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RESEARCH ARTICLE

FINGERPRINT MATCHING AND RECOGNITION USING GABOR FILTER WITH EUCLIDEAN DISTANCE

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ABSTRACT

This paper includes matching of fingerprint images based on the minutiae and bifurcation points. Euclidean distance algorithm helps in recognition of input images depends upon the threshold value. Euclidean distance calculated between the feature vectors. A Gabor filter used to differentiate the extracts features of fingerprint images. Gabor feature of wavelet transform method helps in detecting minutiae and bifurcation points which help in finding the match of input fingerprint image.

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INTRODUCTION

Fingerprint is a collection of various minutiae points (Atul, 2013). They are the points which intersect each other, can be a small dot and can be in a delta shape etc. Minutiae are the discontinuities in local ridge structure .The minutiae points and bifurcation points are the main points which help in distinguish the different fingerprint images. Bifurcation is a point which separated into two forks i.e. in y shape. Recognition and matching of two fingerprint images is depending on the bifurcation and minutiae points. The first process is enhancement of fingerprint image is needed to be done. Image enhancement is to improve the quality of image so the correct minutiae and bifurcation points can be detected. Image enhancement includes segmentation and binearization of image. In segmentation image is segmented into background and foreground region so that the irrelevant data in background region can be ignored. After enhancement recognition of input image is done. Recognition includes the feature and minutiae extraction of fingerprint. The recognition is done with the help of Euclidean distance algorithm and principal component analysis. Euclidean distance helps in finding out the position of the core points in fingerprint images which can also called reference point. And last to match fingerprint after recognition with the help of Gabor feature of wavelet transform method which directly detect the minutiae point from black and white images without pre-processing the image.

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Image Enhancement

A fingerprint image is firstly enhanced before the features contained in it could be detected or extracted. Because of enhancement of fingerprint image true and false minutiae points can be separated. False minutiae features are those minutiae points that are created due to noise or artefacts and they are not actually part of the fingerprint [2]. Image enhancement contains segmentation and binearization to improve the quality of fingerprint image.

Image segmentation

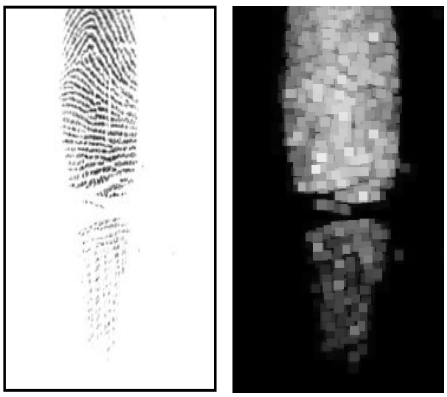
An image contains foreground region and background region. The foreground region often called region of interest (ROI) (Iwasokam Gabriel Babatunde, 2012). The ROI contains ridges and valleys where ridges .are the dark areas and valleys are the white regions. The main focus is on foreground regions thus the purpose of segmentation is to avoid the background regions. Segmentation method is performed by variance

method in which image is divided into two blocks than grey-scale variance is calculated for each block. If the variance is less than the mean, then the block is assigned to be a background region; otherwise, it is assigned to be part of the foreground. The grey-level variance for a block of size W×W is defined as in equation 1:

$$v(k) = \frac{1}{w^2}\sum_{i=0}^{w-1}\sum_{j=0}^{w-1}(I(i,j) - M(k))^2 \quad \ldots\ldots\ldots\ldots (1)$$

Where v (k) is the variance for block k, I(I, j) is the grey-level value at pixel (I, j) and M(k) is the mean grey-level value for the block k.

Segmentation further include image texture segmentation, region based segmentation and boundary segmentation. Image texture segmentation is used along with colour, that helps solve segmenting in image. Region based segmentation attempts to grouping the pixels based on texture properties together. Boundary based segmentation attempts to grouping the pixels based on edges between pixels that come from different texture properties.



