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Biometric Authentication System Using Palm Vein Features

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Abstract - Textual passwords are not uncommon, which are used for authentication as account based passwords. However these passwords are facing risk in the form of phishing attack, burette force attack, social engineering attack and social surfing as well. The thing consisting of authentication, verification and recognition has been known as biometrics, which is being used for human recognition. Biometric passwords replace the techniques of textual passwords and also function as alternatives. Existence of biometric systems is commonly found by using fingerprint, face, iris, etc., on the other hand its risk to duplicating a fake (For e.g.:- "fingerprint gummy finger"). Palm vein authentication is yet another modern biometric technique, which employs the vein pattern in the human palm in order to verify the person's identity. Palm vein on classical biometric (e.g. fingerprint, iris, face). Which have merits, are a low risk of falsification, difficulty of duplicated and stability. The recent and current method which has been proposed to detect a hand vein by using Near Infrared (NIR) Light method. The Captured vein image is used in an infrared illuminator and Radon feature techniques is used to extract the feature of hand vein and feature matching algorithm is used. This is the system implemented using MATLAB.

Key Words: Infrared (IR), Near Infrared (NIR), Region of Interest (ROI), Adaptive Histogram Equalization (AHE), Feature extraction, Feature Matching.

I. INTRODUCTION

Though the most common method among the other methods, used for authentication, being textual password, this method is in risk to phishing attack, burette force attack, social engineering and shoulder surfing. Using arbitrary and lengthy passwords the system can be made secure. But the main problem which remains is that the difficulty of remembering those passwords. Studies have shown that users have a temptation to pick short passwords or passwords that can be easily remembered. Unfortunately, these passwords can be easily guessed or broken. As it is being discussed that Palm vein technologies is one of the upcoming technologies which are highly secure, it has cemented its place being the world's first contact less personal identification system that uses the vein patterns in human palms to confirm a person's identity.

It is a highly secure method as it uses information that is contained within the body and is also highly accurate because the pattern of veins in the palm is complex and unique to each individual. The vein pattern which is hidden underneath the skin and invisible directly by the eye, the vein pattern is difficult to copy compared with other biometric types. Not only that but also the palm vein is impossible to fake. Apart from that, its contact less feature gives it a hygienic advantage over other biometric authentication technologies.

In this paper which deals, Hand vein recognition which consists of following steps: Infrared image, ROI Extraction, Normalization, Binarization, Filtering, Feature extraction, Feature matching.

II. CONCEPTS

Biological attributes the use of light in the near infrared spectrum (NIR) to detect the pattern is based on the principle of absorption of deoxygenated hemoglobin in the blood. The light reaches different depths of tissues according to the wavelength. Between 300 nm and 400 nm reach the surface sections of the epidermis and the dermis of the skin that do contain veins. There is a "spectral window" extending from the 700nm to the 900nm where light penetrates deep into tissues including reaching the blood vessels located in the subcutaneous tissue. The absorption of deoxygenated hemoglobin in the blood flowing through the veins, causing it to be visible as black region to the scanner in response to infrared exposure. Figure 1.Absorption of Deoxygenated Hemoglobin in the Blood Visible as Black Region The concept illustrated in this paper is entirely based on the idea of palm vein authentication. Here, the main objective of this

concept is to provide security to the confidential areas such as password system through biometric passwords. It includes 3 phases: 1 Infrared Image capture, 2. Image processing. 3. Feature Extraction 4. Feature matching.

Figure 1. Infrared Image Capture

III. PROPOSED IDENTIFICATION SYSTEM

Figure 2 shows a block diagram of proposed system. The image of palm vein is captured using monochrome NIR CCD camera. The Captured image is in the RGB Format but further algorithm deals with the grayscale image Extraction of ROI and followed by image processing methods.

