Vein Pattern Recognition: A secured way of Authentication

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Abstract
In today's world the technology is growing and improving day by day and hence the chance of threat to personal information as well as nationalized data is also increasing. No doubt there are a lot of methods which developed either from inside or outside to secure the information but those methods didn't produce satisfactory results so we need a technology that secure our information more efficiently from an unauthorized access. For the purpose Palm vein authentication is the newest biometric technique with high level of accuracy came into existence and becoming popular these days. In this technique the vascular patterns of an individual's palm used as personal identification data. This technique can be used in various fields like ATM, hospitals, for Attendance records, driver identification, on construction sites, banking and financial institutions etc. Business growth can also be achieved by reducing the size of the palm vein sensor and shortening the authentication time. This paper presents a review on the palm vein technology and its development, working principle, its applications, and advantages of using this technology.

Keywords: Biometric technology, vascular pattern, Palm Vein Recognition, Authentication system, Identification, Pattern Matching.

I. INTRODUCTION

In today's world various types of frauds and threats related to the identity of any person are increasing frequently. To avoid these frauds there should be some methods available to improve the security and biometrics is one of the best approaches for this purpose. Biometrics is the kind of science which identifies a person using their physiological or behavioral features. Biometrics offer automated techniques of identity verification by measuring physiological or behavioral features such as fingerprint or voice etc. By using modern biometric technology a person can save their personal information at any time and any place and the un-authorized person cannot take control of this information. Many researchers from last few years have investigated and worked on the features like finger, hand and palm vein recognition for automated personal identification. Among this palm vein authentication technology is being incorporated as a solution product for use in public places as it is more accurate and efficient. In palm vein authentication technique we consider a vein pattern which is the physical structure of the vast network of blood vessels underneath a person's skin so vein patterns are much harder for intruders to copy.
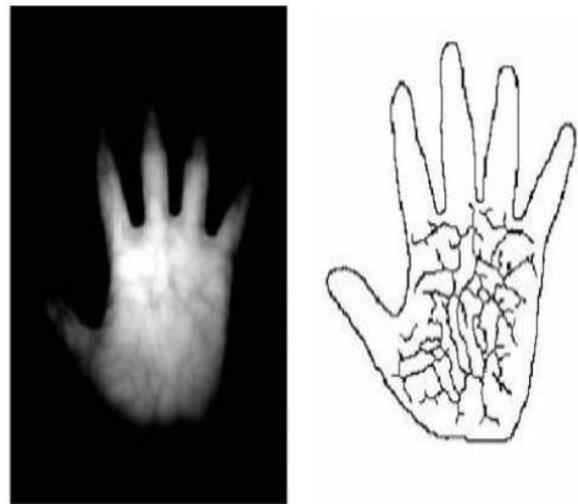

Fig. 1 Examples of Palm Vein images

Palm vein patterns are unique even among identical twins. According to Fujitsu, they compared 140000 palms, TFA -False Acceptance Rate is less than 0.00008%. In vein detection process a device takes a snapshot of the person's veins under a source of infrared radiation at a specific wavelength.

When someone's hand is illuminated with infrared light, the vein of that person appears black then it is recorded as an "id-card" in a database and can use during authentication. These days this technology has a very popular use in banking, hospitals, government offices, libraries etc. also Business growth will be achieved by reducing the palm vein sensor's size and shortening the authentication time.

Palm Vein Authentication System

Palm Secure Specifications	
Description	
Supply Voltage(from US bus power)	4.4 to 5.4V(Input Current: Up to 500mA)
Power Consumption	2.5W or less
Interface	USB 2.0/1.1(Hi speed or Full Speed)
Filter Material	Glass
Acoustic Noise	None
Weight	50g(Approx)
Supported OS	Client: Windows 2000 pro ,XP pro Server: Windows server 2003,Redhat Linux
Outer Dimensions	35mm x 35mm x 27mm
Photography Distance	50mm (+/- 10mm)

II. WORKING PRINCIPLE

A. Palm Vein authentication

Palm vein authentication technology consists of a small scanner that's easy to use, fast and highly accurate. Palm vein authentication uses the vascular patterns of an individual's palm which is used as the information for personal identification of them. In Comparison with a finger or the back of a hand, a palm has a wider and more complicated vascular pattern and thus contains a wealth of differentiate features for personal identification. One should place his/her palm over the scanner.

