Featured Articles

Trends in Finger Vein Authentication and Deployment in Europe

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OVERVIEW: As the need for IT security grows, finger vein authentication technology developed by Hitachi is being adopted in markets throughout the world. Through improvements in authentication and operational technology, this use is spreading beyond security to also encompass applications where the technology provides greater convenience. In the UK, Barclays has adopted the technology for use in biometric authentication, providing a convenient way to reliably verify individuals when they make payments via corporate Internet banking.

INTRODUCTION

WITH the rise over recent years in the number of criminal acts such as terrorist attacks in cyberspace, information leaks due to unauthorized actions by insiders, and fraudulent funds transfers via Internet banking, people are increasingly looking to find more reliable forms of personal identification.

Furthermore, it is common for users to reuse the same ID and password when this method of identification is adopted, meaning that if the password to one service is stolen it opens up the risk of unauthorized access to other services as well. This poses a challenge to the prevention of identity fraud.

Biometric authentication, on the other hand, identifies people from their biological characteristics, with features including being less prone to identification being forgotten or stolen. It is used at companies and at public facilities such as airports in a wide range of applications, including control of arriving and departing passengers, system login authentication, attendance management, and time-clocking.

In addition to preventing identity fraud, attention in recent years has also been directed at such objectives as improving convenience by eliminating the need for entering passwords and reducing the cost of cards and other consumables, with potential being seen for biometric techniques to be utilized as a method of identification on network-delivered services in fields such as the public sector, logistics, healthcare, welfare, education, and finance.

FINGER VEIN AUTHENTICATION

Principles of Finger Vein Authentication

Biometric authentication techniques include the use of fingerprints, faces, veins, and irises. Compared

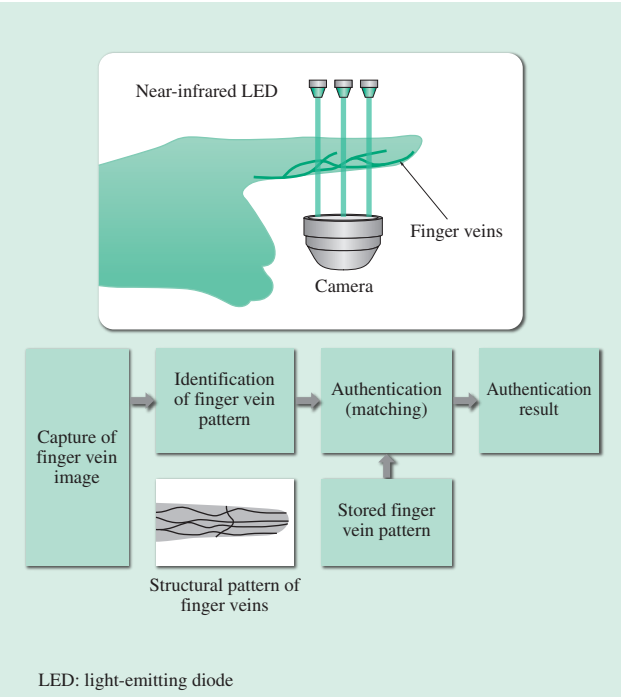

Fig. 1—Overview of Finger Vein Pattern Acquisition and Authentication Process.
The finger vein pattern is identified by finding the location of the veins in the finger vein image and then the individual's identity is authenticated by comparing (matching) this pattern with the one on file.

to other biometric features, veins are recognized as being less prone to changing with growth and age. It is also known that everyone's veins are different, and that the hemoglobin carried in veins absorbs near-infrared light.

Hitachi's finger vein authentication technology identifies people from the pattern of their finger veins obtained by passing near-infrared light through their fingers. The finger vein pattern is obtained by finding the location of veins in the finger vein image and the individual's identity is then authenticated by comparing (matching) this pattern with the one on file (see Fig. 1).