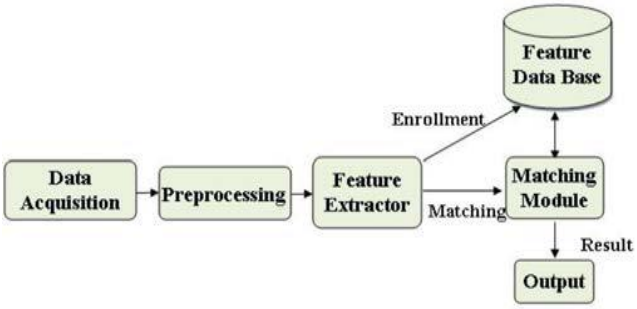

Fig.2 Block Diagram Palm Hand Vein Biometry

A. Formation of Database

Reproducibility of result a needful requirement for the advancement of a technology. Although there are number of papers reporting result, their result are not reproducible as none of them Allow open access to their database. Thus in this research suitable Palm hand vein database available on the internet called 'BOSPHOROUS ' is used.

The Palm Hand vein data used in this paper which consist of 100 different people . There are 4 images with size 80 X 80 in each person . Thus the total number of images are 400. Which is divided into 300 images for training and other 100 images for testing .

The database consist of 4 images each for 100 different people . There are two different phases training phase and testing phase. Training phase consists of 3 images each of 100 different people and other testing phase consist of 1 image each of respective 100 people. Each training image is preprocessed and features of those images are stored in the database for person identification. Features of training images are obtained and then stored in the database. Now, the features of a testing image for matching and identification purpose.

IV. IMAGE PROCESSING

The section describes the operation and transformation that were applied on the digital image on the stage of improvement and processing of the captured image . This stage aims to improve or highlight items of present in the images as well as remove unwanted information. Select the Image Toolbox of Matlab to perform such operations, since it provides a flexible , mathematically efficient working environment and at the same time provides comprehensive set of tools for working with images.

A. ROI Extraction

The next step is to crop the vein images. The region which contains the information of vein patterns is the region of interest. Then from the grayscale image , the region of interest (ROI) is extracted. The ROI is cropped manually by dragging the square of size 80 X 80 on particular interested vein region and then by double click on that square it shows only cropped portion of an image. Figure 3. shows the extracted ROI of a testing image.

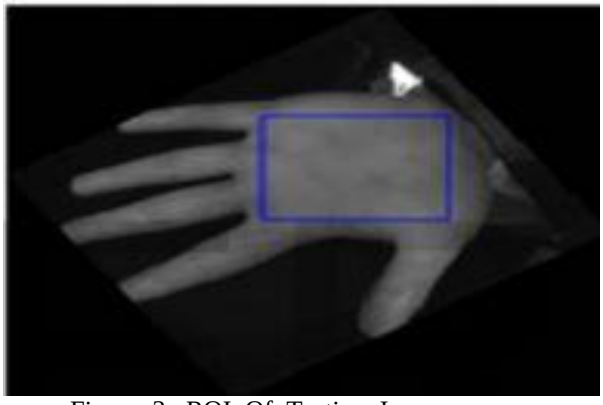

Figure 3. ROI Of Testing Image.

B. Normalization

Normalization is a process that changes the range of pixels intensity values. Some times poor contrast Photograps due to glare include application . Normalization is also called contrast stretching or histogram stretching.

Contrast stretching (often called normalization) is a simple image enhancement technique. That attempts to improve the contrast in an image by "stretching" the range of intensity Values.

C. Binarization

In the image, the binarization is usally performed in the preprocessing stage of different "document" image processing. The concept image binarization converts the image of upto 256 gray levels to a black and white image.

The image intensity value is to convert in to 0's & 1's by the binary operation, and classify all pixels with this threshold values. Only black and white image can be changed as grayscale image.

D. Grayscale Median Filter

Median filter is used to perform noise reduction on an image. Captured palm vein image carry some kind of noise caused by camera to remove that noise we are using Gray scale Median filter. Median filter is very effective at removing "Salt and pepper" type noise. So It will improve the vein image quality.

E. Adaptive Histogram Equalization

Adaptive Histogram Equalization is a contrast enhancement method. Ordinary histogram Equalization operates on an entire image but AHE operates on small regions in the image called 'tiles' . Each tile's contrast is enhanced and then the neighbouring tiles are combined to eliminate artificially included boundaries.

