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Biometric Authentication Using Finger Knuckle Print

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Abstract : *Biometric traits are now highly explored by researchers to establish a system that can be used to accurately identify a person. The finger knuckle print refers to the inherent skin patterns that are formed at the joints in the finger back surface. This paper presents techniques used for acquisition and recognition systems based on finger knuckle print. Automatic Knuckle print recognition systems are based on local ridge features known as Minutiae. To select the minutiae points properly and rejecting unwanted ones is very important. The efforts are focused to choose distinctive modality (FKP) for the secure storage and verification of the biometric template for secrete and safety of authentication.*

Keywords *- Knuckle-print images, knuckle-print recognition, minutiae extraction, ridge bifurcation, ridge ending.,*

I. INTRODUCTION

Biometrics refers to the automatic identification or verification of an individual or a claimed identity by using certain physiological or behavioral traits associated with the person such as knuckle-prints, hand geometry, iris, retina, face, hand vein, facial, thermo grams, signature, voiceprints and others. Knuckle print identification is one of the most important biometric technologies which has drawn a substantial amount of attention recently. Each individual has unique knuckle-prints. The uniqueness of a knuckle-print is exclusively determined by the local ridge characteristics and their relationships [1]. Minutiae have two local ridges which are classified as follows:-

1) Ridge ending
2) Ridge bifurcation.

A ridge ending are the point where a ridges ends abruptly. A ridge bifurcation are the point where a ridge divides or diverges into branch ridge [1].Automatic knuckle-print matching depends on the comparison of these local ridge characteristics and their relationships to make a personal identification. An important step in knuckle-print matching is to automatically and reliably extract minutiae from the input knuckle-print images. The result of minutiae extraction depends on the quality of the input knuckle-print images. In such situations, the ridges can be easily detected and minutiae can be located from the thinned ridges. The ridge structures in poor-quality knuckle-print images are not always well-defined, so cannot be correctly detected [2]. This leads to following problems [3]:-

1) A large number of spurious minutiae may be created.
2) A good amount of genuine minutiae may be ignored.
3) Large errors in their localization (position and orientation) may be introduced.

A knuckle-print expert is often able to correctly identify the minutiae by using various clues. Unless the local ridge orientation, ridge continuity, ridge tendency, etc., as long as the ridge and valley structures are not corrupted completely [4]. Knuckle-print features can be divided into three classes as follows [5];-

Class1:- The features which show macro details of the ridge flow shape.
Class2:- The minutiae points are discriminative enough for recognition.
Class3:- The pores complement the uniqueness of Class 2 features.

II. MINUTIAE EXTRACTION

The Minutiae extraction method is used for Knuckle Print authentication. Minutiae detection method needs to locate efficiently and accurately the minutiae points. The two most widely used method for extraction are as follows [5]:-

1) To operate on binarized image
2) To operate on grayscale image

Mostly the method used for minutiae extraction is the Crossing Number (CN) concept which is categorized under binarized image. This method depends on the use of the skeleton image where the ridge flow

pattern is eight-connected. The minutiae are extracted by scanning the local neighborhood of each ridge pixel in the image using a 3x3 window[5]. The CN value is then computed, which is defined as half the sum of the differences between pairs of adjacent pixels in the eight-neighborhood. Using the properties of the CN the ridge pixel can then be classified as a ridge ending, bifurcation or non-minutiae point.

Table 1.Properties of Crossing Number

CROSSING NUMBER	PROPERTY
0	Isolated Point
1	Ridge Ending Point
2	Continuing Ridge Point
3	Bifurcation Point
4	Crossing Point

Images from the same finger but collected at different times are very similar to each other. Meanwhile, images from different fingers are very different, which implies that FKP has the potential for personal identification [6]. The Crossing Number for a ridge pixel *P* is calculated by using the eqn no.(1):-

$$\text{C N=. } 5\sum_{i=1}^{8}|P_i - P_{i+1}|, P_9 = P_1 \ldots..(1)$$

Where,

Pi is the pixel value in the neighborhood of *P*.

III. PROPOSED METHODOLOGY

This paper proposes a method using minutiae for finger knuckle print authentication, it consider all the relevant information from the image and finally gives authentication to relevant data whose information matches with database Following is the algorithm for knuckle print authentication:-

1) **Capturing the raw images**:-
   a. Specifications:
- Finger scanning window size 16.26x24.38mm.
- Image resolution is 96x96 500 DPI Raw finger knuckle.
- Image size is 4.46 KB.

   b. These images are stored in the raw format in the database.

