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Finger Print Based Gender Classification by using Fuzzy C- Means and Neural Network Model

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Abstract:
Fingerprint contains ridge and valley which together form distinctive patterns. A fingerprint Biometric trait is one of the important traits working with good results in the gender classification. The plan agreements with the problem of gender classification using fingerprint images. The project proposed a technique for classifying the gender based on feature extraction. The related feature to be removed and differentiate the gender is on and Minutiae extraction and ROI. The extracted feature is used to train neural network based model on the extracted data.
Background: *A survey of fingerprint identification, gender classification and age classification. The basic drive to deliver this survey is to present a current review of the existing literature. To afford a complete survey, existing identification techniques of fingerprint identification are grouped as general survey on fingerprint identification, survey on gender classification and age classification. The complete descriptions of corresponding methods within each group are presented. A handful of researches have been conversed in the literature for the identification of fingerprint. Even though the fingerprint occupies itself as an imperative role in the identification and verification, fairly few machine vision methods has been proposed for gender classification and age calculation.*
Materials and Methods: To enhance the fingerprint image quality by reducing noise, the work implements various improved algorithms like, Segmentation, Normalization, Orientation estimation, Ridge frequency estimation, Gabor filter and Binarisation and Thinning. These image enhancement algorithms will issue precise and accurate pixel pattern for further work. And work is to be performed in two phases i.e.Traning mode & Recognition mode.
Results: In this study came through different output based on different criteria and displayed on below result tab as well. As so far done and success rate is >90-94% as compared to other techniques.
Conclusion: As the fingerprints are unique for individuals in the universe, it gives a unique identification and there is no doubt that fingerprint evidence is most acceptable and reliable evidence. Most of the traditional methods used in identification of gender gave the satisfactory results but efficient attempt with higher accuracy. Clarity of image, frequency domain analysis, singular value decomposition techniques etc. will play a very important role to increase the efficiency and still there is a scope to work on this to improve the results
Key Word: *Fingerprint, ROI; MM; OCM; RTVTR; MFANNs; SVRRBF;*

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I. Introduction

A fingerprint is epidermis of finger consist of the pattern of interleaved ridges and valleys. The endpoints and bifurcation points of ridges are called minutiae. Fingerprint minutiae patterns of ridges are determined as unique through the combination of genetic and environment factors. This is the reason, the fingerprint minutiae patterns of the identical twins are different. Also the ridge pattern of each fingertip remain unchanged from birth to till death.
The gender classification and identification based biometric applications are designed for:

- **E-commerce**: like, personal authentication or identification for network, e-records security, e-commerce, Internet access, online banking and ATMs, credit cards, physical access control of peripherals, cellular phones access, PDAs, medical records management, library access and virtual learning etc.
- **E-Governance**: like, Digital signature or steganography, national ID cards, driver's licenses, border travel control, passport control, and welfare-disbursement etc.
- ***Forensic applications:*** *such as, corpse identification, criminal investigation, terrorist identification, parenthood determination, and missing children.* [1]

Many social and organizational communications and services today depend on gender of person performs the role. Fingerprint classification is an important preprocessing and verification step in fingerprint identification. In this research, it investigates the problem of gender classification from fingerprint. The work has been motivated by studies in anthropometry, biometric characteristic, and pattern recognition suggesting that it is possible to distinguish between male and female fingerprints.

II. Material And Methods

This system firstly acquires the fingerprint image. It used fingerprint data set, one for female data and second for male data and this process convert image data to text numeric code sequence for each fingerprint image. Standard Apriori algorithm is used to mine fascinating rules. And then mine the association rules on the filtered dataset using predefined minimum confidence and minimum conditional support. Then for each text file processing for association rule mining and classification done through classifier. After classification data can be categorize as a male or female data Study Design: Prospective open label observational study

