Person Identification Using Peg Free Hand Geometry Measurement

Mrs. Sampada A. Dhole*
Ph.D. Scholar, Bhatati Vidyapeeth (Deemed Univ.)
Pune,Maharastra,India
Email: sampadadhole@rediffmail.com

Prof.Dr.V.H.Patil
Professor, Matosree college of Engg.& research center ,Nashik
Email: vhpatil@gmail.com

ABSTRACT:-

Hand geometry based biometric identification has most suitable and acceptable biometric trait for low security applications as it is less invasive and very user friendly. This Research proposes study of personal identification using hand geometry features. Hand geometry features consist of the length & width of fingers, length & width of palm, deviations, and angles. Image acquisition done without using pegs. In this research system total 28 features are extracted. The identification is done using Euclidian distance. Results are tested on real time database as well as standard database. The proposed method gives FAR= 0.48& FRR=1

Keywords:-Image acquisition, Thresholding, Binarization, key point detection

1.INTRODUCTION

In the era of Information Technology, openness of the information is a major concern. As the confidentiality and integrity of the information is critically important, it has to be secured from unauthorized access. Security refers to prohibit some unauthorized persons from some important data or from some precious assets. So we need accurate, automatic personal identification in various applications such as ATM, driving license, passports, citizen's card, cellular telephones, voter's ID card. Hand geometry is most widely used for person identification in the recent years. Hand geometry based biometric system are gaining acceptance in low to medium security applications.

Hand geometry recognition systems are based on a number of measurements taken from the human hand, including its shape, size of palm, and length and widths of the fingers.. The technique is very simple relatively easy to use, and inexpensive. Environmental factors such as dry weather or individual anomalies such as dry skin do not appear to have any negative effects on the verification accuracy of hand geometry-based systems. The hand images can be obtained by using a simple setup including a web cam, digital camera. However, other biometric traits require a specialized, high cost scanner to acquire the data. The user acceptability for hand geometry based biometrics is very high as it does not extract detail features of the individual. An individual's hand does not significantly change after a certain age.

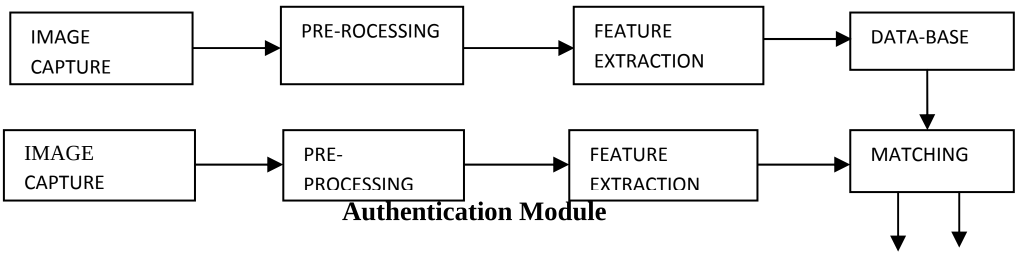
Strengths of hand geometry Biometric: -

- Ease of use; hand is placed on the unit's surface, the system also works fairly well with dirty hand.
- Resistant to fraud, model of an enrolled person's hand and fingers, it would be difficult to submit a fake sample.
- Template size, template size of hand geometry is extremely small if it is compared with other biometrics systems.

2. IMPLEMENTATION:-

In enrollment module features are extracted & stored in database. In Authentication module features are extracted & match with the database feature. Depending on matching score result displayed (yes/no).

Enrollment Module



Authentication Module

Fig 1:-Hand Geometry Identification System Accept Reject

The Major steps involved in Hand Geometry Based identification are,

a) Fingerprint Acquisition
b) Image pre_processing
c) Feature Extraction
d) Matching

The following section gives the description of the steps followed in extraction of the Hand features in enrollment module.

a)Image Acquisition

Image acquisition is the first step in a hand geometric system. The image acquisition involves capturing and storing digital image from vision sensors like color digital cameras, monochrome and color CCD camera, video cameras, scanner etc. The proposed image acquisition system consists of digital camera and black flat surface used as a background. User can places one hand pointing up, on flat surface with the back of hand touching the flat surface. The user can place hand freely as there are no pegs to fix position of hand. Then image is acquired using digital camera. Users are only requested to make sure that their fingers do not touch one another. In our experiment left hand images of users are acquired. The image resolution used is 120 dpi.