Fig. 2: Palm on Sensor

The scanner use a special characteristic of the reduced hemoglobin coursing through the palm veins and absorbs the image near to the infrared light. When the infrared ray image is captured, then visible only that blood vessel pattern which contains the deoxidized hemoglobin as a series of dark lines.
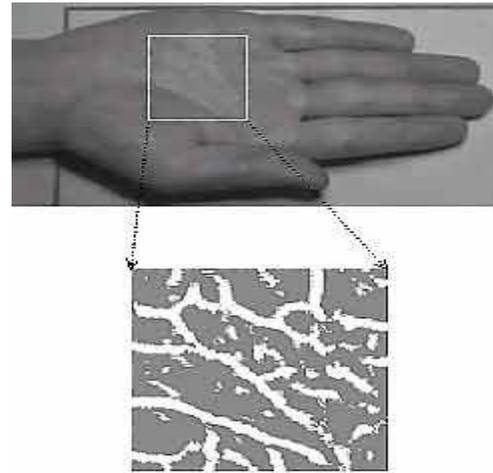

Fig. 3 Infra red on Palm

The integrated optical system in the palm vein sensor uses this phenomenon to produce an image of the palm vein pattern and that image is digitized, encrypted and then finally store that image as a registered template in the database. Based on this feature, the vein authentication device translates the infrared ray image's black lines as palm's blood vessel pattern, and after that then matches it with previously registered blood vessel pattern.

B. Contact less palm vein authentication

It consists of image sensing and software technology. The palm vein sensor captures the infrared ray image of an individual's palm. The infrared ray's lighting is controlled. Depending on the illumination around the sensor, the sensor is able to capture the palm image in spite of the position and movement of the palm. With the help of pattern matching method, software matches the translated vein pattern with the registered pattern by measuring the position and orientation of the palm.

Fig. 4 Contact less sensor

III. PRE-PROCESSING

A. Region of Interest Segmentation

It is used to find firstly ROI (region of interest) which is that part of an image from where we get maximum number of veins and then that are used to taken for further pre-processing. In order to account for the potential in the captured contactless palm vein images, the size and location of ROI is selected based on the instance between two webs.

B. Image Enhancement

These techniques help to improve the visibility of any portion as well as feature of the image suppressing the other portion's information and the features. Enhancement is the modification of an image to change the impact on the viewer. Generally enhancement changes the original digital values. Firstly Restoration processes will complete then enhancement.
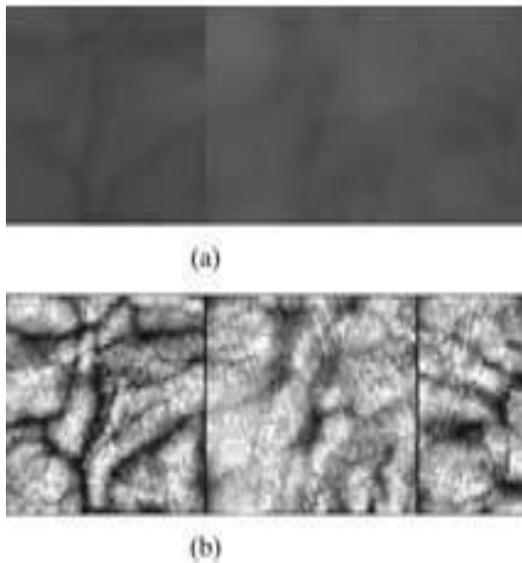

Fig. 5 Image Patterns

C. Feature extraction

The World's one of the most interesting concepts is that it can be considered as it is made up of pattern. The pattern is mainly an arrangement. It is characterized by the order of elements of which it is made, instead of intrinsic nature of the elements. This definition summarized our purpose as feature extraction. This step is responsible for extracting the pattern of the veins by taking into account the correlation between adjacent pixels.

D. Pattern Matching

To recognize the image means that to check that whether the image exist in the database. When an individual wants to get access to the system, then the image of the vein, known as the test image is captured. The test image's coordinates obtained and represented as the training set. Then the weight of the new image is measured and projected on the vein space. This space contains all the vein images. Thus, it is checked that whether the input image exist in that space. Then the Euclidean distance between the projected image and those registered image is being calculated. First of all, system checks whether the test image is a vein by testing it with any arbitrary value. Then Euclidean distance is calculated to find that whether the test image exist in the database. If it matches, then it is accepted.