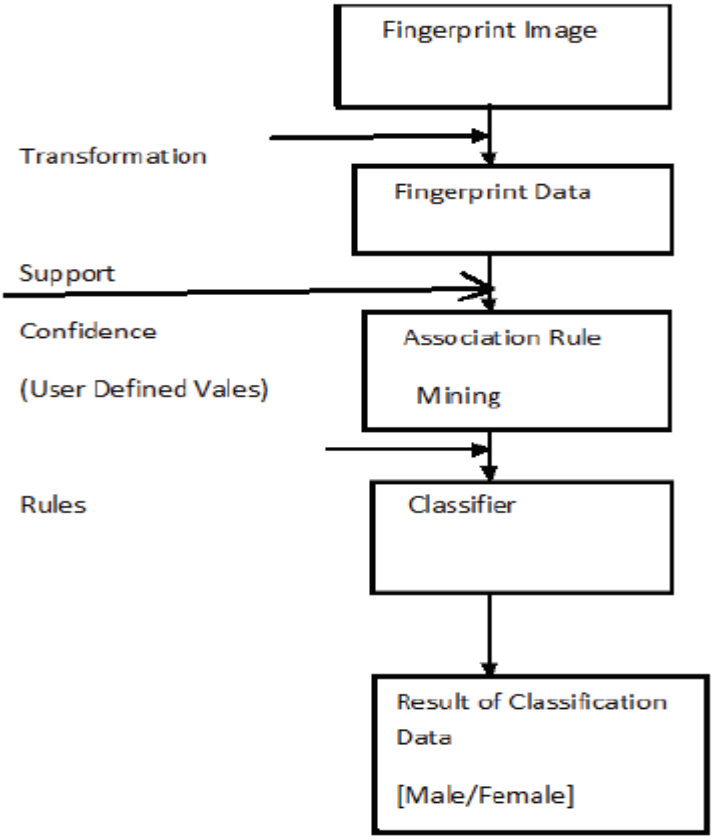

Fig: Flowchart of the algorithm

In our study we created ANN for classification of fingerprint images. As a skilled system which can classify the complicated fingerprint images. Fingerprint is then classified using ANN. ANN is based on the basis such that it receives a set of input (I1, I2……In), these inputs are multiplied with a set of weights (W1, W2, and Wn). This results in a standard start function which is known as the function of squashing which permits the output range to some random finite value In mathematical terms, the neuron is fired when (I1 *W1 + I2*W2 +……+ In * Wn)>T, where T is a defined optimal threshold value.

i. Pre - Processing

1. The original image is segmented from the training which guarantees the elimination of noise. A single image is divided into blocks of 16x16 size and the difference between each block is calculated. If the variance is lesser when compared with the threshold value then its value is removed from the original value. This method is applied for all full images. The image got from the above step is the standardized to get the chosen difference of the given image. The standardized image is given by

$$G(i,j)\begin{cases} Mo+\dfrac{\sqrt{VARo(I(i,j)-M^2}}{VAR} \\ Mo-\dfrac{\sqrt{VARo(I(i,j)-M^2}}{VAR} \end{cases} if\,(I(i,j)$$

Therefore I (i,j) denoted the gray level value at G (i,j) denotes the standardized gray level (i,j).VAR and Mo represents the difference and the expected mean value respectively.

2. The image direction is estimated in the next step full image is subdivided into 16x16 and the local direction in the figure is calculated by

$$Vx(i,j)=\sum i+\frac{w}{2}\sum j+\frac{w}{2}2\theta x(u,v)\theta y(u,v),$$

$$m=i-\frac{w}{2}w=j-\frac{x}{2}$$

$$Vy(i,j)=\sum i+\frac{w}{2}\sum j+\frac{w}{2}(\theta x(u,v)-\theta y(u,v)),$$

$$w=i-\frac{w}{2}w=j-\frac{w}{2}$$

$$\theta(i,j)=\frac{1}{2}\tan-\left(\frac{Vy(i,j)}{Vx(i,j)}\right)$$

The least square estimation of limited ridge direction at the pixel (i,j), estimates the local ridge direction.

3. The points between two blocks of images are smoothened by passing it through low pass filter as shown below

$$X[k]=\frac{1}{w}\sum_{d=0}^{w-1}G(u,v),k=0,1,,,l-1,$$

$$u=i+\left(d-\frac{w}{2}\right)\cos\theta(i,j)+\left(k-\frac{1}{2}\right)\sin\theta(i,j),$$

$$v=j+\left(d-\frac{w}{2}\right)\sin\theta(i,j)+\left(\frac{1}{2}-k\right)\cos\theta(i,j)$$

4. The X-signature value for every block is measured in a perpendicular direction, from each block. The window for measuring the frequency between the points obtained in X-signature is calculated on 16X32 block which is represented as below:

$$X[k]=\frac{1}{w}\sum_{d=0}^{w-1}G(u,v),k=0,1,...i-1,$$

$$u=i+\left(d-\frac{w}{2}\right)\cos\theta(i,j)+\left(k-\frac{1}{2}\right)\sin\theta(i,j),$$

$$v=j+\left(d-\frac{w}{2}\right)\sin\theta(i,j)+\left(\frac{1}{2}-k\right)\cos\theta(i,j)$$