Fig 2:Aquired Images

b) Preprocessing

The next stage is image pre-processing module. Image pre-processing relates to the preparation of an image for later analysis and use. The role of the pre-processing module is to prepare the image for feature extraction. The steps involved in preprocessing are as follows,

- RGB TO GRAY Conversion

In this proposed system hand image is captured through digital camera so the original image is colored image. For digital image processing it is necessary first colored hand image convert in to gray scale image. Color image can be converted into gray scale image by using following formula:

$$GRAY = 0.299*r + 0.587*g + 0.114*b$$

Fig.3: Grey Image

- Noise Removal

It is necessary to remove the noise from the image because it may produce difference between the actual image and captured image. There are many methods to remove the noise. In this proposed system the noise is removed by using Gaussian low pass filter.

(a) Noisy Image (b) Filtered Image

Fig.4: Noise Removal

- Binarisation :-

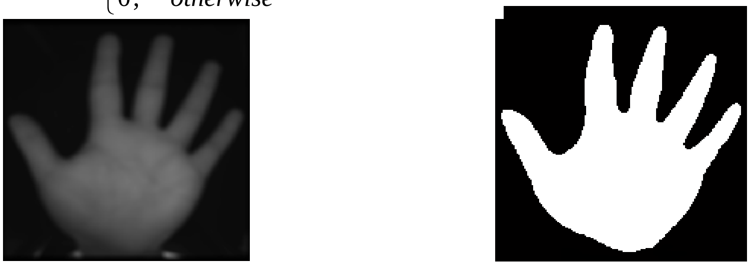
In this step gray level image will be converted into an image with two levels 0 or 1 where 0 will be white color and 1 will be black.

Input image (i,j) < threshold , Output image (i,j) = 1

Input image (i,j) ≥ threshold , Output image (i,j) = 0

G (i,j) represents the gray value of pixel (i,j) after Binarisation, I(i,j) represent the original gray value.

$$G(i,j) = \begin{cases} 1, & if \quad I(i,j) > threshold \\ 0, & otherwise \end{cases}$$



(a)Before Thresholding (b) After Thresholding

Fig. 5: Binarisation

- Edge Detection:-

For edge detection canny edge detector is used. Canny's approach is based on three basic objectives:

- **Low rate error**: The edge detected must be as close as possible to true edges

- **Edge points should be well localized**: The distance between the point marked and as an edge by the detector and the centre of the true edge should be minimum
- **Single edge point response**: The no of local maxima around the true images should be minimum. The detector should not identify multiple edge pixels where only a single edge point exists.

Canny's edge detection algorithm consists of the following basic steps:

<u>Step 1</u>:- The first step is to filter out any noise in the original image before trying to locate and detect any edges. For noise removal Gaussian filter is used.

<u>Step 2</u>:- After smoothing the image and eliminating the noise, the next step is to find the edge strength by taking the gradient of the image. The Sobel operator is used to find gradient in x & y direction.

-1	0	+1
-2	0	+2
-1	0	+1

G_X

+1	+2	+1
0	0	0
-1	-2	+1

G_Y

The magnitude, or edge strength, of the gradient is then approximated using the formula:

$$|G| = |Gx| + |Gy|$$

<u>Step 3</u>:-

The direction of the edge is computed using the gradient in the x and y directions. The formula for finding the edge direction is just:

$$\text{Theta} = \text{invtan}\,(Gy / Gx)$$

<u>Step 4</u>:-

After the edge directions are known, non-maximum suppression now has to be applied. Non-maximum suppression is used to trace along the edge in the edge direction and suppress any pixel value (sets it equal to0) that is not considered to be an edge. This will give a thin line in the output image.

<u>Step 5</u>:-

Finally, hysteresis is used as a means of eliminating streaking. Streaking is the breaking up of an edge contour caused by the operator output fluctuating above and below the threshold. To avoid hysteresis, uses 2 thresholds, a high and a low. Any pixel in the image that has a value greater than T1 is presumed to be an edge pixel, and is marked as such immediately. Then, any pixels that are connected to this edge pixel and that have a value greater than T2 are also selected as edge pixels.

<u>Step 6</u>:- Border tracing

The process starts by scanning the pixels of the binary image from the bottom-left to the right. When the first black pixel is detected the border tracing algorithm using eight neighborhood pixels is initiated to trace the border of the hand in clockwise directions. During the border tracing process, all the coordinates of the border pixels were recorded.

