accurate result. The below table 1 show the initial RMS value of DCT and the energy value of DWT of some fingerprint of our system.

Table 1:-Result of RMS value and Energy value

Fingerprint sample	Age	Gender	RMS	Energy			
1	10	F	59.3761	361.3691	5.7616	7.2886	2.9728
2	23	F	63.7226	357.4415	8.3296	9.3428	3.7033
3	28	F	63.6953	354.2216	5.7676	7.6595	1.9737
4	14	F	63.7304	377.2066	9.2376	9.8173	3.7916
5	20	F	63.6601	337.9679	9.2701	9.9390	3.8467
6	12	M	63.1485	357.7253	14.1909	12.7012	8.0286
7	17	M	62.9845	337.6088	6.9992	7.6595	3.0417
8	18	M	63.1915	324.5096	8.4152	9.5516	3.6059
9	14	M	63.7500	398.5313	8.5729	8.6429	3.8137
10	15	M	63.6797	381.6567	6.5901	7.1353	2.8560

The result of age and gender identification is shown in the below figure 3.

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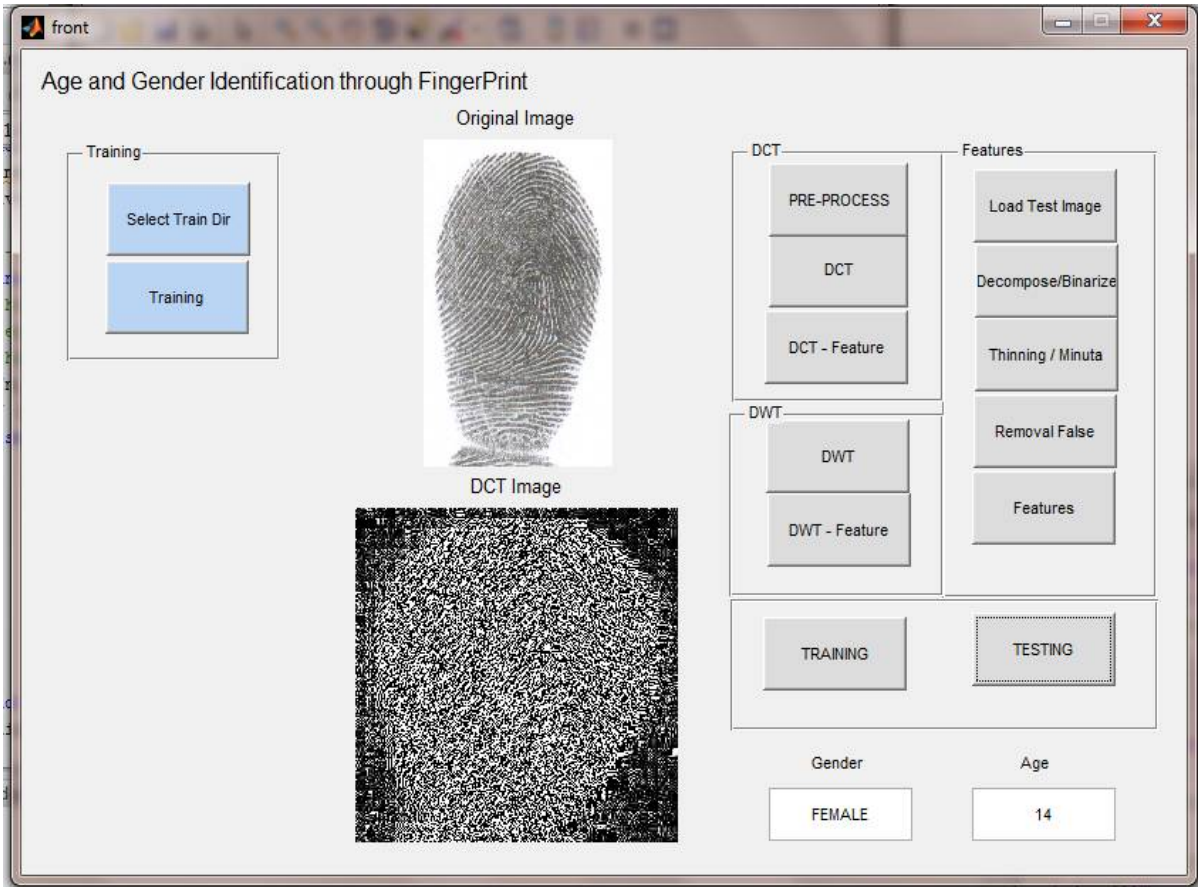

Fig3:-Age and gender identification.

VI. CONVLUSION

We presented a system which can determine both age and gender. We observed that constant variation may be present from one age to another age. The inaccuracy in result could be because of many people have larger body size or body growth as compare to their counterpart in different age and gender.

VII. FUTURE SCOPE

In future this work can be extend to determine several other parameters as well as several other methodologies can be used to obtain the result accurate for age and gender classification. There may be possible that several other features can be used in future to determine age and gender which may improve the result.

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