E. DEVELOPMENT AND USE OF TECHNIQUE

Many biometric products were introduced earlier like fingerprint and iris recognition but palm vein recognition put into practical applications very easily and is reported the first commercial product in 1997. Later various products launched in the market like in 2003 fujitsu and hitachi have developed the series of commercial vein recognition products. Choi *et al*. (2007) discussed the use of palm-dorsum recognition in finance and banking, travel and transportation, hospitals, construction sites and schools. Watanabe (2008) investigated the application of a palm vein authentication device in door security system, login authentication and financial services. Wu *et al*. (2009) projected a finger-vein identification based driver detection system.

In addition to the palm, vascular pattern on the back of a hand or a finger can also become the good source of vein authentication. As the palm has no hair, it is easier to photograph its vascular pattern, even though its complex pattern covers the widest area. If we compare the skin color tone of back of the hand and finger the palm also has no significant variation. Veins are internal in the body and have a wealth of differentiating features, so the security level becomes very high as it is very difficult to falsify or copy the palm vein identity of anyone.

Fig. 6 Application Areas

A. ATM

Using the services of Vein Authentication the customers does not require any bank card or pass book for any type of transactions and hence this service provide higher security. As not any withdrawals can be done from non-registered branch and ATMs, therefore chance of frauds can be minimized. Any customer who want to avail this secured service he/she has to open a Bio-security deposit account in the bank where they can photographed their palm veins in order to guarantee secure data management. The palm vein data is stored only on the vein data base server at branch office where account is opened. The Super IC Card contains the customer's palm. Not any other information related to customer is stored in the bank and hence it provides another key feature of this system. After applying for a Super IC Card by the customer, the bank sends the card to the customer's home. To activate the palm vein authentication function, the customer brings the card and his passbook in the registered bank Counter where customer's vein information can be registered on the card. After registration procedure the customer can make any type of transactions at that branch.

B. PCs & Hospitals

In personal computers we can use palm vein technology by using a mouse which contains a vein sensor inside it. When power is supplied to computer system and mouse the sensor inside it will be ready to sense palm veins. When a person place his/her palm on the mouse the sensor sense the veins and if they are matched with the registered ones the system allows the person to use it. Sometimes we save our private and crucial information in the system. This technology can also be applied on the folders where this type of information is stored. For example different hospitals use the contactless palm vein authentication system in their various departments of planning and management where they cannot provide any unauthorized access to private information for security purpose.

C. Door Identification System

Today palm vein authentication is at its boom in Electronic Security Industry. Every manual system is replaced by the products offered by this market. By using this trend we can use this technology in our homes and buildings to improve the security where doors are locked and guarded by an electronic reader.

Fig. 7 Palm Vein Access Control Unit

First of all this reader will verify the identity of the person and sends correct signals to the electromagnetic lock for opening the door. Also by using this technology no one is needed to carry a bunch of door keys with him as there is a need of only a smart card containing a relevant data on it is to be carried out. This data is verified by the reader while swiping of card and the person is permitted to enter in the building.
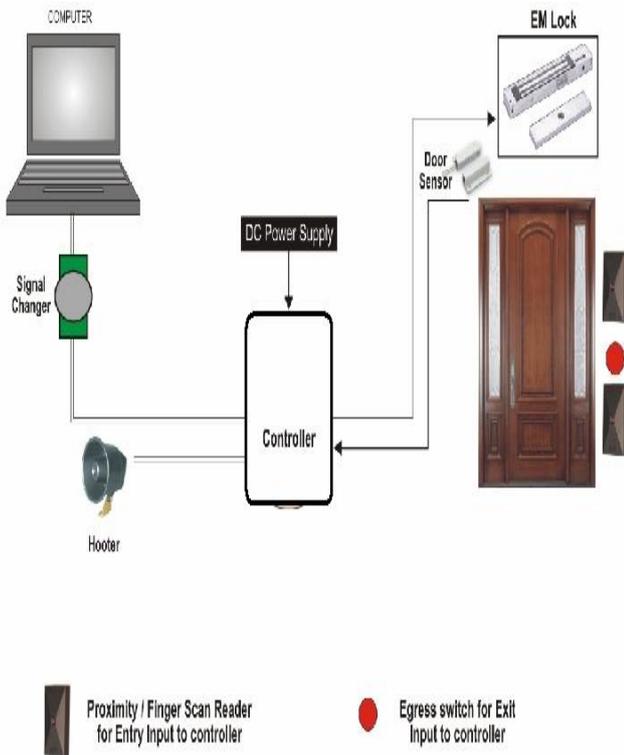
Fig. 8 Door identification system

