

A Review and Study on Fingerprint Based Gender and Age Classification Techniques

Heena Bawa¹ and Ajmer Singh^{2*}

ABSTRACT

In the period of technology and sciences, Gender Classification have great importance. Fingerprints have been used in Forensic for sorting criminal cases. Fingerprints remain same throughout the life of any person. So, fingerprint recognition and classification techniques help to reduce the bigger data into small data. This review study introduces various methods used for classifying fingerprints, their advantages and their limitations. After studying various methods, this review paper proposes a more efficient method for classifying fingerprint.

1. INTRODUCTION

Fingerprints are the unique identity of any person. No two persons have same fingerprints even not twins. Gender Classification deals with identifying or classifying the Gender of human being using certain criterion, parameters so as to get the correct result as male or female. Humans can easily identify whether the person standing in front is male or female. But a computer can't classify the person in the same way. There are various techniques that help computer or machine to identify or classify the human as male or female. These techniques can be using face, fingerprints, body figure, etc. And there are many techniques to extract features from these parameters. Fingerprints are considered to be the best method for gender identification because the fingerprints of person remains same throughout the life.

2. VARIOUS CHARACTERISTICS OF FINGERPRINTS THAT HELP IN IDENTIFYING THE PERSON ARE

Ridge Ending- Ridge ending is defined as the type of ridge that ends abruptly.

Ridge Bifurcation- Ridge bifurcation is defined as the single ridge that get divided into two ridges.

Ridge Enclosure- Ridge Enclosure is a single ridge that bifurcates and then reunites to become a single ridge afterwards.



Figure 1: Original Fingerprint Image

¹ Dept. of ECE Asst. Prof. Dept. of ECE, Lovely Professional University, Email: heena34bawa@gmail.com

² Lovely Professional University, Email: ajmer.17381@lpu.co.in (corresponding author)

Spur- Spur is a bifurcation that is a short ridge branching of one long ridge.

Crossover- Crossover is a short ridge that runs in parallel between the two ridges.

There are various techniques that helps in finding out the above characteristics of the fingerprints as well as the frequency and spatial domain features. Frequency domain parameters are the features which are obtained after converting the image into its frequency domain by using the techniques like Discrete Wavelet Transformation (DWT), Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT), etc. [1]. The term spatial domain refers to the image plane that deals with pixels. It is an aggregation of pixels of an image. Gray scale manipulation, histogram equalization, etc. [2] are the techniques used for spatial domain feature extraction. The extracted features are then used for training and testing the algorithm. There are various kinds of classifiers that can be used to classify the image into its class like Euclidean distance, Neural Networks (NN), Fuzzy C-Mean, etc.

3. GENDER CLASSIFICATION PROCESS

Gender Classification process consist of various steps. For example, Building of Database, pre-processing, feature extraction, feature matching, fingerprint classification.

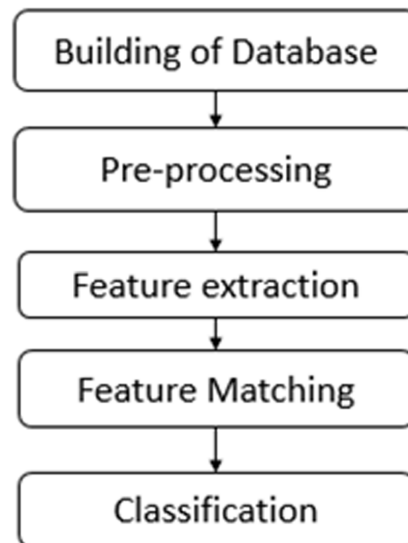


Figure 2: Gender Classification Process

4. REVIEW OF LITERATURE

K. Thaiyalnayaki [3], has proposed texture analysis technique using Discrete Wavelet Transform (DWT) for extracting feature from the fingerprints. The system operates in calculating Skewness, Kurtosis and standard deviation of the wavelet transform of the image. Canberra distance metric is used as a classifier. In the texture classification phase, feature set of the test sample is calculated and is then used to compare with the feature set stored in the database. Distance between the texture class stored in the database and the test image is computed. The test image is similar to the database class if the distance between them is less. Feature set comprising 93 dataset were taken and tested which has given 94.28% efficiency.

Ritu Kaur [4] has proposed a technique for fingerprint based gender identification using Frequency domain analysis which estimates gender using Fast Fourier Transform (FFT), Discrete Cosine Transform (DCT), and Power Spectral Density (PSD). The calculated values are compared with the threshold and then decision is made. The proposed method has accuracy of 90% for female and 80% for male.