(a)Binarize Image (b) Edge Detected Image

Fig. 6: Canny Edge Detection

- Thinning :-

In this process we eliminate the redundant pixels of ridges till the ridges are just one pixel wide. This is done using the MATLAB's built in morphological thinning function.

Bwmorph (binary image, 'thin', Inf)

The operation is based on following criterion,

- Do not remove ridge end points
- Does not break connectedness of the ridge

This is because for center pixel there are 8 neighbors in window, so there can be maximum of 256 combination of criterion whether the center pixel is delectable or not.

1 = pixel is on the ridge (foreground),0 = pixel is not on the ridge (Background)

P7	P0	P1
P6	1	P2
P5	P4	P3

0	1	1
0	1	1
0	1	1

Apply this window at each pixel within edge and go on assigning 0 and 1 till we get center pixel values as 1 and reset in the mask as 0.

0	0	0
0	1	0
0	0	0

All such single pixels must be joined to get continuous thinned image.

(a) Edge Detected Image (b)Thinned Image

Fig. 7: Thinning

- Identification Of Key Points

  Identify the top points and valley points in an image.

- *Top points:*

  These points are the fingertips determined by five fingers.

- *Valley points:*

  These points are determined by the depression between the fingers.

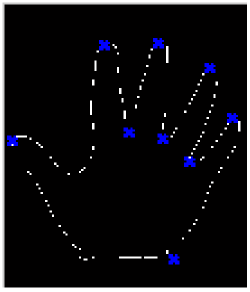


Fig 8:-key points

c) Feature Extraction

After pre-processing, 28 features have been extracted (18 widths, 3 heights, 4 deviation and 3 angles).

- Width

Each of the four fingers is measured in different heights, avoiding the pressure point near the pressure point near the tops. The width of the palm is also measured and the distance among the three inter-finger points in vertical and horizontal directions.

- Height

The height of the middle finger, the little finger, and the palm is measured.

- Deviations

Deviation is measured as the distance between a middle point of the distance between a middle part of the straight line between the inter finger point and the last height where the finger width is measured.

- Angles

Angle is measured between the inter finger point and the horizontal points.

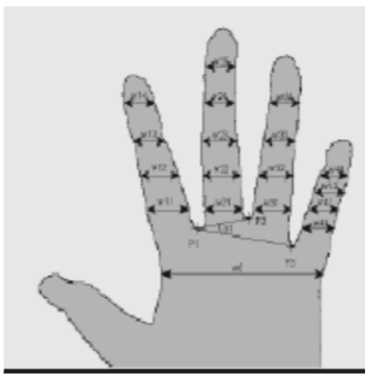


Fig 9:-Features Extracted

d) MATCHING

For Matching Euclidean Distance algorithm is used. If the value is greater than threshold then we accept it otherwise we reject it.

- **Euclidean distance**

Euclidean distance is the ordinary distance between two points. It is measure as the square root of the sum of the squares of the differences between the corresponding co-ordinates of the points. Set of Images of same user are taken and mean of these feature vectors is the Template. Template vector dimension must same as Input vector.

$$d = \sqrt{\sum_{i=1}^{L} (x_i - t_i)^2}$$

Where, d is the Euclidean distance, L is dimension of the feature vector, Xi is the ith component of the sample feature vector, Ti is the ith component of the template feature vector.

3. RESULTS:-

Our Results were tested on standard database & collected samples of hand geometry. We had collected total 100 person's 6 samples each. so total collected samples are 600.

