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RESEARCH ARTICLE

Detection of an Individual after Piercing Using Ear Biometric

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Abstract— ***Biometric authentication using ear biometric is very popular now a days. Ear biometric is new comer in this field. Biometric became demandable in this modern era for the purpose of security. The human ear is a perfect source of data for passive person identification in many applications. In this paper, problem of identification due to piercing is being considered. The implemented method consists of three stages. In the first stage, pre-processing of ear is done. In the second stage, features are extracted. In next stage, matching is done between pierced and non-pierced image of an individual.***

Key Terms: - Ear biometrics; feature extraction of ear; verification; identification; ear recognition

I. INTRODUCTION

Biometrics deals with identification of individuals on the basis of their physiological and behavioural characteristics. Identification of individual by ear biometrics shows potential because it is a passive identification. Biometrics methods proved to be very efficient .In fact, only biometrics technique accurately recognize humans. In modern era, biometrics has gained a lot of attention. Human ear is a perfect data for passive person identification, which provide security in the public places**.** The ear has desirable properties such as shape, universality, uniqueness and permanence [1].

There are many approaches in the literature for an automated ear recognition system. Systems developed for ear recognition using 2D and 3D images. The approach of voronoi diagrams is proposed by Burge and Burger. Hurley, Nixon and Carter have introduced a system based on force field feature extraction. Choras proposed a system based on geometric feature extraction. Ear recognition from 2D images based on contour matching is developed by Chen and Bhanu [2, 3, 4, and 5].

The proposed technique is able to detect subject's ear even after piercing is done. Identification of individual become challenging if the systems database consist of subject's ear without piercing and the verification check is done after piercing. The implemented method proves that despite of slight changes that occurs in subject's ear due to piercing, individual verification is being achieved.

A photo of the subject's ear is taken and fed into the computer. The image undergoes through pre-processing steps. Then edge detection is carried out on this picture. From this detected edge shape of the ear, is separated. Next the features like pixels count, mean, standard deviation, and skewness are extracted from the ear. Matching is being conducted between subject's non pierced ear and pierced ear. This match is compared with a predefined threshold value, which decides the identity of the person.

II. OVERALL SYSTEM

The proposed system for person identification by ear biometrics is shown in Fig. 1. It comprises of two stages:

- Enrolment: Initially subject's non pierced image is acquired. The feature extraction is being carried out. Then the image is being stored in the system database.
- Verification: In this stage, pierced image is acquired through digital camera or other means. In the pre-processing step the image is converted to gray scale. Then using threshold a binary image is obtained. Next histogram image is generated. After that edge detection is used to detect the edges of the ear. Then all the features are extracted. This image is matched with the enrolled image for verification.