Suman Sahu [5] has proposed a technique for fingerprint based gender identification using Adaptive Neuro Fuzzy Interference system. The features used in this proposed work are Ridge to valley Area Ratio

(RVA) and frequency domain based features (like horizontal, vertical, diagonal and amplitude). These features are then used to train the Adaptive Neuro Fuzzy Interference System (ANFIS) classifier. This method has given better and faster results than neural nets.

Mangesh K. Shinde [6] has proposed a technique for identifying gender using Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD). Energy of the sub-bands of DWT and non-singular values obtained from SVD are taken as features for training the algorithm. K nearest neighbor algorithm is being used as a classifier which make use of Euclidean distance to predict the gender. A large database of male and female fingerprints have been used. The algorithm is being tested for every finger of male and female. The maximum success rate is found to be for left hand for male and that too for index finger, which is 82.90%. And for female, the maximum success rate is 82.60% and that for little finger of left hand. The overall success rate of the algorithm is found to be 78.65%. The success rate of the proposed mechanism can be further increased by using spatial domain parameters.

Ravi Wadhwa [7], in 2013, has proposed a method to identify the age and gender of person from the fingerprints. The proposed method has used Ridge to valley area (RVA) and Discrete Cosine Transform (DCT) for classification. Entropy and RMS value of DCT coefficients are calculated along with Ridge to Valley Area for extracting features from fingerprints. The results obtained are about satisfactory.

S. Sudha Ponnarasi [8], in 2012, has proposed a method for gender classification using fingerprints. Ridge count, Ridge thickness to valley thickness ratio (RTVTR), white lines count, and ridge count asymmetry are being used as features for the system. These features are then used to train the algorithm. Support Vector Machine (SVM) is used as a classifier. It defines a decision boundary for the fingerprint to be classified. It uses the concept of membership functions and the classification work is based on the lines which separates or distinguishes between objects of different classes, here there are two classes male and female.

Rajio Jackson Tim [9], in 2013, has proposed a technique for gender classification which uses Discrete Wavelet Transform (DWT) and Principle Component Analysis (PCA) as features for the algorithm. Both the techniques are used in combination in order to improve the efficiency of the system. A dataset of 200 male and 200 female fingerprints are taken and used for training the algorithm. Before calculating the features, image is being passed through a pre-processing stage in order to enhance the appearance of the fingerprint. After training, the algorithm is tested which uses minimum distance approach called Euclidean Distance as a classifier which calculates the distance between the sample feature vector and the feature vector stored in the database. The class with which minimum distance is obtained, is assigned to the sample fingerprint image. This technique has produced an overall efficiency of 70% for both male and female. The proposed work can further be extended by using neural networks as classifiers instead of Euclidean Distance.

Ahmed Badawi [10], has proposed a method for gender classification which has many applications forensic anthropology in order to find out the criminals. It also helps to reduce the large data into smaller data by identifying the class of the fingerprint. The method has used a huge dataset of 1100 male and 1100 female fingerprint images which has different age group and these images are used for training the algorithm by extracting the features. Ridge count, Ridge thickness to valley thickness ratio (RTVTR), white lines count, ridge count asymmetry, etc. are the features extracted and used for training and testing. Three different kinds of classifiers are being compared in this method and they are Linear Descendant Analysis (LDA), Fuzzy C- Mean (FCM) and Neural Network (NN). Efficiency obtained by using the three different classifiers with the dominant features of the fingerprint is as

1. FCM gave overall efficiency of 80.39%
2. LDA gave overall efficiency of 86.5%
3. NN gave overall efficiency of 88.5%

The proposed method is used to reduce the search list of criminals by providing with the likelihood chance of the gender of the criminal. The accuracy of the proposed method can be further improved by modifying the feature extraction methods.

D. Gnana Rajesh [11] has worked on the technique of classifying the gender by using un-decimated wavelet Transform (UWT) for extracting the features from the fingerprints. The proposed method has used a database of 100 male and 80 female fingerprints for training the algorithm. Before processing the image, the fingerprint image is being rescaled into three different sizes, for example, 1.32×3 pixels, 2.64×64 pixels, 3.128×128 pixels. The features from the fingerprint are extracted using UWT decomposed sub bands. T-test class ranking is being applied in order to calculate the dominant UWT coefficient from the three coefficients. The accuracy of the algorithm is about satisfactory with more than 90% efficiency.

