A REVIEW OF FINGERPRINT RECOGNITION TECHNIQUES

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Abstract— A popular biometric used to authenticate a person is fingerprint which is unique and accurate and it is permanent in a person's life. Now a days everybody uses fingerprint in various real life applications .The poor Quality of image is still a big problem to identify a person by its fingerprint .This paper discusses on various Techniques and method like Correlation matching, Minutiae based matching, Pattern based matching to recognize a person.

Keywords— Fingerprint recognition, Correlation , Minutiae , Pattern based matching

I. INTRODUCTION

Fingerprint recognition is a method of identifying and confirm the identity of the user. Fingerprint recognition is one of the most well known biometrics function. The reason for being popular is easy for authentication on computers and machines. The three basic patterns for fingerprint recognition is arch, loop and whorl. The arch contains one side of the finger and the loop enters the side of the fingers and the last one contains circular and central points of the finger.

Fingerprints are stored in database with each Ids. These biometrics are used in colleges for attendance. Attendance are stored in their database. The attendance is calculated when the user place his/her finger on the sensor. It is very easy in use just place your finger on the sensor and enter. The biometric machine identify the user by their fingers. Fingerprints are the tiny ridges, valley patterns on the tip of each finger. No two person have been found the same fingerprints –they are totally unique. Fingerprint are more unique than DNA . DNA must be same of siblings but the fingerprints cannot be same. Figure 1 shows fingerprints of different persons.

FIG.1 : DIFFERENT FINGERPRINT IMAGES
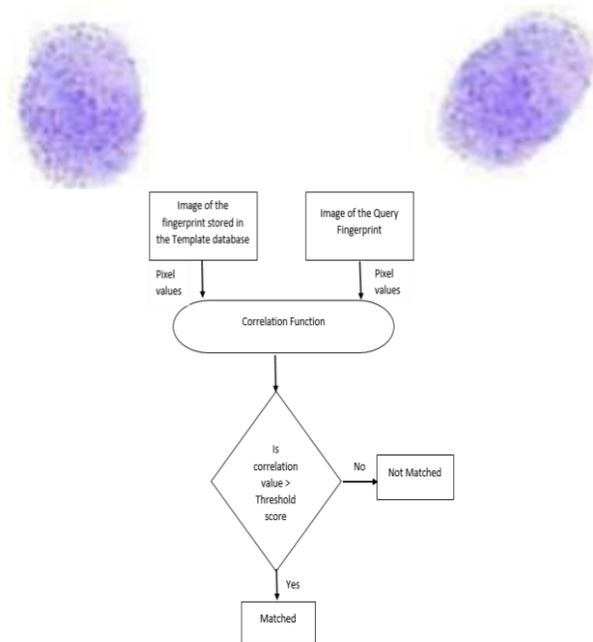
II . FINGERPRINT MATCHING TECHNIQUES

There are three famous fingerprint matching   techniques:

A. *Correlation-based Matching*

The Correlation based matching fingerprint technique is a technique which works on pixel values of the images. In correlation method we use gray scale information of the user's fingerprints. In this matching algorithm first we select the template and the pixel values of those template and compare it with the pixel values of all images which is stored in template database and then we search for the maximum value which is called obtained correlated data and it should be grater than selected threshold score. Maximum value of selected template gives us an accurate match of the template from all the images which is stored in database . This technique comes under the category of area based matching algorithms in which we can select image pixel and compare it with existing data and then gives result on the basis of comparison.

It is a good approach to match the fingerprint with high resolution. In this algorithm they match ridge, shape, breaks etc. This technique take high computational effort as compared to other techniques . Correlation based method take less time and need less pre-processing of data as compared with Minutiae based and pattern based technique but sometime this is less accurate than those technique. It is important to calculate very less difference between the pixel value of two images for matching purpose. The aim of this is to get maximum correlation value .

Fig 2. shows the process of correlation based fingerprint matching and the process start from the evaluation of pixel value of two images and after this we compare the correlation value with threshold score .

Fig. 2. (Process of Correlation Based Fingerprint Recognition)

Correlation value is compared with threshold value. Figure 3 shows the process to calculate the threshold value.
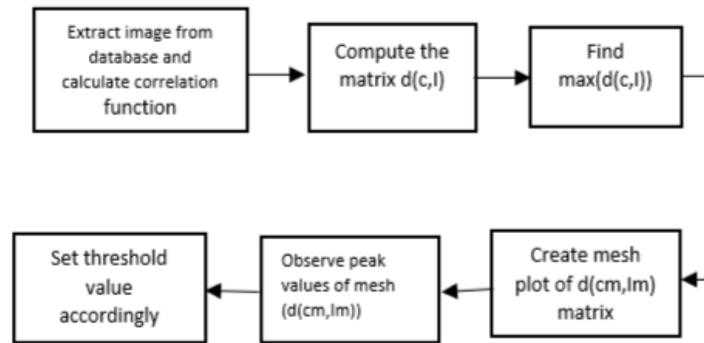
Fig. 3. Calculation of Threshold value for Correlation method