2) **Pre-processing Stage**:

a. Once the image is been capture by imaging device histogram is perform so as to obtained equalization of all intensity level.

b. The next after image enhancement the image binarisation is perform i.e. converting image to binary. The required part is then selected and the unwanted data is left, so as perform authentication on region of interest.

c. The next step is do thinning which reduces all ridge thickness to a pixel; by performing thinning operation the points of minutiae are available with continuity of ridges.

3) **Feature Extraction**:

a. This stage involves extraction of features of the loaded finger knuckle

b. These features consist of Minutiae – ridge terminations and ridge bifurcations, ridge frequency and orientation of these ridges.

c. The inclusion of these three features of a finger knuckle help to have an unique database thus resulting in a good matching result and also a higher accuracy.

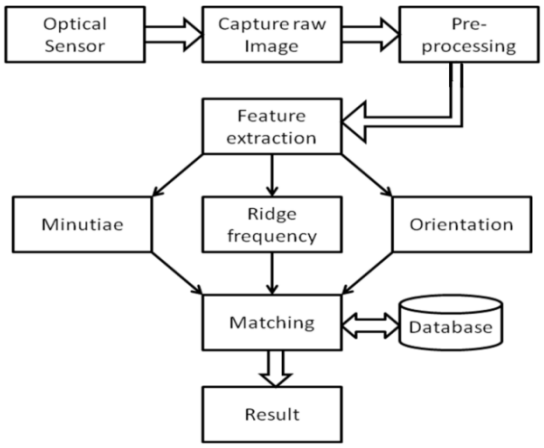

Fig No. 1 Block diagram for implemented FKP Authentication using minutiae.

4) **Matching and Result**:

a. The next step after feature extraction is matching.
b. Matching consists of comparison of the query image with that of the template stored in the database.
c. After the comparison, result generated is completely based on a threshold.

5) **Database Collection**:

a. A Database of 12 persons was created.
b. Finger knuckles were acquired from various persons with their ages varying from 20 to 70years.
c. In the 1st phase, the 10 samples of the left index finger each of 12 users were collected.
d. In the 2nd phase, the 10 samples of the left index finger each of 15 users were collected.
e. Therefore, 10 samples were acquired from each user and hence database consists of 270 samples.
f. The Sensor used for acquiring samples was 'Optical Sensor'.

IV. Results

The results obtained by minutiae extraction process are shown below:

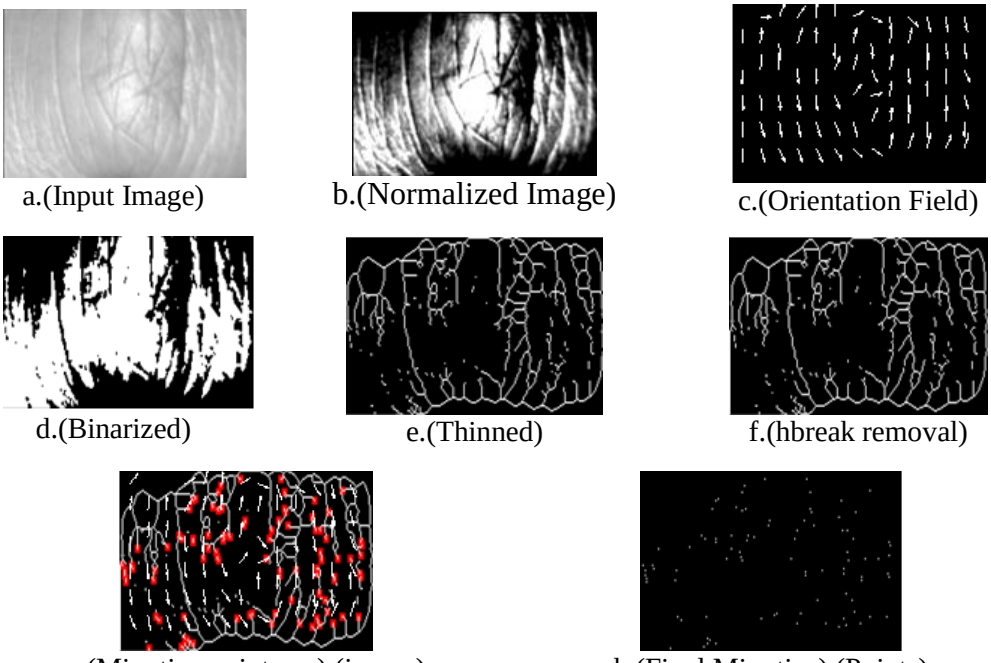

Fig No. 2 Step-wise results of images

The authentication is based on the parameter minutia number, which is significantly different for each individual person .As seen in the Figure 3 minutia number for person A is 2750 and as seen in Figure 4 the minutia number for person B is 5088.