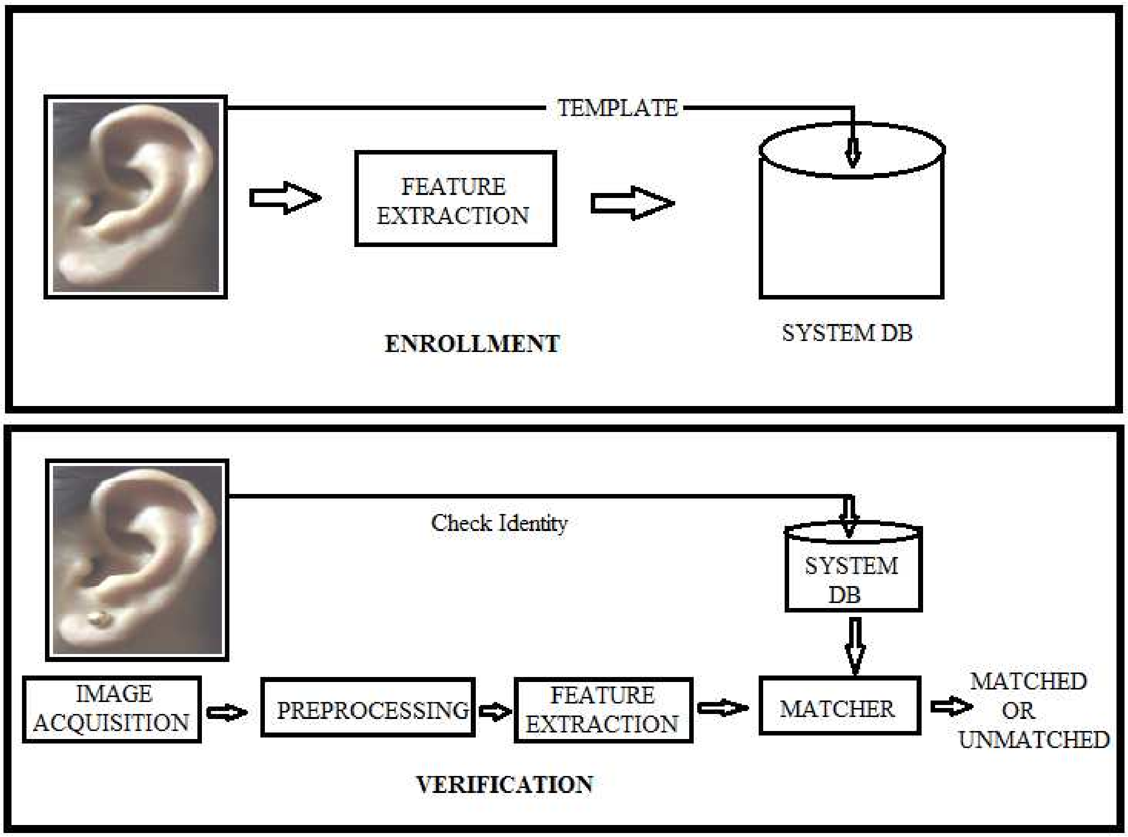

Fig 1. Person identification using ear biometric

III. EAR RECOGNITION

The ear recognition systems can be divided into four [6] main parts - image acquisition, pre-processing, feature extraction, matching.

A. Image Acquisition

The side face images are acquired as shown in Fig. 2 using Digital camera under same lightening conditions with no illumination changes (use of flash gives a fairly constant illumination). All the images are taken from the left side of the face with a distance of approximately 10-15 cm between the ear and the camera. The images have been stored in BMP format.

Fig 2 Image Acquisition

B. Pre-processing

It consist of four parts- Grayscale [7], Thresholding, Histogram, Edge Detection [8].

1) Grayscale: In this approach the ear part is manually cropped from the side image. The cropped colour image is converted to grayscale image as shown in Fig. 3. A gray scale image is an image that contains only shades of gray. Grayscale images are also called monochromatic, denoting the presence of only one (mono) colour (chrome). Grayscale images are often the result of measuring the intensity of light at each pixel in a single band.

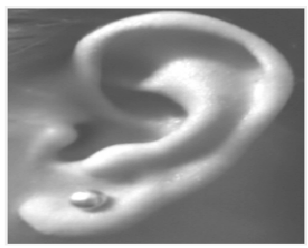

Fig. 3 Grayscale Conversion

2) *Thresholding:* It creates a binary image as shown in Fig. 4 and the process is also called as binarization e.g. performs cell counts in histological images. Image thresholding classifies pixels into two categories: one to which some property measured from the image falls below a threshold, and other at which the property equals or exceeds a threshold. The threshold value is set to a fixed value after evaluating each and every image so as to get the binary image.

Fig.4 Thresholding

3) Histogram: Histogram is a graphical representation of the tonal distribution in a digital image. The horizontal axis of the graph represents the tonal variations, while the vertical axis represents the number of pixels in that particular tone. Histogram equalization is used for adjusting image intensities to enhance contrast. Equalisation is done to achieve enhanced image. This enhanced image is used in the next step i.e. for edge detection. The histogram image is shown in Fig. 5.

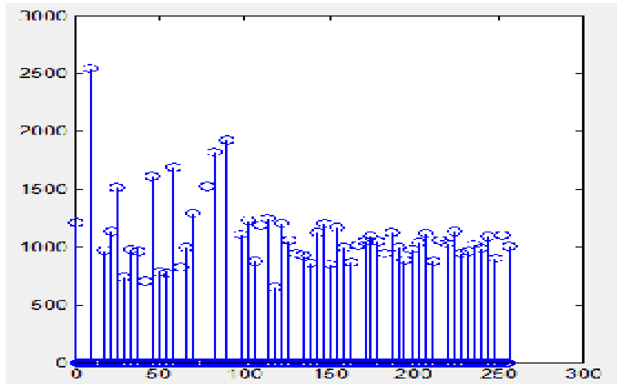

Fig. 5 Histogram

4) *Edge Detection*: It is used to locate areas with strong intensity contrast and helps in extracting information about an image. Canny edge detection is used in this system for edge detection. This step creates a fine image of ear using the edge value as shown in Fig. 6.

