

Palm vein authentication technology and its applications

Masaki Watanabe, Toshio Endoh, Morito Shiohara, and Shigeru Sasaki
Fujitsu Laboratories Ltd., 1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki, 211-8588, Japan
fabio-bsym2005@ml.labs.fujitsu.com

Abstract

This paper discusses the contactless palm vein authentication device that uses blood vessel patterns as a personal identifying factor. The vein information is hard to duplicate since veins are internal to the human body. The palm vein authentication technology offers a high level of accuracy, and delivers the following results: a false rejection rate (FRR) of 0.01%, and a false acceptance rate (FAR) of 0.00008% or lower, based on Fujitsu research using the data of 140,000 palms.

Several banks in Japan have used the palm vein authentication technology for customer identification since July 2004. In addition, Fujitsu has integrated the technology into the access control of electronic door lock systems. Fujitsu plans to further expand applications for this technology by downsizing the sensor and improving the verification speed.

1. Palm vein authentication

Palm vein authentication uses the vascular patterns of an individual's palm as personal identification data. Compared with a finger [1] or the back of a hand, a palm has a broader and more complicated vascular pattern and thus contains a wealth of differentiating features for personal identification. The palm is an ideal part of the body for this technology; it normally does not have hair which can be an obstacle for photographing the blood vessel pattern, and it is less susceptible to a change in skin color, unlike a finger or the back of a hand.

The deoxidized hemoglobin in the vein vessels absorb light having a wavelength of about 7.6×10^{-4} mm within the near-infrared area [2]. When the infrared ray image is captured, unlike the image seen in Fig.1, only the blood vessel pattern containing the deoxidized hemoglobin is visible as a series of dark lines (Fig.2). Based on this feature, the vein authentication device translates the black lines of the infrared ray image as the blood vessel pattern of the palm (Fig. 3), and then matches it with the previously registered blood vessel pattern of the individual.



Fig. 1. Visible ray image



Fig. 2. Infrared ray image

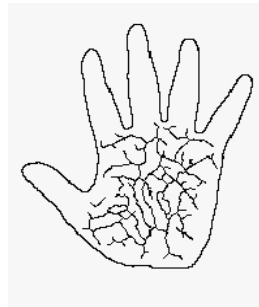


Fig. 3. Extracted vein pattern.



Fig. 4. Palm vein sensor

2. Implementation of contactless palm vein authentication

The contactless palm vein authentication technology consists of image sensing and software technology. The palm vein sensor (Fig.4) captures an infrared ray image of the user's palm. The lighting of the infrared ray is controlled depending on the illumination around the sensor, and the sensor is able to capture the palm image regardless of the position and movement of the palm. The software then matches the translated vein pattern with the registered pattern, while measuring the position and orientation of the palm by a pattern matching method.

Implementation of a contactless identification system enables applications in public places or in environments where hygiene standards are required, such as in medical applications. In addition, sufficient consideration was given to individuals who are reluctant to come into direct contact with publicly used devices.

3. Result of experiments

As a result of the Fujitsu research using data from 140,000 palms (70,000 individuals), Fujitsu has confirmed that the FAR is 0.00008% and the FRR is 0.01%, with the following condition: a person must hold the palm over the sensor for three scans during registration, and then only one final scan is permitted to confirm authentication.

In addition, the following data has been used to confirm the accuracy of this technology: data from 5-year to 85-year old people of various backgrounds based on statistics from the Ministry of Internal Affairs and Communications of Japan's population distribution; data from foreigners in Japan based on the world population distribution announced by the U.N.; data of the daily changes of Fujitsu employees tracked over several years; and data of various human activities such as drinking, bathing, going outside, and waking up.

4. Practical applications

4.1 Product development geared toward financial solutions

A rapidly increasing problem among financial sectors in Japan is the illegal withdrawal of bank funds using stolen or skimmed fake bankcards. To address this, palm vein authentication has been utilized for customer confirmation of transactions at bank windows or ATMs.

The smart card from the customer's bank account contains the customer's palm vein pattern and the matching software of the palm vein patterns. A palm vein authentication device at the ATM (Fig.5) scans the customer's palm vein pattern and transfers it into the smart card. The customer's palm vein pattern is then matched with the registered vein pattern in the smart card. Since the registered customer's palm vein pattern is not released from the smart card, the security of the customer's vein pattern is preserved.

In 2004, the Suruga Bank and the Bank of Tokyo-Mitsubishi in Japan deployed a secured account service utilizing the contactless palm vein authentication system. Several other banks in Japan have followed suit in 2005. Fujitsu plans to develop another type of ATM (Fig.6) for use at convenience stores in Japan, embedding the palm vein authentication sensor in the ATM.

4.2 Access control device using palm vein authentication

The palm vein pattern sensor is also used for access control units. The "palm vein authentication access control device" (Fig.7) is comprised of the palm vein pattern sensor, a keypad and a small display. This device controls access to rooms or buildings that are for restricted personnel. The device consists of two parts: the palm vein sensor, plus the control unit that executes the authentication processing and sends the unlock instruction. A simple-configuration system can be achieved by connecting this device to the electric lock control board or electric locks provided by the manufacturer.

5. Conclusion

Fujitsu palm vein authentication technology offers contactless authentication and provides a hygienic and non-invasive solution, thus promoting a high-level of user acceptance. Fujitsu believes that a vein print is extremely difficult to forge and therefore contributes to a high level of security, because the technology measures hemoglobin flow through veins internal to the body. The opportunities to implement palm vein technology span a wide range of applications.



Fig.5. ATM with palm vein pattern authentication sensor unit

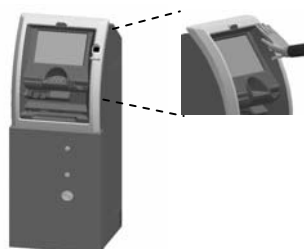


Fig.6. ATM for convenience stores with downsized palm vein pattern sensor unit



Fig.7. Palm vein access control unit

References

- [1] "Extraction of Finger-Vein Patterns Using Maximum Curvature Points in Image Profiles," in Proceedings of the 9th IAPR Conf. on Machine Vision Applications, N. Miura, A. Nagasaka, and T. Miyatake, (MVA2005, Tsukuba Science City, Japan, 2005), pp. 347-350.
- [2] Bio-informatics Visualization Technology committee, *Bio-informatics Visualization Technology* (Corona Publishing, 1997), p.83, Fig.3.2.