D. Checking attendance in schools

An organization like schools and colleges can use Biometric devices used time-attendance to enhance security and productivity of an organization. Palm Secure uses infrared light to capture and store a student's palm vein pattern which is matched against pre-registered palm vein patterns .As part of the project this service can be used for food service environments in the schools to manage the meal plans. Once the students have enrolled, they can simply walk up to the cafeteria register with their food and place their hand on the scanner. In a matter of seconds the system pulls up their information and imposes the necessary charges required to complete the transaction. Also Parents can deposit a student's meal funds online meal account can see what their child purchased for lunch, monitor diets. Additional features include medical emergency alert messages for each student if he unknowingly purchases a meal that may have adverse effects.

Fig. 9 Attendance System

E. Financial and Bank Services

Financial damage like fraud withdrawals of money rapidly increasing in recent years using fake bankcards, and this become a major social problem now a days. As a result, there has been a rapid increase in the number of laws and acts to control the theft of personal information in financial institutions like the "Act for the Protection of Personal Information" came into effect in Japan on May 1, 2005 which results that financial institutions start focusing on biometric authentication together along with IC or smart cards as a way to strengthen the security of personal identification. The IC Card contains the customer's palm vein data and by applying various algorithms it performs vein authentication by itself. This system is beneficial in the manner that the customer's information is not stored at the bank. In July 2004, Suruga Bank3 launched its "Bio-Security Deposit" — the world's first financial service to use Palm Secure to ensure the high security of its customers using vein authentication which does not require a bankcard or passbook, also prevents withdrawals from branches other than the registered branch and ATMs. In order to guarantee secure data management, the palm vein data is stored only on the vein database server at the branch office where the account is opened. In October 2004, The Bank of Tokyo-Mitsubishi4 launched its "Super-IC Card Tokyo-Mitsubishi VISA." This card combines the functions of a bankcard, credit card, electronic money and palm vein authentication. From a technical and user-friendly point of view, The Bank of Tokyo-Mitsubishin arrowed the biometric authentication methods suitable for financial transactions to palm veins, finger veins and fingerprints. After a survey

the bank decided to employ Palm Secure because the technology was supported by the largest number of people.

F. Travel and shipping

In this sector palm vein recognition technology can be applied to supervise operate valuables logistics personnel such as customers, couriers, warehouse manager etc. In the receiving process, after inspection and packaging, courier use their own palm vein feature to login, scan the customer's palm vein distinctiveness to determine the sender's identity, then scan the express barcode and upload the data. In the sending process, courier use their own palm vein feature to login, scan the customer's palm vein uniqueness to determine the recipient's identity, remind customers face to face recognition, after the inspection is completed, ask the customer autographed recipients to sign the waybill column, then scan the express barcode and upload the data. This scheme complete synchronously the management of the personnel and express, improve the staff observation, ensure the valuables logistics safety, reduce the incidence of the accident about items lost, damaged, mimic.

G. Login unit using Palm Secure

The palm vein authentication login unit controls access to the information that stores electronically. As with the units for financial solutions, there are two types: a server type and an IC card type. Because Palm Secure login unit can be used for authentication using conventional IDs and passwords, as well as existing operating systems and applications can be used continuously. To enhance the operability, it is also possible to build the unit into an existing application. In the early stage, units were limited to the businesses handling personal information that came under the "Act for the Protection of Personal Information" enforced in April 2005. But use of the units is now expanding to revolutionary businesses that handle confidential information.

H. Made for Construction Sites

Palm vein authentication is also very useful technique at the construction sites for access control systems. For the purpose MSite was a biometric access control system, designed for the Construction

industry. It uses the worker's identity and their skills information to manage the sites effectively. MSite is a modular site access control system because it uses the biometric hand scanners to make sure that only accredited and inducted workers are permitted on the site. It also provides the time and attendance reporting to ensure well-organized workforce management.

On the expiration of accreditation cards MSite automatically locks them out of site. It also reduces the management overhead by ensuring that only the inducted staff has been allowed on site.