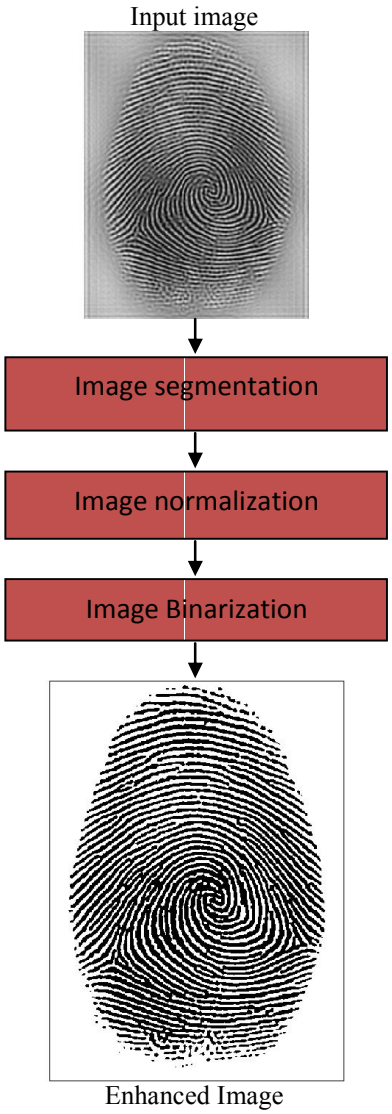
Input image texture and boundary Segmentation

After segmentation

Fig. 1. Segmentation process

Image Binarization

Binarization converts a grey level image into a binary image to improve the contrast between the ridges and valleys in a fingerprint image which leads in the extraction of minutiae. The Binarization process determine the grey-level value of each pixel in the enhanced image, and, if the value is greater than the global threshold, then the pixel value is set to a binary value one, otherwise it is set to zero (Atul, 2013).



Recognition of Fingerprint

Fingerprint recognition is the process of comparing input image against another fingerprint image to determine if the impression is from the same finger. There are many techniques for fingerprint recognition, some of these techniques like Gabor based techniques, neural network method, and wavelet based techniques and Euclidean distance. Gabor filter recognise the fingerprint image taken by digital camera only i.e. touch less fingerprint and the accuracy of this recognition is around 92.7 percent. Neural network recognise fingerprint with accuracy of 92 percent. Wavelet recognise fingerprint with the accuracy of 90 percent (Chomtip Pompanomchai, 2010). Based on the literature survey, the Euclidean distance method is not only simple but also effective to solve the fingerprint recognition problems.

Following Recognition of image algorithm consist three phases i.e. initial processing, minutiae extraction, fingerprint matching. Image enhancement is required to improve the quality of image so that relevant minutiae points can be detected. For image enhancement histogram, filtering and transform type techniques can be used. Binarization is used to convert a fingerprint image into grey-level image to detect

minutiae points. ROI is called region of interest means the relevant part of fingerprint image on which minutiae and feature extraction is performed.

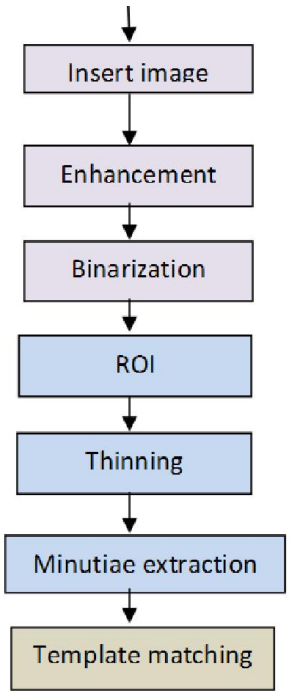


Fig. 3. Fingerprint recognition process

The objective of thinning is to find the ridges of one pixel width. Ridge Thinning is to eliminate the redundant pixels of ridges till the ridges are just one pixel wide. An erroneous pixel is defined as the one with more than two 4-connected neighbours. These erroneous pixels exist in the fork regions where bifurcations should be detected. The existence of erroneous pixels may destroy the integrity of spurious bridges and spurs, Exchange the type of minutiae points, and Miss detect true bifurcations. Before minutiae extraction, there is a need to develop a validation algorithm to eliminate the erroneous pixels. Enhanced thinning algorithm includes Scanning the skeleton of fingerprint image row by row from top-left to bottom-right. Check if the pixel is 1, Count its four connected neighbour, if the sum is greater that two, mark it as an erroneous pixel, Remove the erroneous pixel (Manvjeet Kaur, 2008).

