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Comparative Study of Classifiers for Gender Identification using Fingerprints

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Abstract-Gender Identification has shown prominent role in various applications in digital age, some of them are human computer interaction, forensic investigation, Biometrics, targeted advertisement etc. In this paper, we have studied the behavior of Uniform Local Binary Pattern Descriptors with different classifiers for the gender identification using fingerprints. Among many studied classifiers, we have observed that Nearest Neighbor Classifier has performed best as compared to other classifiers with the accuracy of 95.4%.

Keywords- Gender Identification; Fingerprints; Texture Descriptors; Classifier Comparison; Soft Biometric.

1. INTRODUCTION

Human visualization is independent to identify and self-adaptive to recognized the demographic qualities of a person like age and gender. We can easily identify the male and female difference. But, the computer visualization system is not advanced to do all these tasks. As a result the automatic verification of the demographic attributes of human beings is an important task for different applications like HCI (human computer interaction), surveillance.

Fingerprint is the most famous method to identify a person. In this digital era, system safety is main challenge as a large amount of data is easily switched over computer networks. Attaining optimistic proof of identity is the important part of data security and in some cases gender gives additional support for authentication process.

In this paper, we studied the behavior of well-known texture descriptor technique Uniform Local Binary Pattern with different classifiers for gender identification using fingerprints. MAJOR HEADINGS Major headings should be typeset in boldface with the words uppercase.

2. LITERATURE REVIEW

Gender Identification using fingerprint is active area of research over the past decade as it serves for many interesting applications in medical studies, forensic investigation and human computer interaction. In [1] authors used deep learning based frame work with single minutiae for gender identification. Authors in [2] presented an approach to identify the gender based on discrete wavelet transform based features and back propagation neural network for gender identification using fingerprints. Ridge and valley based features are used in [3] for gender identification using fingerprints, they have optimal threshold criteria to classify the gender with focus on forensic anthropology. Authors in [4] described the discrete cosine transform, FFT and Power spectrum density based features for gender estimation from fingerprints. In [5] authors described a method for gender identification using fingerprints, to do this, they have used ridge density features of a fingerprint.

In [6] authors applied method in which each fingerprint represented using feature vector consisting of ridge thickness to valley thickness ratio (RTVTR) and the ridge density values later support vector machine is applied to classify the gender using fingerprint. Authors in [7] proposed a method based on discrete curvelet transform and GLCM based features with Neural Network Classifier for gender classification using fingerprints.

Authors in [8] presented an approach based on 2D discrete wavelet transform and principal component analysis for gender identification using fingerprint. In [9] authors, presented a method based on gender classification using DWT and SVD based approach for gender identification using fingerprints.

In this paper, we have presented the approach for gender identification using uniform local binary patterns with different classifiers. This primary comparative study of different classifiers will be helpful for future research in the field of fingerprint based gender identification.

3. OUR METHOD

Our method involves the three main steps namely, pre-processing, feature extraction and classification. In pre-processing we have performed basic operation like resizing and image enhancement. Uniform Local Binary Pattern based texture descriptor is computed for each fingerprint and presented in the form of feature vector. Further different classifiers are applied to check the behavior of ULBP in gender classification. The block diagram of our method is given in figure for better understanding.

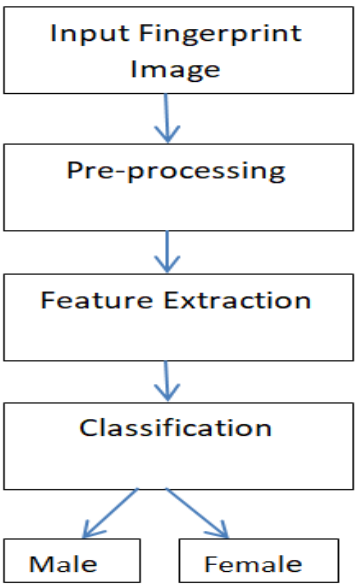

Fig. 1 Block Diagram of Proposed Method

Pre-processing: Pre-processing is required for better image representation, in our case we aim to enhance the image of fingerprints and prepare them for texture descriptor extraction. For doing this, we have first resizes an image to size of 164x164; later histogram equalization technique is applied to enhance the image.