F. Edge Detection

Edge detection is one of the most important phenomenon in image processing. It also shows the abrupt change in the intensity of the gray level. " Edges can be defined as a set of connected pixels that lies in the boundary between two regions." In this paper using Canny Edge detection technique is used for extracting structural information and reduce the amount of data to be processed. Canny Edge detection is a reliable detection of veins.

V. HAND VEIN FEATURE EXTRACTION

A..Radon Transform Technique

Once Palm veins are detected, We select the ROI and we apply the Radon Transform is used to extract Features. The Radon transform is used to detect Straight lines in an image.

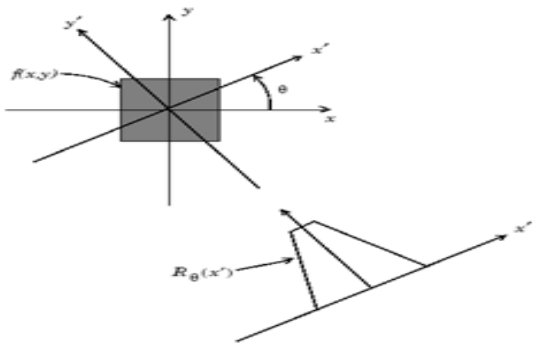

Figure 4: Geometry of the Radon transform

It is the projection of the image intensityna along a radial line oriented

At specific angle. Let (x,y) the ROI of the palm vein image $Rf(\rho,\theta)$ its radon transform given by:

$$R_f(\rho,)=\iint f(x,y)\delta(\rho-x\cos\theta-y\sin\theta)dxdy \quad (1)$$

where $\theta\in[0,\pi]$, $\rho\in[-\infty,+\infty]$ and $\delta(.)$ is the Dirac function defined by $\delta(t)$=1 if t=0 and $\delta(t)$=0 otherwise. The Radon transform of $(x,)$ is the line integral of f parallel to the y' axis. Thus equation (1) can be expressed as:

$$R_\theta(x')=\int_{-\infty}^{+X} f\ (x'\cos\theta-y'\sin\theta, x'\sin\theta+y'\cos\theta)dy' \quad (2)$$

The Radon transform is a mapping from the Cartesian Rectangular coordinates (x,y) to a distance and an angle (ρ,θ) also known as polar coordinates.

For a mathematical purpose , to extract the line parameters from the input vein image the Radon Projection matrix is obtained . After applying theta projection matrix is obtained in which the number of projection values for the particular theta are obtained.

B. Feature Matching and Result displays

Matching the maximum correlation coefficient between testing image and 300 stored training images is calculated.. Then out of those 300 correlation coefficient , a maximum value is obtained and the respective image from the training database is taken into consideration. If the considered image from the training database and the input image from the testing database belongs to one person then the result is display as "Correct Identification of Person". Otherwise , The result is showed as " Incorrect Identification of Person". The maximum correlation coefficient value for person number 50 is 0.7899 and it shows the result as "Correct Identification of Person

V. EXPERIMENTAL RESULTS

All the images are taken from BOSPHORUS Database . After performing the experiment for all 100 test images, Confusion Matrix is a table used to describe the performance of a classification model on a set of test for which the values u are known. There are two cases – True Positive(TP) and False Positive. True positive is the case in which we predict yes and even the person identification is correct. False Positive is the case in which we predict yes but the person identification is incorrect.

N=100	Predicted YES
NO	FP=07
YES	TP=93
TOTAL =100	

Accuracy = TP / Total
Error Rate = FP/ Total

The overall accuracy of proposed system.is 93%

VI. CONCLUSION

Using the systematic proposed methodology, infrared vein detection for identification of a person is done. It's been shown that hand vein pattern biometry is a promising technique. The proposed work is rationed to NIR images. The program is written in MATLAB. The BOSPHORUS database is presently publicly available for the sake of reproducible results at http://bosphorus.ee.boun.edu.tr/. In future, person verification can be done.

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