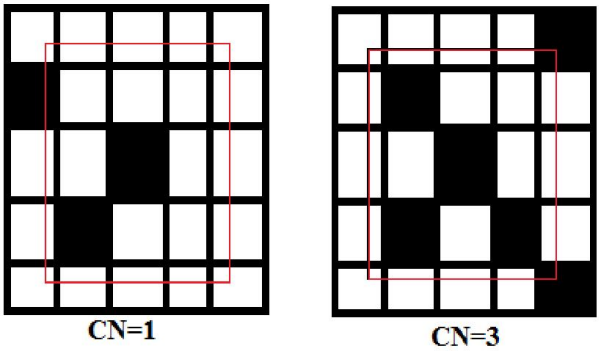


Fig.4. Bifurcation and minutiae value depend upon CN

According to research in Minutiae extraction cross-numbering is the most common method.CN can be applied only on skeleton images. Minutiae's are extracted by scanning the local neighbourhood of each ridge pixel in the image using a 3x3 window as shown in figure 3 (Ala Balti *et al.,* 2012). The ridge pixel can then be classified as a ridge ending, bifurcation or non-minutiae point. For example, a ridge pixel with a CN of one corresponds to a ridge ending minutiae, and a CN of three corresponds to bifurcation minutiae (Ala Balti *et al.,* 2012). CN value is computed as half the sum of the difference between pairs of adjacent pixels in the eight-neighbourhood as given below in equation 2.

$$CN = 0.5 \sum_{i=1}^{8} |p_i - p_{i+1}| \quad \text{..... (2)}$$

Where *Pi* is the pixel value in the neighborhood of *P*. For a pixel *P*, its eight neighbouring pixels are scanned in an anti-clockwise direction as below in figure.

Table 1. Neighbouring pixel

P4	P3	P2
P5	P	P1
P6	P7	P8

Fingerprint Matching Using Gabor Filter with Euclidean Distance

The first step to match the two fingerprint images by finding the minutiae points and bifurcation points. The technique find the total number of minutiae and bifurcation points in an input fingerprint image and after that match all these located minutiae and bifurcation points in stored database of fingerprint images. The process of matching minutiae points is based on accuracy of minutiae points. Fingerprint matching algorithm include three process below

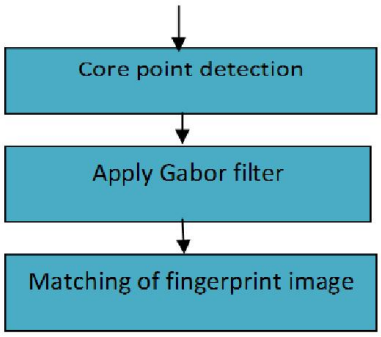


Fig .5. Fingerprint matching techniques

Core point detection

A fingerprint has many loops. The loops can be left loop, right and whorl loop. The core point exists at the centre of the innermost loop which is the top most region of that innermost loop. In some fingerprint images like whorl type fingerprint the core point is difficult to found. The solution to find in these type of images to associate core point with maximum number of ridge lines. The solution to find in these type of images to associate core point with maximum number of ridge lines. According to Chomtip ASDF(average squared directional field) is applied to find the core point.

Fig. 6. Core point

Gabor filtering

After detecting the core point a circle is created around the core point.than divide this circle into 128 sectors (Muhammad Umer Munir, 2006). Find the mean and variance of each pixel intensities in that 128 sectors and make them constant (Muhammad Umer Munir, 2006). After this different type of gabor filtering is applied which produced different sets of filterd images and these filtered images contain spacieal information in each sectors called feature vectors. All the minutiae points are the form of feature vector that is computed from all the 128 sectors in every filtered images (Muhammad Umer Munir, 2006).

Matching of fingerprint images

Its all depend upon the euclidean distance which is calculated between two minutiae points i.e. feature vector. The difference can also be between core point and the bifurcation points surrounded the core point. If the euclidean distance is less than the mean value than the two fingerprint images got matched otherwise it is fail to match two images. The result of finding an image in traindatabase on the basis of minutiae and bifurcation points given below

Tabble 2. Result Evaluation on the basis of minutiae and bifurcation points

Input Images	Total Minutiae Points	Total Bifurcation Points
Fig 1	375	336
Fig 2	152	113

Conclusion

In this paper the research is about matching the fingerprint images by using gabor filter with euclidean distance algorithim which gives the validate result of matching two fingerprint images.The main motive of the research is to compare all the techniques to check the validity how efficient it is in matching the fingerprint images.

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