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Fingerprint Based Gender Classification using ANN

Sudharshan Duth P, Megha P Mirashi

ABSTRACT: ***Fingerprint contains ridge and valley which together form distinctive patterns. A fingerprint Biometric trait is one of the important trait 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 Gabor filters and Minutiae extraction and ROI. The extracted feature is used to train artificial neural network based on the extracted data.***

Keywords— Fingerprint, Gabor filters, ROI, ANN, Gender classification.

I. INTRODUCTION

A unique finger pattern is epidermis of finger comprise of the example of interleaved edges and valleys. The endpoint and bifurcation points of edges are called ridges. Fingerprint minutiae details examples of edges are resolved as one of the kind through the mix of hereditary and condition features. Unique fingerprint patterns of the same character are dissimilar. Likewise the edges example of each unique finger patterns stays unaltered from birth to till death. The gender classification based biometric applications are intended for :

1) E-commerce:- like, individual validation or ID for system, e-records security, web based business, internet get to, web based keeping money and ATMs, charge cards, physical access control of peripherals, mobile phones get to, PDAs, restorative records the executives, library get to and virtual learning and so forth.

2) E-Governance: like, Digital mark or steganography, nationwide ID cards, car driver certificates, documents control, and so forth.[1]

3) Scientific applications: for example, carcass recognizable proof, criminal examination, fear based oppressor ID, parenthood assurance, missing kids. Numerous social and authoritative correspondences and administrations today rely upon gender of a person performs the role. Unique finger pattern order is a vital preprocessing and verification step in fingerprint classification. A finger pattern contains edges and valleys on the fingertip. Minutiae points are these neighborhood edges attributes that happen either at an edges finishing or an edge bifurcation. An edge finishing is characterized as the point where the edge closes unexpectedly and the edge bifurcation is where the edge parts into at least two branches. Minutiae details classification turns into a tough task in low-slung quality unique mark pictures where sound and contract differentiation lack outcome in pixel designs like minutiae. This is a main angle that has been contemplated in this undertaking for removal of the minutiae by a base mistake in a specific area.

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***** Correspondence Author (s)
Sudharshan Duth P, Department of Computer Science, Amrita Vishwa Vidyapeetham, India.
Megha P Mirashi, Department of Computer Science, Amrita Vishwa Vidyapeetham, India.

II. REFERRED WORKS

Hong et al [1] as proposed an algorithm to assurance that the presentation of a fingerprint system will be strong to the value of input fingerprint image. Fingerprint improvement procedure, which can increase the clearness of ridge and valley structures of fingerprint image based on the valued limited ridge path and occurrence. It gives the results that including the improvement algorithm improve both the ridges and valley structure and the confirmation accurateness. Capelin. et al [2] as proposed a fingerprint image rebuilding from normal templates. This work proposes to rebuild fingerprint image from the regular patterns and examines to what extents built image are related to the unique ones. It gives the results that the rebuilt image is very accurate, there is a chance to cheat modern commercial fingerprint recognition system. Feng et al [3] as planned a technique for fingerprint angle field rebuilding from minutiae pattern. They propose a Gaussian weighted technique for fingerprint direction path rebuilding from the minutiae pattern only. In the technique, previous evidence about ridge flow features is considered very accurately perfect the ridge direction. The results effects show that our technique can obtain in exact direction field in terms of the exactness of the direction field based fingerprint classification and the presentation of the fingerprint matching. Abdullah and Abash [4] proposed global algorithm. And enhance the forensic measure by proposing global feature extraction for gender classification. It gives the result show new algorithm gives the higher acceptable reading above 70% classification rate, when it compared to manual method. Felon and Fate Ajala [5] as proposed fingerprint based age and gender detector system using fingerprint pattern analysis. They proposed a technique back propagation neural network for gender classification and discrete wavelet transform for age classification. It gives the result overcome the limitations of earlier technique and algorithm with competitive and satisfactory results.

III. METHODOLOGY

i.Artificial Neural Network

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.

VI. DISCRIPTION OF STEPS OF THE ALGORITHM

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.

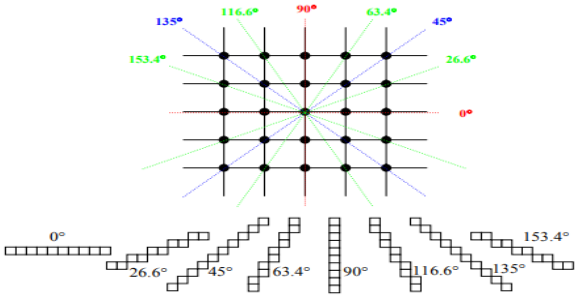
6. The frequency and spatial coordinate values are taken care of by Gabor filter. These values serve as the input to form a Gabor mask which includes direction, frequency and the difference between x and y direction. Filtering is applied on each block using its local direction and frequency. The Gabor 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.