Gornale [12] has proposed a gender identification method using fingerprints. This method has used Fast Fourier Transform (FFT), eccentricity and major axis length as features for training the algorithm. They have taken a dataset of 550 female and 450 male fingerprint samples and that too of left thumb. For classifying the fingerprint image into its category, an optimal threshold value is chosen with which the calculated value is compared. The method of identifying gender has provided an accuracy upto 80% for male and 78% for female fingerprints.

Gnanasivam P. [13] has given a technique for identifying the gender from fingerprint using Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD). This method has used all the sub bands of DWT along with the spatial features of SVD by taking only non- zero values. The proposed system has taken a database of 1980 male fingerprints and 1590 female fingerprints for computing the features required to build the feature vector database. K nearest neighbor (KNN) is being used as a classifier which compares the feature vector calculated from the testing fingerprint image with the feature vector stored in the database. The performance accuracy of female fingerprints of left hand for little finger is 94.32% whereas for left hand index finger is 95.46%. The overall performance accuracy for female fingerprints is 84.69% and for male is 91.67%. The performance of the algorithm can further be increased by using the spatial parameters.

3. GENERAL METHOD FOR GENDER CLASSIFICATION

The frequency domain and the spatial domain are the two approaches which is to be used as a feature extracting techniques. In this method, Artificial Intelligence (AI) and Machine Learning (ML) are to be

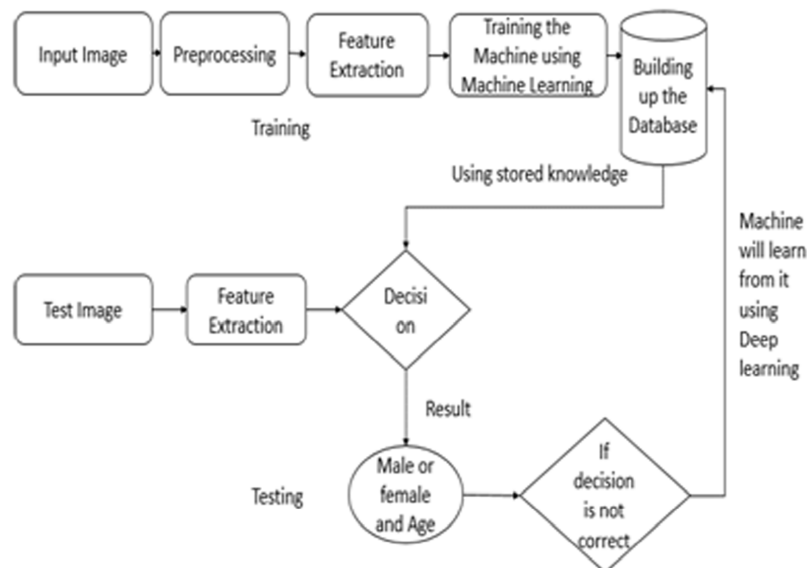


Figure 3: Methodology for age and gender identification

used which will train the algorithm or system with various fingerprint sample images. The training will be done with the features including the gender specification and the age specifications. The algorithm will then be tested with a random sample image. Based upon the knowledge, which the algorithm has gained, the algorithm on its own will predict the class of the image. If the algorithm fails to predict the correct result, then the algorithm will learn from that result which is to be done by using the concept of Deep Learning (ML). The purposed method will be designed using Python Programming Language.

4. CONCLUSION

From the papers being studied, the maximum efficiency attained is 94.28% using hard computing in which DWT is used as feature extracting technique and Canberra Distance Matrix is used as a classifier. Following table shows comparison of different papers:

Table 1
Comparison of papers

<i>Papers</i>	<i>Max. Efficiency (%)</i>
Thaiyalnayaki, 0975 - 8887	94.28
Ritu Kaur	90
Akhil Anjekar1, March 2015	78.65
Rijo Jackson, 2013	70
Ahmed Badawi, Jan 2006	88.5
D. Gnana Rajesh, July 2014	90
S. S. Gornale	80-male, 78-female
Gnanasivam P.	91.67-male, 84.69 female

The study shows that by moving from Hard computing to Soft Computing for extracting features and classification, the efficiency get increased. So, the efficiency will get increase if the classification of fingerprint images is being done using the concepts of Deep Learning.

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