Features of Finger Vein Authentication

Finger vein authentication has the following features.
(1) The data used for authentication is obtained from the finger veins in a person's body, and the difficulty of stealing this finger vein pattern makes identity fraud difficult.
(2) The technique has sufficient complexity and is highly accurate.
(3) Improvements to the algorithm provide fast authentication speed, and the technique is easy to use because it only requires the person to place their finger over a reader.

Compared to fingerprint recognition, another widely used biometric authentication technique, finger vein authentication has the following advantages.
(1) A high degree of repeatability between recording the initial pattern and subsequent checking because the condition of the finger surface (moisture or dryness, etc.) has little influence.
(2) Unlike people's fingerprints, which can be replicated from marks they leave behind, counterfeiting someone's finger vein pattern is difficult.
(3) Authentication can be performed without touching the sensor unit, meaning that the technique is not significantly influenced by dirt or scratching on the reader sensor.

History of Technique's Development as a Proprietary Hitachi Technology

Hitachi commenced basic research into finger vein authentication in 1997, and started selling it in products for the physical access control (PAC) market in Japan in 2002. Since then, it has also been used in financial applications such as automated teller machines (ATMs) and counter terminals, and information technology (IT) security applications such as personal computer (PC) login authentication. Finger vein authentication readers for embedded use in other equipment have also been used in a variety of applications beyond bank ATMs and PAC devices, including key lockers and drug cabinets.

Overseas, Hitachi supplies solutions that are designed to suit specific regions in collaboration with various regional partners. In addition to such applications as PAC systems and attendance management, the technology is used for things like preventing duplication in administrative services or tracing healthcare measures in countries that lack a residential registration system.

In addition to corporate internal security, the technology is currently also used for things like locker locks and data management at fitness centers, and work is progressing on its adoption as a security platform for such applications as attendance management for preventing overwork or as a means of personal identification in Internet banking or e-learning for gaining qualifications (see Fig. 2).

LATEST TECHNICAL TRENDS IN BIOMETRIC AUTHENTICATION IN JAPAN

Empty-handed Authentication (1:*N* Authentication)

Over the last few years, Hitachi has been responding to demand for large membership management and PAC systems that use biometric authentication. Identification by finger vein authentication readers can be performed in two different ways: 1:1 authentication, in which the person's finger is compared with their data on file after they have first swiped a card or otherwise identified themselves, and 1:*N* authentication, in which the person only has to have their finger scanned and then is identified from the data on file (here, *N* is the population parameter). "Empty-handed" 1:*N* authentication is very convenient because users do not have to carry a card or other form of identification. However, because there is an inverse relationship between accuracy and the number of comparisons (*N*), the following measures are needed in large membership applications to minimize the maximum value of *N*.

Use in Combination with Reservation Systems

When used to identify users who have a reservation, the reservation system for a membership application can use its reservation data to minimize the number of comparisons required, thereby increasing the authentication throughput. This method is used in the following situations.