5. Here every block is filtered along the path of the position using the value of the frequency obtained in every block.
6. The frequency and spatial coordinate values are taken care of by Gabor filter. These values serve as the input to form a Gabor mask which includes direction, frequency and the difference between x and y direction. Filtering is applied on each block using its local direction and frequency. The Gabor filter at direction θ = 90° in equation (2) can be two separate independent functions as given below:

$$G(x,y,fo)=G(x,fo)G(y)=\exp\left\{-\frac{1}{2}\left(\frac{x2}{\sigma_x^2}\right)\right\}\cos(2\pi fox)\exp\left\{-\frac{1}{2}\left(\frac{y2}{\sigma_y^2}\right)\right\}$$

where

$$G(x,fo)=\exp\left\{-\frac{1}{2}\left(\frac{x2}{\sigma_x^2}\right)\right\}\cos(2\pi fox)\,and,G(y)=\exp\left\{-\frac{1}{2}\left(\frac{y2}{\sigma_y^2}\right)\right\}$$

The function of x-axis has GBP calculation which is based on band pass gaussian function and The function of y-axis has GLP calculation which is based on low pass gaussian function.where F0 is constant which determines ridge frequency. Thus the calculation is only done with a single variable either x or y. this can be implemented as a separate transform by applying 1-Dimentional band pass fuctionality along with each row of the fingerprint block and then this is followed by 1-Dimentional low pass gabor filter for each column of the fingerprint image. Suppose a straight line in any chosen direction is drawn it is vary tedious task to separate repeated pixels to form straight line in a desired direction.Thus this approach needs an independent reassembling process which makes this process complex. In traditional gabor enhancement ridge direction is quantized into 8 direction. ie 0°, 22.5°, 45°, 67.5°, 90°, 112.5°, 135°, and 157.5°. For useful separate Gabor enhancement path of filter is formed by sampling grid and resulting in approximate 8 direction i.e. 0°, 26.6°, 45°, 63.4°, 90°, 116.6°, 135°, 153.4°. These 8 path and position of pixel is well defined. Then fingerprint image is tested with square grid image as shown in fig. a space between samples to the next sample in any direction may be different.

ii. Minutiae Extraction process

The removal of minutiae is stage of improvement where in the improved image is converted into binary values in this progression. The fingerprint image is then shaped and the minutiae points are removed by using the technique given below. The image edges are thinned because edges of a single pixel which is varied for approximation of neighborhood edge region. As real fingerprint were collected on different age groups different experiments are conducted on fingerprints internal database of 200 samples (100male and 100female) minutiae details life intersecting points, ridge counts, number of blobs and terminating points in the fingerprint image were extracted. The following gives the steps involved in minutiae processing.
1: Input the fingerprint image.
2: Pre-process the input image i.e. Removal noise, image resize, etc.
3: Change the gray image to binary image.
4: Calculate the intersecting points, number of blobs, ridge counts and terminating points.
5: Select the optimal threshold value to classify the gender.

6: Output: Male or female fingerprint images.

iii. Post-processing

The above step of minutiae points contains false minutiae, because of ridge breaks. And it is to be removed. False minutiae found at the margins end of the image so that is to be deleted using segmented mask. As a first step preprocessing contains the blocks which have larger difference than the threshold value and it has zero for blocks with lesser differences. The removal of minutiae may occur due to ridge breaks. A 11X11 size is used for the minutiae points which is kept at the center, is then tested for calculating the new minutiae points in the block. If new minutiae occur in that block then Each and every minutiae in the block are deleted. Thus minutiae points extracting from ridges breaks are removed. By this procedure of eliminating false minutiae has a risk to be very careful of its existence.

Proposed methodology

Normalization: Adaptive local mean and variance approach
Orientation field estimation: Local ridge detail method
Filtering: Direct gray scale filtering based on Gabor function
Binarization: adaptive thresholding approach
Thinning: Improved fast thinning approach
Minutiae extraction: Crossing number method
False minutiae elimination: Euclidean distance method
ROI: Extracting
NN: Classification of Male and Female