Feature Extraction: LBP is the local texture descriptor [10] which extracts the local features from the image in terms of decimal code of binary digits. First input image is converted to gray scale, then for each pixel its surrounding neighborhood r will considered, then based on center pixel, thresholding operation will be performed and array of binary numbers will converted to single decimal value, the process is repeated for the complete image and equivalent LBP image is going to be produced from which histogram of 256 values is computed as feature descriptor. Further the same LBP can be optimized based on occurrences of transitions in the sequences of 0 and 1. If there is no transition or only two transitions then it will be uniform LBP code, if more than two transitions then it will be non-uniform code. In this way, ULBP only considers 59 values and can be used a feature descriptors. In our experiment, we have presented each fingerprint image using 59 dimensions feature vector obtained by applying Uniform Local Binary Pattern [11].

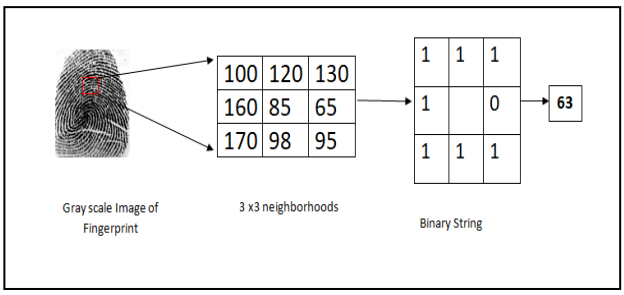

Fig. 2. Computation of LBP

Classification: For the classification of fingerprint whether in male or female category we have considered the different classifiers namely Simple Tree, Complex Tree, Medium Tree, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Linear Support Vector Machine with different kernels extended to Quadratic, Cubic, Gaussian, KNN, Boosted Tree, Bagging Tree, Subspace discriminant, sub space KNN.

4. EXPERIMENTS

There is no public data is available for the gender identification using fingerprints, therefore we have collected our own dataset of 300 fingerprints belongs to 150 for male and 150 for female. For evaluation of our method we have applied 10 fold cross validation with different classifiers mentioned in classification section. The results obtained with different classifiers for gender identification using fingerprints are shown in Table 1. From the table one it can be noted that the basic K-NN classifier is performed better for gender identification task and given accuracy of 95.4%. The same trend is followed by the QDA, Quadratic SVM, Cubic SVM and sub space K-NN classifier and gives the accuracy almost more than 90% that is 91.3%, 92.5%, 93.8% and 92.5 % respectively. While tree based classifiers have not performed well in our experiment and given low accuracy. The comparison with other works is kept out of scope in this paper as our prime aim is to comparison of performance of different classifiers for the gender identification using fingerprints. In future, we will consider the combination of classifiers for enhancement of weak classifiers where result is low.

Table 1. Accuracy of different classifiers for gender identification using fingerprints.

Sr. No.	Classifier	Accuracy in %
1	Simple Tree	64.2
2	Complex Tree	85
3	Medium Tree	85
4	LDA	85
5	QDA	91.3
6	Linear SVM	79.2
7	Quadratic SVM	92.5
8	Cubic SVM	93.8
9	Fine Gaussian SVM	87.5
10	Medium Gaussian SVM	86.3
11	Coarse Gaussian SVM	65.8
12	Cubic KNN	86.7
13	FINE KNN	95.4
14	MEDIUM KNN	85.8
15	COARSE KNN	53.8
16	COSINE KNN	85
17	Boosted Tree	55.8
18	Bagged Tree	88.8
19	Sub Space Discriminant	83.8
20	Sub Space KNN	92.5

5. CONCLUSION

In this study, we have presented comparison of different classifiers based on uniform local binary pattern descriptors. In our experiments, we have observed that nearest neighbor classifier is performed well and given good accuracy, the same trend is followed by the SVM based methods and quadratic discriminant analysis. But tree based methods have not performed well. In future, we will develop a method based on combination of classifiers for gender identification using fingerprints, where weak classifiers are going to combined with strong classifiers.

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