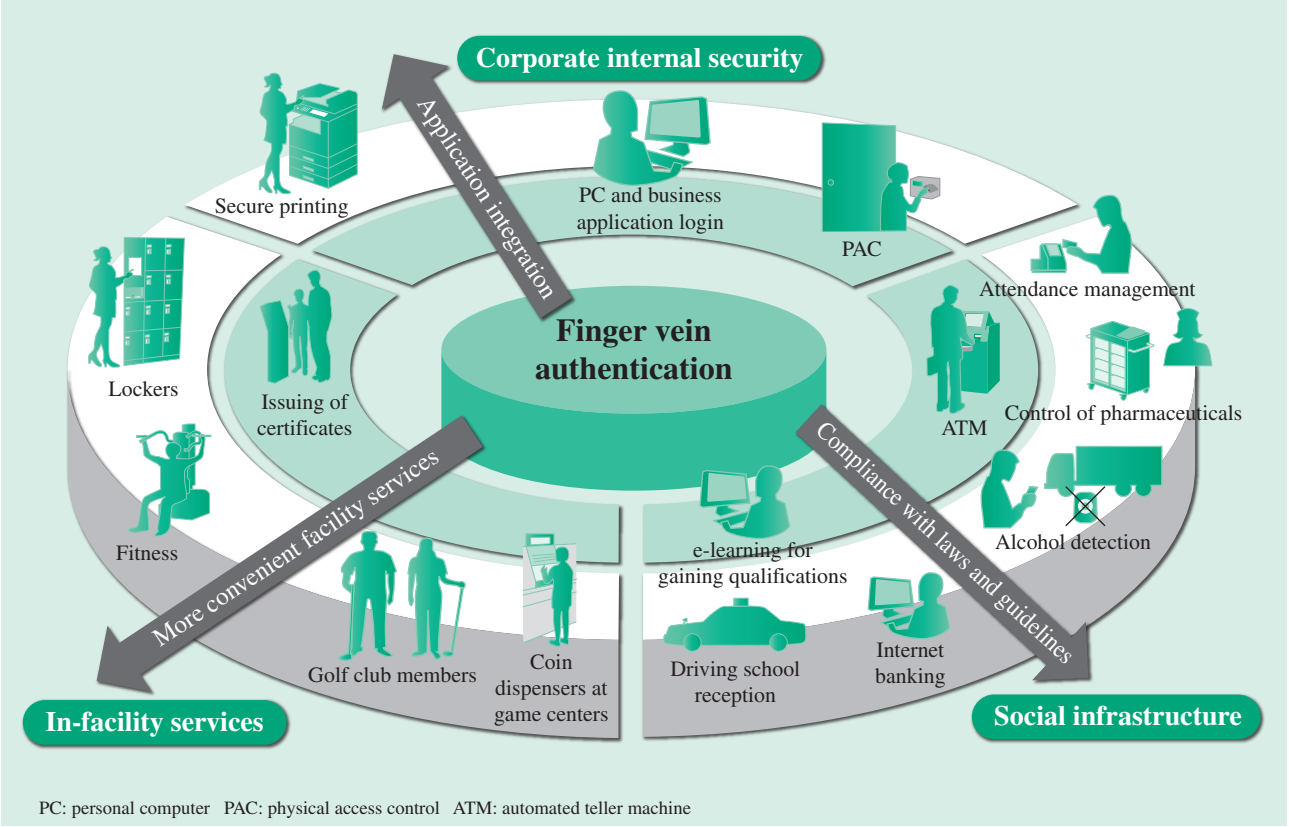

Fig. 2—Applications for Finger Vein Authentication Solutions.
Finger vein authentication solutions have applications in various fields, such as corporate internal security, in-facility services, and social infrastructure.

(1) fitness clubs
(2) golf clubs
(3) theaters or concert halls
(4) sport stadiums (football, baseball, skating)

Because the reservation holders are known in advance, this involves use of 1:*N* authentication from within this smaller population. In the case of fitness or golf clubs, Hitachi finger vein authentication systems have already been installed at more than 100 sites around Japan, where they have gained a reputation for improving both security and convenience.

In the case of theaters or sports venues, numerous companies are investigating the use of similar systems for upcoming major events.

Use in Combination with Passwords and Date of Birth or Other Identifiers

One way to reduce *N* is to use identifiers such as date of birth, address (region), or occupation, and such systems are starting to be adopted in healthcare and financial payment applications. Specifically, systems have been, or are expected to be, installed for the following applications.

(5) radiation therapy systems
(6) blood donation systems
(7) ATMs
(8) canteen and other retail payments
(9) evacuee registration systems

Common practice is to minimize the number of comparisons needed when performing authentication by inputting the user's date of birth or password by some means.

In the radiation therapy and blood donation healthcare applications, Hitachi's finger vein authentication is helping prevent misidentifications and manage medical data appropriately.