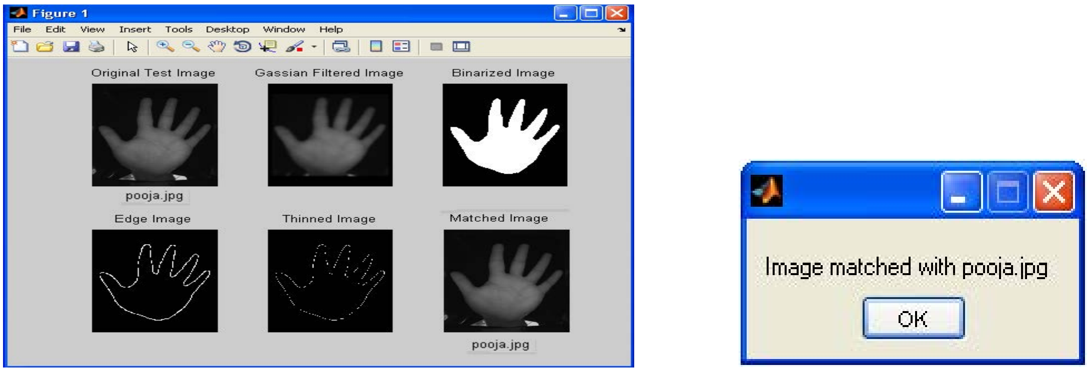


Fig 10:-Results of Hand geometry measurement

- **Performance measurement parameters:-**
- False Acceptance Rate :-

$$FAR = \frac{\text{Total False Acceptence}}{\text{Total False Attempts}}$$

- False Rejection Rate

$$FRR = \frac{\text{Total False Rejection}}{\text{Total True Attempts}}$$

- Equal Error Rate :-

  Equal error rate is a point where FRR and FAR are same.

Our experimental results shows that FAR=0.48,FRR=1,EER=0.46

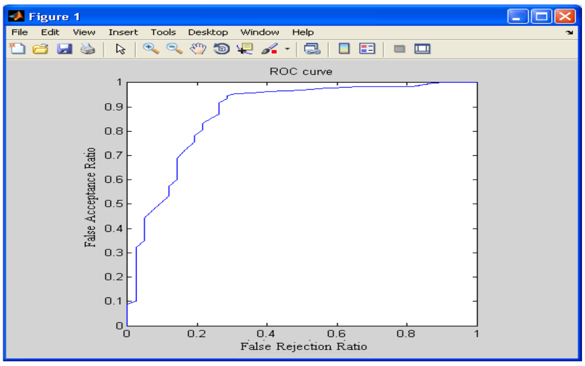


Fig 11:-Receiver operating characteristics

4.CONCLUSION

Hand Geometry Identification system uses Geometrical features of Hand such as length, width, angel and deviation to identify individuals. It is most commonly used biometric system which is simple, easy and used for wide variety of applications such as physical access and logical access applications. Hand geometry technique has been adopted only in small scale and medium security level personal authentication applications mostly due to the less distinctive feature representations. In future, we can implement this project together with other Biometrics such as Palm Prints, Finger Print etc. to improve efficiency of system.

5.REFERENCES:-

[1] K. Jain, A. Ross, S. Pankanti, “A Prototype Hand Geometry-based Verification System”, 2nd Int. Conference on Audio- and Video-based Personal Authentication (AVBPA), Washington, March 1999, pp. 166-171.
[2] R. Sanchez-Reillo, C. Sanchez-Avila, A. Gonzalez-Marcos, “Biometric Identification Through Hand Geometry Measurements”, IEEE Trans. on PAMI, Vol. 22, No. 10, October 2000, pp. 1168-1171.
[3] K. Jain, N. Duta, “Deformable Matching of Hand Shapes for Verification”, Proceedings of IEEE International Conference on Image Processing, Kobe, October1999
[4] Miguel A. Ferrer, Carlos M.Travieso, Jesus B. Alonso, Joan fabregas,Marcos Faundez,”Hand Geometry Identification System Performance”,978-1-4244-4170-9/09,2009IEEE
[5] Vivek Kanhangad,Ajay kumar,David Zhang,”Combining 2D and 3D Hand Geometry features for Biometric verification”,978-1-4244-3993-5/09,2009 IEEE
[6] Md.Arafatur Rahman, Farhat Anwar, Md.Saiful Azad,”A simple and effective technique for verification with Hand Geometry”, 978-1-4244-1692-9/08, 2008 IEEE
[7] Ralph Gross, Daniel Yurovsky,Latanya Sweeney,Wanhong Xu,Xiaoqian Jiang,Yiheng Li,”New direction in contact free Hand recognition”,1-4244-1437-7/07,2007,IEEE
[8] Gang Zheng, Chia-Jiu Wang, Terrance E.Boult,”Application of projective invariants in Hand Geometry Biometrics”, 1556-6013, 2007 IEEE
[9] C.Oden,”Combining implicit polynomials and geometric features or hand recognition”, pattern Recognit.Lett, Vol.24, pp.2145-2152, 2003 IEEE
[10] R.Sanchez-Reillo,”Hand Geometry pattern recognition through Gaussian mixture modelling”,0-7695-0750-6/00,2000 IEEE