Hand Vein Detection using Infrared Light for Web based Account

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ABSTRACT
The most common account based password used for authentication is Textual passwords. But Textual passwords are in risk to phishing attack, burette force attack, social engineering and shoulder surfing. Biometrics is used for human recognition which consists of authentication, verification and recognition. Biometric passwords are introduced as alternative techniques to textual passwords. Many biometric systems exist today by using fingerprint, face, iris, etc but risk to duplicating a fake (For e.g.:- "fingerprint-gummy finger"). Palm vein authentication is one of the modern biometric techniques, which employs the vein pattern in the human palm to verify the person. The merits of palm vein on classical biometric (e.g. fingerprint, iris, face) are a low risk of falsification, difficulty of duplicated and stability. In this propose method, detecting a hand vein by using Near Infrared (NIR) Light method for web based account. A CCD camera will capture the image of person's palm vein region. The captured image will process through Mat lab software and emphasize to get vein structure. The detected palm vein structure which acts as a password for web based account for password security.

Keywords:
Biometric, Near- Infrared Image, Normalization, Binarization, Filtering, Image segmentation, Pattern Thinning, Matching.

1. INTRODUCTION
The most common method used for authentication is textual password. But this method is in risk to phishing attack, burette force attack, social engineering and shoulder surfing. Arbitrary and lengthy passwords can make the system secure. But the main problem is the difficulty of remembering those passwords. Studies have shown that users tend to pick short passwords or passwords that are easy to remember. Unfortunately, these passwords can be easily guessed or broken.

Palm vein technologies are one of the upcoming technologies which are highly secure. It is the world's first contactless personal identification system that uses the vein patterns in human palms to confirm a person's identity. It is highly secure because it uses information 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 is hidden underneath the skin and invisible directly by the eye, the vein pattern is difficult to copy compared with other biometric types. Besides, the palm vein is impossible to fake. Moreover, its contact less feature gives it a hygienic advantage over other biometric authentication technologies. In this paper, Hand vein recognition for web based account system which consists of following steps: Infrared image, Normalization, Binarization, Filtering, Image segmentation, Pattern Thinning, Matching.

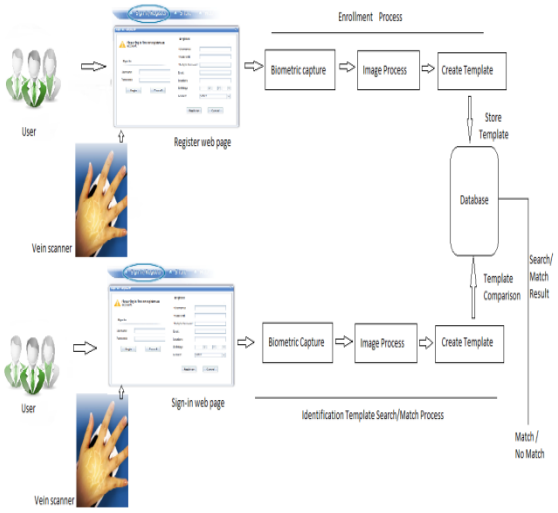

Figure 1.**Overview of System Architecture**

2. 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 as shown in Figure. 2. 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.

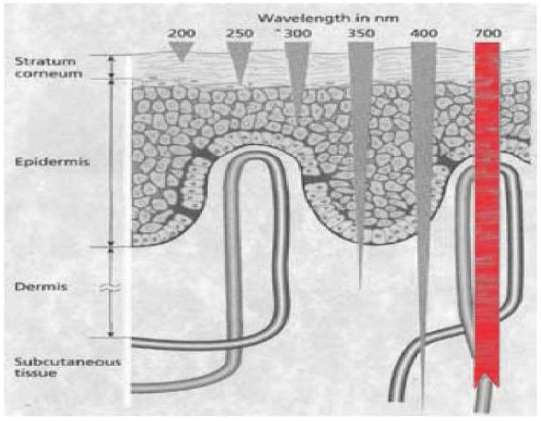

Figure 2.Depth of penetration into the skin at different wavelengths

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 3.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 for web based account through biometric passwords. It includes 3 phases: 1. Registration, 2. Infrared Image capture, 3. Image processing. The process of figuring out the validate person is accomplished in the following manner:

3. REGISTRATION

Here we register the new user by accepting the details of new user like user name, E-mail and palm vein structure.