Fig. 6 Edge Detection

C. Feature Extraction

The extracted features [9] are described below

1) *Count of black and white pixel*: After edge detection, calculation is done to count the number of black and white pixel in an image.

2) *Mean:* It calculates the mean value of image stored in a form of matrix.

3) *Standard deviation*: It is the average distance from the mean of the data set to a point. The way to calculate it is to compute the squares of the distance from each data point to the mean of the set.

4) *Skewness*: It returns the skewness (it is a measure of symmetry) of the image. A Distribution, or data set, is symmetric if it looks the same to the left and right of the centre point.

D. Matching

After extraction of required features from the ear image, matching is done. Source image is the subject's ear without piercing. The target image is the subject's ear with piercing. Source and target image is compared on basis of pixel count and mean of the two images.

IV. EXPERIMENTAL ANALYSIS

A. Data Acquisition

For data acquisition [10] a digital camera kept at the distance of 10-15 cm from subject's ear. The images are stored with a resolution of 250*250 in the data base of system. The code is written in Matlab 7.0.0 is used for data processing & matching. Also GUI is created in Matlab for pre-processing, feature extraction and verification of a person.

B. Ear Database

It contains the ear images, of different people taken in advance; Images of around 12 people are taken and stored in a folder with filenames. Each folder in the database has two images of the non-pierced ear and pierced ear. Two images per person have been taken and stored.

C. Results

In this section we provide the input GUI, the experimental results i.e. mean difference, matching percent of ears.

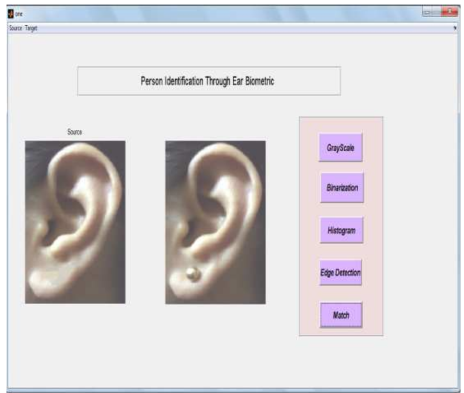

Fig.7 Input GUI

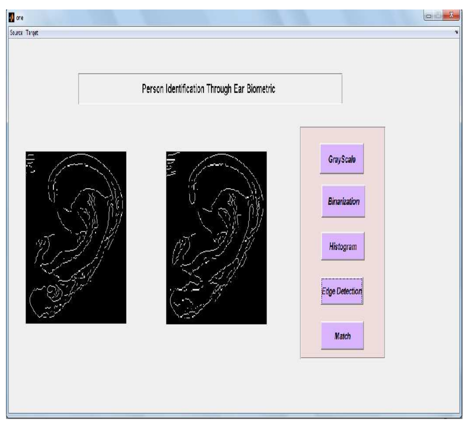

Fig. 8 Ear Matching

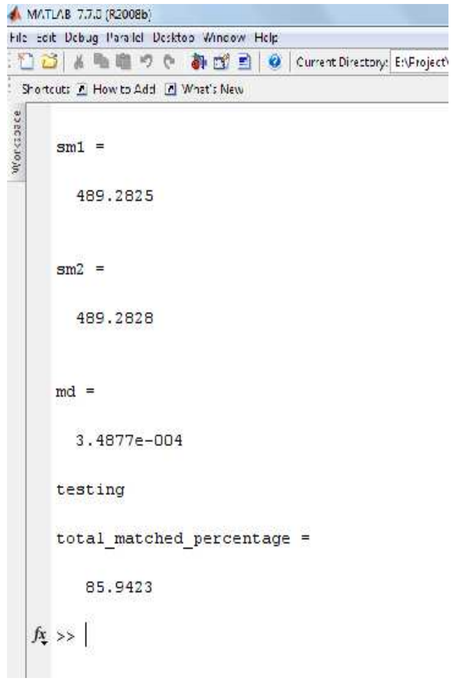

Fig.9 Mean difference and Match Percent

Fig. 10 Match Found

V. CONCLUSION

In this paper, a novel approach is presented for verification of human ear even after piercing. The approach consists of four stages such as image acquisition, pre-processing, feature extraction and finally ear feature matching. First of all, appropriate threshold value is identified and then ear boundary is detected. Then edge detection is done. Data taken from the ear image is compared with the database. The ear detection algorithm is quite simple and, hence, has low computation complexity.

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