III. Result

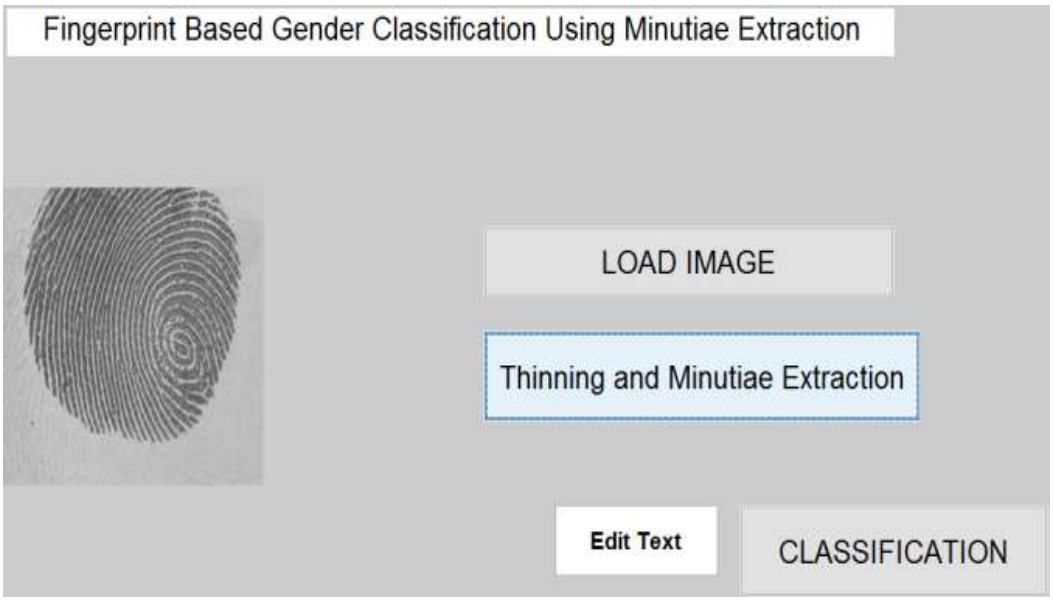

Fig 1: Preprocessing image

Fig 2: Input image

Fig 3: Binary image

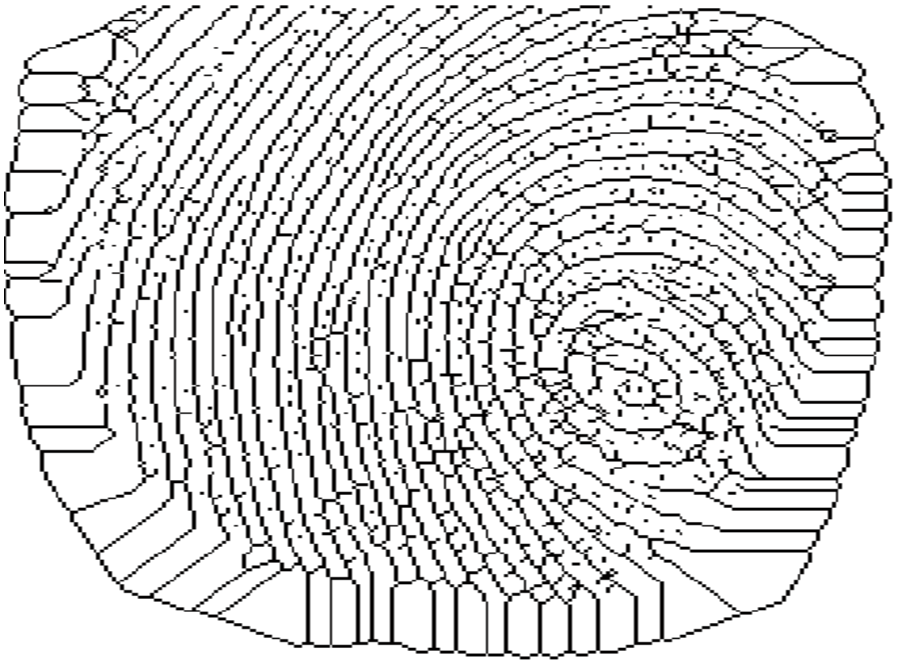

Fig 4: Thinned image

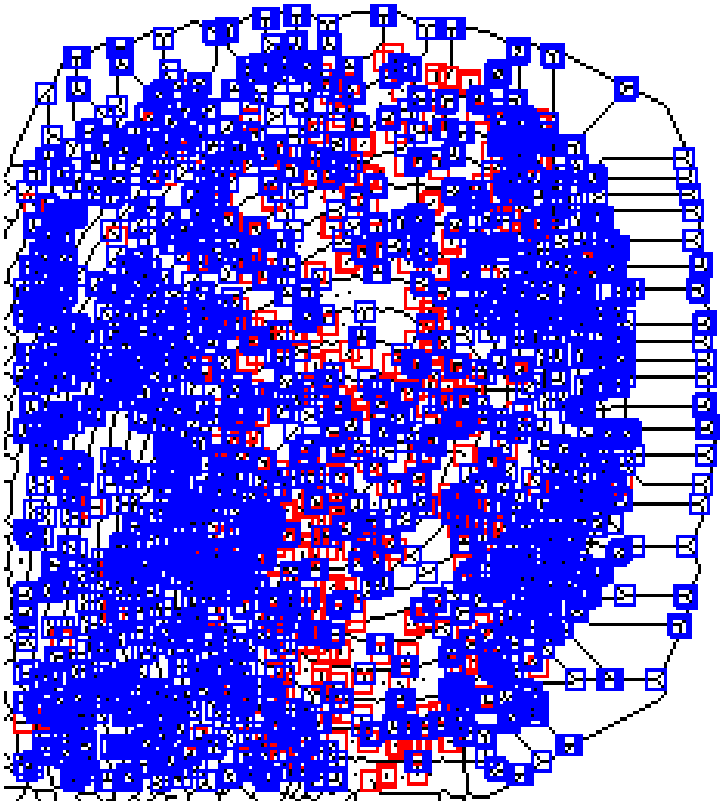

Fig 5: Minutiae extraction

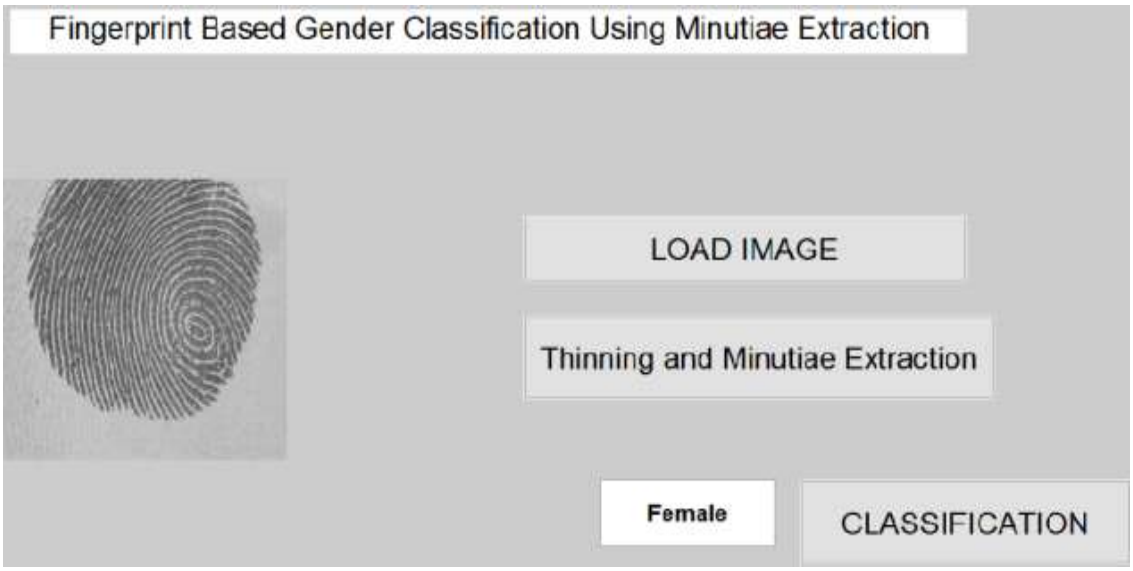

Fig 6: Classification using NN

IV. Discussion

In this fingerprint based gender identification technique biometric is most important data set for go ahead with any type of predication analysis and come to the conclusion basis. While undergoing through this study come across different challenges for capturing the fingerprint data on real time and after that need to check whether that i.e. images collected are good quality. Until unless images are good quality that will difficulty for processing & transformation on different levels with the steps, once decided then will find out the different properties on the fingerprint like ridge, ridge density, RVTR, valley, core and Bifurcation with the help on different methodizes. Result set differentiated from all process then create SVM ranges for different dataset value and it helpful for taking decision based on output.

V. Conclusion

The lack of a reliable and the best gender prediction system motivates researchers for a continuous developing in prediction algorithms, especially in the areas for a cosmetic surgery and the security applications. In summary, three robust machine learning techniques named MFANNs, SVRRBF, and k-NN models are used to predict the gender detection. A set of 450 subjects is selected from the FERET dataset and used for gender prediction system. Improving results computation, a 10-folds CV technique is used and the performance averages for the accuracy rate and SEE values are reported. Results of our three-gender prediction can be listed in an ascending form as: MFANNs, SVR-RBF, and k-NN. It is shown that MFANNs registered the highest performance accuracy rate and lowest errors. Comparing the results achieved in this study versus the ones obtained in the previous related works, authors claim that the findings is a highly recommended and extreme-reliable for gender prediction. Future research can be extended to amplify the input features from the face area, iris, and eye detection to perform gender prediction.

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