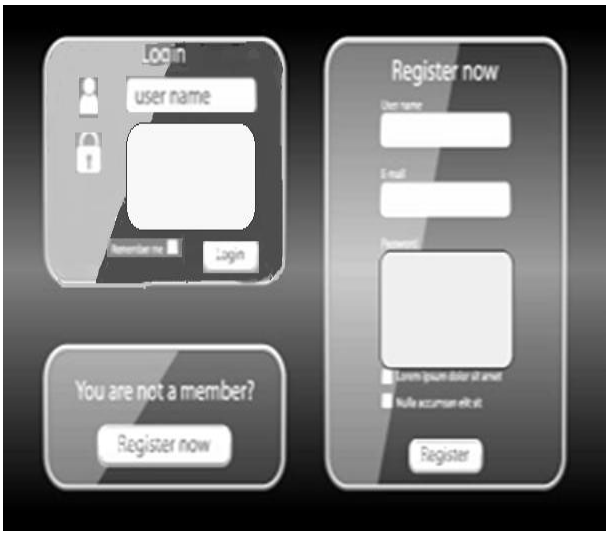

Figure 4.Registration without Screen

4. INFRARED IMAGE CAPTURE

A special imaging device is used to obtain the infrared image of the palm. An infrared light irradiates the palm of the hand and the light passes through the palm. A CCD camera located in the palm side of the hand captures this light. As hemoglobin in the blood absorbs the infrared light, the pattern of veins in the palm side of the palm is captured.

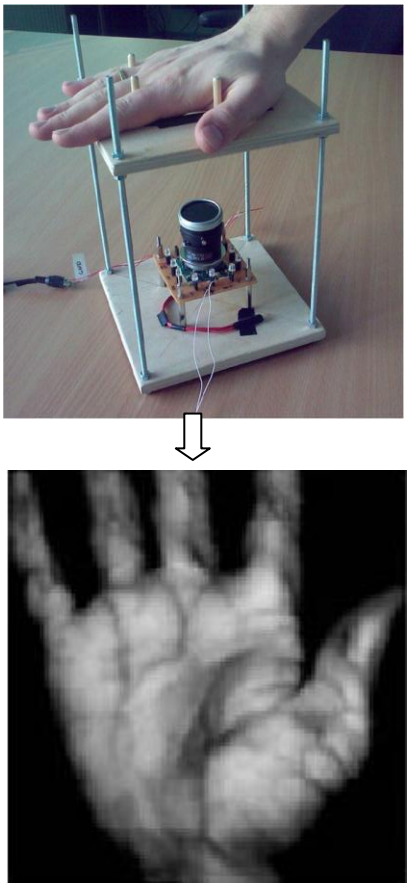

Figure 5.Infrared Image Capture

5. IMAGE PROCESSING

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

The image acquired through the experimental prototype is sent to the PC through the USB connector from where joined you the Matlab environment to begin the stage of processing and improving the image.

5.1 Normalization

Normalization is a process that changes the range of pixel intensity values. Applications include photographs with poor contrast due to glare. Normalization is sometimes 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 it contains to span a desired range of values, e.g. the full range of pixel values that the image type concerned allows.

5.2 Binarization

In the image processing, the binarization is usually performed in the pre-processing stage of different “document” image processing.

Image binarization converts an image of up to 256 gray levels to a black and white image.

Binarization operation is to convert the image intensity value into 0's & 1's , and classify all pixels with this threshold values .Only black and white image can be seen as grayscale image. This is used for the further processing of the image to extract only the important features and make it black or white.

Figure 6.Grayscale Pattern

5.3 Grayscale Median Filter

Median filter it is often desirable to be able 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.

The median filtering is used to remove noise from images. It is very effective at removing "salt and pepper" type noise. So, that hence will improve the vein image quality.

Such noise reduction is a typical pre-processing step to improve the results of later processing (For example, edge detection on an image).

5.4 Image Segmentation

To separate the palm vein region from the background, an image segmentation process is performed.

It involves three processes namely:

(i) Palm Edge Detection ,

(ii) Edge Smoothing ,

(iii) Palm Region Fillings.

(i). Palm Edge Detection

Edge detection is very important step in digital image processing and computer vision. In an image, edges represent object boundaries and thus help in detection and segmentation of objects in an image. Edge detection refers to canny algorithms which try to identify points in a digital image.

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It canny also produced a computational theory of edge detection explaining why the technique works. In this situation, an "optimal" edge detector means:

- **Good detection** - the algorithm should mark as many real edges in the images as possible.
- **Good localization -** edges marked should be a close as possible to the edge in the real image.
- **Minimal response** - a given edge in the image should only be marked once, and where possible, image noise should not create false edges.

(ii). Edge Smoothing

Edge smoothing is a process to remove noise on the image by using a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise from blur image and reduce detail. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen, distinctly different from the bokeh effect produced by an out-of-focus lens or the shadow of an object under usual illumination.

(iii). Palm Region Filling

Begin with a point p inside the boundary, and then fill the entire region with 1's

- All non-boundary (background) points are labelled 0
- Assign a value of 1 to p to begin...
- The following procedure fills the region with 1's,

$$X_K = (X_{K-1} \oplus B) \cap A^C, k= 1, 2, 3 \ldots ,$$

Where X_0= p, and B is the symmetric structuring element

- The Morphological region filling algorithm terminates at iteration step k if $X_K = X_{K-1}$
- The set union of X_K and A contains the filled set and its boundary.