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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.

Step-1: Input the fingerprint image.
Step-2: Pre-process the input image i.e. Removal noise, image resize, etc.
Step-3: Change the gray image to binary image.
Step-4: Calculate the intersecting points, number of blobs, ridge counts and terminating points.
Step-5: Select the optimal threshold value to classify the gender.
Step-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 Region of Interest.
- **ANN:** Classification of Male and Female

VII. EXPERIMENTAL RESULTS

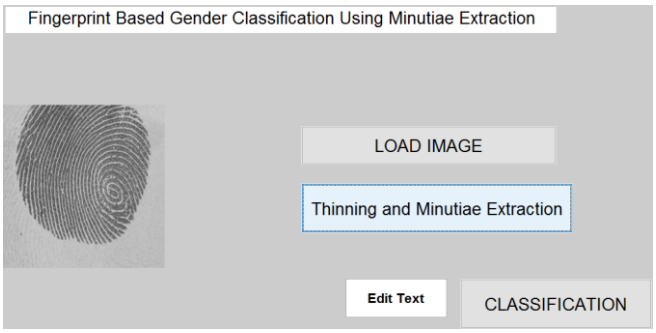

Fig 1: Preprocessing image

Fig 2: Input image

Fig 3: Binary image

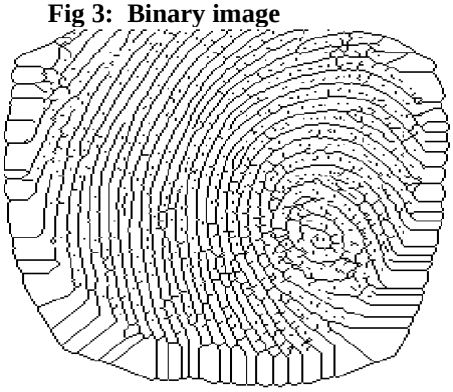

Fig 4: Thinned image

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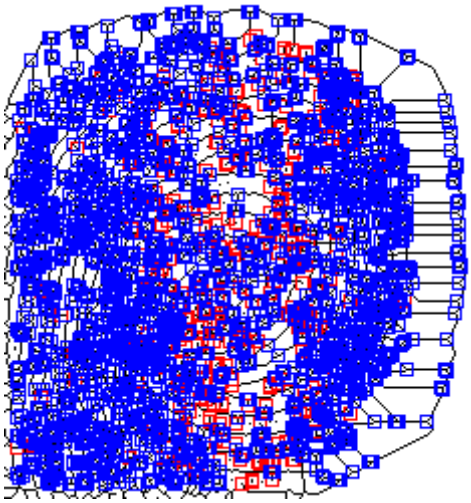

Fig 5: Minutiae extraction

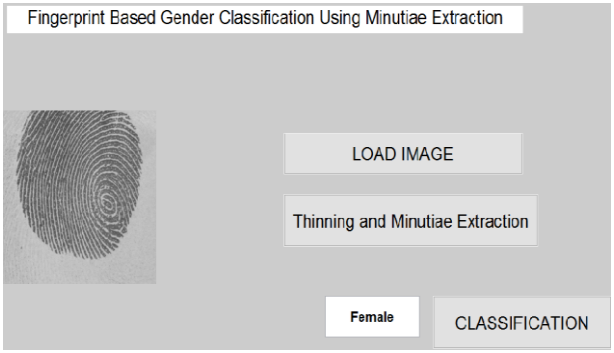

Fig 6: Classification using ANN

VIII. 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.

FUTURE WORK

We can use different techniques which gives the enhanced result. And gender classification can be more exact and suitable for all the forms of presentation. It should be recalled that for age classification we can use RTVTR. The age classification and the blood classification can be done in future. The scope of our project is wide in recognizing the suspects in criminal activity.

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AUTHORS PROFILE

P.SudharshanDuth is serving as Assistant Professor in the Department of Computer Science at Amrita Vishwa Vidyapeetham, Mysuru Campus. His interests include Bio-metrics, Digital Image Processing, Internet of Things, Sentimental Analysis and Software Engineering. He has published around 12 research papers in various domains such of Biomedical Image Processing, Sentimental Analysis and IOT in various scopus indexed international journals.

Megha P Mirashia student of Amrita School of Arts & Sciences, Mysuru is currently pursuing her Masters in Computer Applications,she has is a BCA graduate from SDM and had contributed for project on Fairness network resource allocation for data exchange, Mysuru (2016) her area of research includes Digital image processing. She has skills and expertise in image processing, web designing ASP.net ,C,C++ C#, SQL .