Fig. 10 Authentication system at construction sites

I. Driver Identification

Vehicle's active driver assistance and Accident prevention systems settings can be optimized with the help of Driver identification technique that is based on the palm vein authentication technology. For example, particular type of restrictions can be imposed for new drivers. With the help of the driver profiles, the on-board accident prevention and assistance systems can provide different driving styles. When a person sits at the driver's seat then the seat and the backrest are adjusted to the exact position automatically that has been stored for the identified person. Headrest, the rear view mirror and the door mirrors are also automatically adjusted to the position of the seat and body height. While such kind of aids that are clearly focus on the safety also add the comfort which is also a factor. Other standard features of the driver identification include the personalized settings for the navigation system, driver information systems and multi-media devices.

Fig. 11 Driving System

The anti-theft protection is also a benefit of it. If it cannot identify the person which is on the driver's seat then system sends a message to the owner's mobile. Then the owner has many options like He or she can immobilize the vehicle via "remote control" or authorize use on a case-by-case basis. Or notify the police.
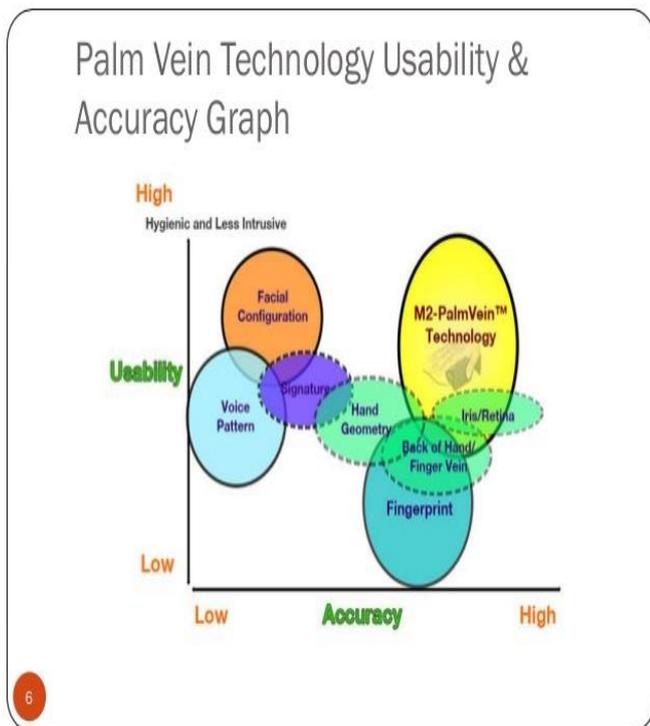

Fig. 12 Use of Technology

F. CONCLUSION

After studying the different research papers, we analyzed different Palm Vein Authentication, its corresponding method and the usage of this technique in our day to day activities. There are a number of palm vein recognition techniques which have already been developed but still there is a scope of further improvements, a new technique with higher accuracy, robustness and with more features. If this technology is introduced in India we can solve many threat related problems such as password protection in ATM, security in financial services etc and if we implement this technology in government offices we can make the employees to work according the government timings. With this we come to a conclusion that surely this technology will bring a revolution in the field of science and technology in the near future.

References:

[1] Ajay Kumar, David C. M. Wong, Helen C. Shen, Anil K. Jain (2003)' Personal Verification using Palmprint and Hand Geometry Biometric' Springer-Verlag Berlin Heidelberg

[2] Debnath Bhattacharyya, Poulami Das, Tai-hoon Kim, Samir Kumar Bandyopadhyay (2009). 'Vascular Pattern Analysis towards Pervasive Palm Vein Authentication' Journal of Universal Computer Science, vol. 15

[3]"Finger vein recognition with manifold learning", Journal of Network and ComputerApplications, vol.33, no.3, pp. 275-282, 2010.

[4]A. Mallikarjuna, S. Madhavi, "Palm Vein Technology Security", IJARCSSE, Volume, 3 Issue 7, July2013.

[5]Gitanjali Sikka1, Er. Vikas Wasson2 Palm Vein Authentication: A Review International Journal of Science and Research (IJSR) Volume 3 Issue 9, September 2014

[6]Nirmal et al., International Journal of Advanced Research in Computer Science and Software Engineering 4(6), June - 2014, pp. 41-44

[7]D. Wang , J. Li, and G. Memik, "User identification based on fingervein patterns for consumer electronics devices", IEEE Transactions onConsumer Electronics, vol. 56, no. 2, pp. 799-804, 2010.