Note that intersection at each step with A^C limits the dilation result to inside the region of interest.

Figure 7.Image Segmentation Pattern

5.5 Pattern Thinning

The image which is extracted undergoes thinning using the Thinning algorithm. Now this thinned image is used for the authentification and identification purposes. Basically to decrease the geometric value of the object image thinning is done. Stentiford Algorithm of thinning is used for thinning the vein pattern. The resultant image is shown as below

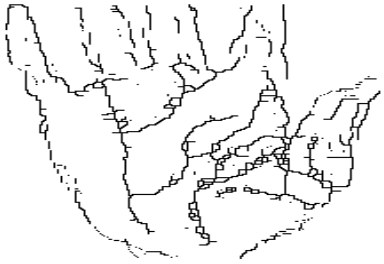

Figure 8.Thinned Pattern

5.6 Matching

Vein matching is used to determine the identity of a person, or verify that someone is indeed who he or she claims to be.

To perform matching, the ICP (Iterative Closest Point) algorithm is take place. ICP matching algorithm is a process used for comparison between user's register input scanned pattern with stored pattern into the database for verification, the person is either granted or denied access, all in a period of seconds.

5.6.1 Algorithm for ICP matching

Account register
Checks if it is a valid account
If account exists
Enter palm for authentication
Compares scanned pattern with stored pattern using ICP algorithm
If patterns match User account log-in successfully
Else
Mismatch in pattern
User Account log-in failed

Note: - If patterns are matches the user's account will be log in or if a pattern is mismatch the account will not be log in. Any un-authorized person cannot access our account easily. Only authorized person can access their account.

Table 1: Various analyses by different authors

Authors	Pattern Extraction	Feature Extraction	Matching
Hassan et al[4]		SITF	Linear Vector Quantization
Zhou and Kumars[5]	Histogram equalization	Hessian Phase	Neighborhood matching Random Transform
Ladoux et al[6]	Gaussian low-pass 51x51 Filter	SITF	Euclidean distance between SITF descriptors
Zhang et al [10]	Gaussian-shaped filter		template matching (exclusive or operation)

5.7 Adding Details In The Registration Form

In this step the details added to the registration form and working on authentication process.

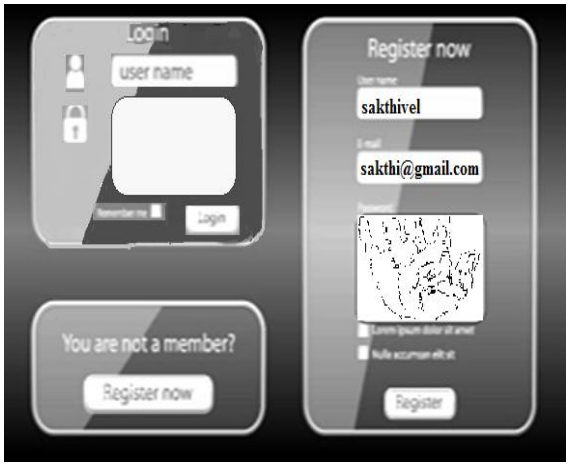

Figure 9.Registration with Screen

5.8 Authentication

We are working on the authentication process.

5.9 Advantages

- It is a contactless for person identification system because the information contained within the body.
- Vein patterns are unique to each individual; even identical twins have different vein patterns.
- Contactless, hygienic and non-invasive.
- This technology is non-intrusive; it does not involve any physical contact between the user and the system.
- Security level is very high and accurate.

6. CONCLUSION

Palm vein technologies are one of the upcoming technologies which are highly secure. It is the world's first contactless personal identification system that uses the vein patterns in human palms to confirm a person's identity. It is highly secure because it uses information contained within the body.

If this technology is introduced in our country we can solve many problems such as password protection in ATM.

The security is utilized in various fields such as : Security Systems - Door lock and integrated building security systems , Log-in Control - login into pc's or servers and network data access , Healthcare - ID verification for medical equipment and electronic record management , Financial Services - ATM, Banks, vault access , etc .

Surely, this technology will bring a revolution in the field of science and technology in the near future.

7. ACKNOWLEDGEMENT

My paper wouldn't have been successful without the assistance and blessings of number of people. I would like to acknowledge the help rendered by each of them.

I would like to express my special thanks of gratitude to my project guide Prof. Mr. C. MAHESH M.E, Head of the Information Technology (Dept of Information Technology, Vel Tech Technical University, Avadi, Chennai) for giving me this golden opportunity to do this paper work.

I want to thank my friends and staff who have encouraged me over the course of this paper.

Last but not the least, the constant moral and spiritual encouragement from my lovable parents has been a source of

inspiration throughout the period of my paper work, and therefore, the submission of gratitude shall be incomplete without expressing my grateful reverence to them.

I wish to express my profound sense of gratitude and sincere thanks for fruitful discussions to my brother who supported me in the successful completion of this work.

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