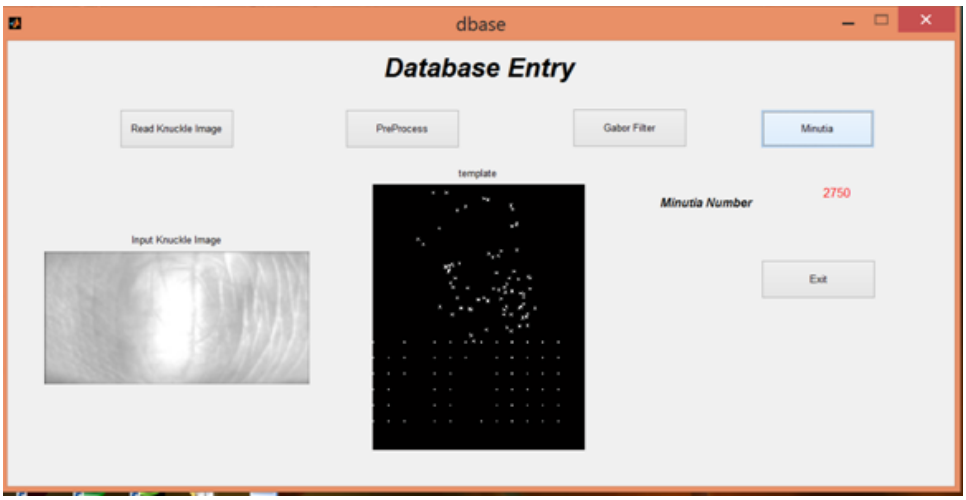

Fig. No. 3. Person A

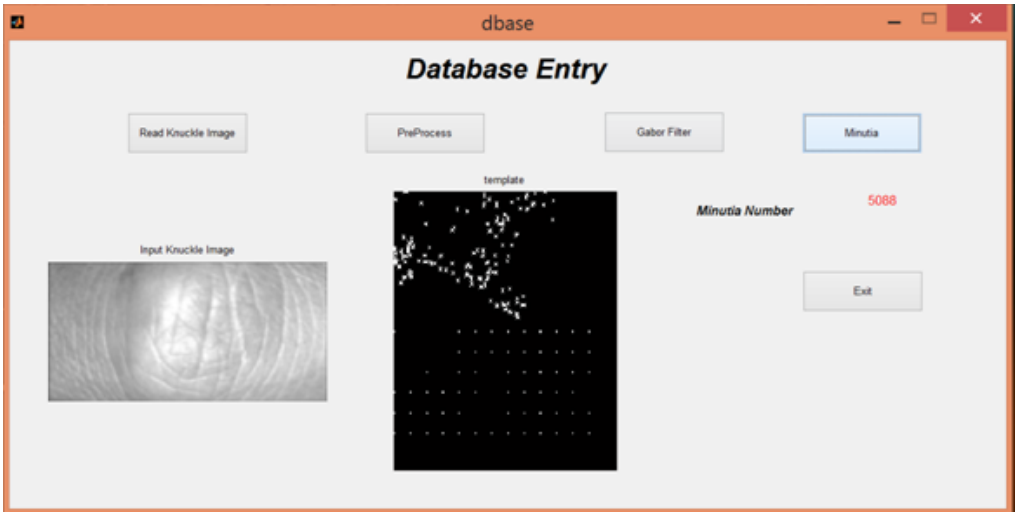

Figure 4: Person B

Now, during the authentication process, the number of the input image and the number of the image stored by that name in the database is compared. If the minutia number of both the images is same, authentication is complete and successful, on the other hand if the minutia number for both the images is below the tolerance value, then authentication has failed and the user is an imposter.

V. Conclusion

This paper draws attention to the finger knuckle traits for secure authentication. This paper reviewed techniques to extract minutiae from knuckle-print images. But low quality knuckle-print images need preprocessing to increase contrast, and reduce different types of noises as noisy pixels also generate a lot of spurious minutiae as they also get enhanced during the preprocessing steps. Further, more emphasis is to be laid on defining the local criteria, in order to establish the validity of a minutia point, which is particularly useful during knuckle-print matching and adopting more sophisticated identification models, for instance extending minutiae definition by including trifurcations, islands, bridges, spurs etc. Also, the paper leads to the further study of the statistical theory of knuckle-print minutiae.

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