B.   Minutiae-based matching

Minutiae based matching technique is a type of technique which is used to match the fingerprint using fingerprint machine. Minutiae based technique is very popular and widely used algorithm to identify the person . It basically works on minutiae to verify the user's Fingerprint. We can extract the detail of minutiae and on the basis of minutiae detail we can decide whether the fingerprint is matched or not. Extract the minutiae features of fingerprint and match it with stored fingerprint template. After matching of the fingerprint we can stored as a set of points in 2-D plane. The major important part to match the fingerprint is minutiae point. This minutiae point is define the uniqueness of the fingerprint. A good quality fingerprint image having 25 to 80 minutiae points .   There is a problem in minutiae based matching algorithm that they cannot extract the minutiae from a poor quality image.

Hence, the pair or minutiae point of both fingerprint may not be considered in this condition. First we can convert the minutiae points into 2 dimensional image and after this calculate the transformation parameter to match the fingerprint . Distance between two minutiae set determine the similarity of two different fingerprint. Figure 4 shows this process.
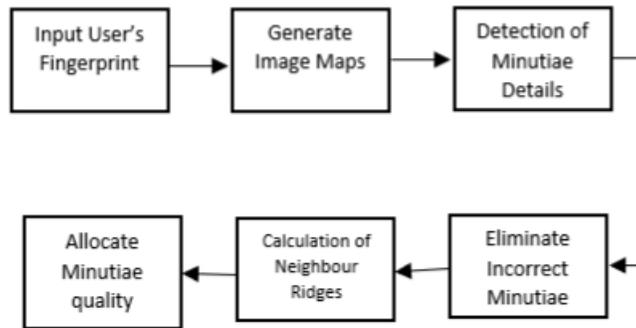
Fig. 4. Generalized Minutiae Process

TABLE I.   COMPARISON BETWEEN MINUTIAE AND   CORRELATION BASED   TECHNIQUE

Parameters	Minutiae based approach	Correlation based approach
Basic concept	Minutiae i.e. It take small physical details of fingerprints.	Based on correlation values and threshold value.
Gray scale information	Gray scale information is not utilized	Gray scale information is used in this approach
Poor quality images	This approach Can't handle poor quality images	It Can easily handle poor quality images
Computational power	Less computational power is needed in minutiae technique.	More computational power is needed
Usage	It is most widely used in fingerprint recognition.	We cannot use this approach in real time applications .
Cost	Minutiae approach is Less costly than	High cost due to more power consumption

	correlation.	
Rotation	It can easily handle the rotations more than 10 degree	Not able to handle the rotations more than 10 degree

C. Pattern- based Matching

The Pattern-based algorithm is the most generally used fingerprint matching Technique along with minutiae-based. A fingerprint image has four patterns which are whorl, right loop, left loop and arch. This algorithm compares these four patterns between previously stored fingerprint images on the template database and fingerprint of the person. The images of the fingerprints are needed to be always aligned within the same orientation which is achieved by finding the central point in the fingerprint images and focusing on it with the help of the algorithm. In pattern-based matching technique, the template database consists of various fingerprint images having different type, size, and orientation of pattern. The person fingerprint image is graphically compared with the stored template dataset to detect if they match or not or degree of their similarity.

Pattern based method perform various step for matching the fingerprint. First it enhances the quality of image using method called intensity adjustment whose work is to removes the ambiguity from the fingerprint image. Then image segmentation is done along with the Binarization. The process of converting a grey level image into a binary image is called Binarization. The segmentation of images helps in defining which part of fingerprint image belongs to background and foreground area. Then Principal component analysis (PCA) method is applied which converts the higher dimensional space to lower dimensional space. Lastly, Gabor filter are applied on the image and the feature vectors are extracted. The extracted feature vectors are used to generate feature maps and this map is matched with fingerprint which is stored in database.

Before the Pattern based matching technique, the ink-technique approach was used to identify individual's fingerprint, In this technique first the person fingers are dabbed with ink then the imprint on paper cards is taken, which further are scanned to produce the digital image. In this technique, the matching of the fingerprint is done using the scanned images produced above. This method is still being used in various areas especially in the forensics field, where fingerprints are generally captured from crime scenes. However, ink-technique approach is not feasible for biometric systems where we need to scan and match fingerprints in real time. Modern Pattern-based matching technique can easily be used for biometric systems which make them more useful with the current developing world.

CONCLUSION

In this paper, we have discussed different techniques of fingerprint recognition, it is used to identify a person . All these mentioned techniques verify that the fingerprint is fast and accurate for more reliable and secure system. The Minutiae-based matching is a very useful and widely used technique which is applied for Extract the minutiae features of fingerprint . The Process of biometric identification is represented with the help of flow charts .Future research work for this is to improve the quality of the image by adding some image enhancement technique for better matching of fingerprint .

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