Empty-handed Payments (Large-scale 1:*N* Authentication)

Empty-handed payment methods (large-scale 1:*N* authentication) are seen as having future applications in business. As the name suggests, this system enables users to make payments simply by scanning their fingers with a finger vein authentication reader, without needing to carry their wallet or electronic money (cards). Hitachi has already trialed empty-handed payment at staff canteens and retail stores. Work is also starting on finger vein authentication systems for payments at sites such as student cafeterias

at universities or staff canteens at companies from 2015 onward. Because it eliminates the use of cash or vouchers and enables users to visit a canteen without bringing anything with them, the system is hygienic and leads to greater customer satisfaction.

In order to implement large empty-handed payment systems in the future, it will be necessary to enhance the technology to the point where it can perform 1:*N* authentication with values of *N* in the tens of thousands or more.

Sequential Fusion Authentication and Multi-modal Techniques

Potential ways of performing authentication with values of *N* in the tens of thousands or more include using more than one finger or more than one form of biometric identification. Performing authentication on a number of fingers in turn is called sequential fusion authentication, and a method that uses two or more forms of biometric identification at the same time to identify a person is called a multi-modal technique. As an advanced form of sequential fusion authentication, Hitachi has devised a technique for scanning a number of fingers simultaneously and is working on its development with the aim of commercializing the technique in the near future. Once a device (gate) equipped with this technique becomes commercially available, its potential applications will include use at major events and concert venues.

EXAMPLES FROM EUROPE

Finger Vein Authentication Reader for Barclays in the UK

The financial sector is recognized as one area in which the adoption of biometric authentication techniques offers major advantages. With electronic payments and electronic transaction processing (such as Internet banking) becoming widespread, identity verification is becoming increasingly important. Finger vein authentication suits this application, which requires a high level of accuracy and security.

Hitachi started marketing finger vein authentication readers outside Japan in 2006, and has expanded the range of applications to include PAC systems, incorporation into ATMs, and PC login. Barclays Bank PLC, a large financial institution in the UK, is known for actively seeking to introduce customers to innovative technologies. Barclays and Hitachi have been working on the development of a new application for finger vein authentication in corporate Internet banking.

Barclays' corporate customers can access bank systems via a web portal to make or authorize funds transfers and other banking transactions.

A new finger vein authentication system jointly announced with Barclays in September 2014 enhances the trustworthiness of Internet banking by using finger vein authentication readers supplied by Hitachi to capture images of users' distinctive finger vein patterns and only issue a digital signature if they pass verification. Barclays' customers can complete procedures in a few seconds because they only need to place their finger over the reader to open an online connection to their accounts, without needing to use a password or similar. Barclays is able to provide robust security to its customers without keeping copies of their users' actual finger vein data.

Hitachi's finger vein authentication is already being used by banks in Japan and elsewhere as a substitute for passwords, for single sign-on (SSO) authentication, and in ATMs. The new finger vein authentication system developed by Hitachi and Barclays in collaboration combines finger vein authentication with a highly secure electronic signature technique, and the readers used by the system incorporate a function for reading encrypted subscriber identity module (SIM) cards and biometric authentication. This allows the use of public key infrastructure (PKI) to settle banking transactions using electronic authentication and signatures via the Internet. By storing the user's finger vein authentication data on the encrypted SIM card, the data can be used to make payments more secure. This is a new initiative for the financial sector that has never been used before, even in Japan. Creating the specification for this corporate solution involved working closely with Barclays over a long period of time, and Hitachi now supplies the hardware and software.

Because many financial institutions from around the world, not just Barclays, face difficulties with Internet banking that include login and payment processing, Hitachi is looking to deploy this solution not only in the UK, but also globally.

Other Applications for Finger Vein Authentication Readers in Europe

Hitachi began marketing finger vein authentication readers for ATMs in FY2006 in Europe, where they are becoming more widely adopted. In a recent example, Hitachi worked jointly with Wincor Nixdorf to supply and commission virtual teller machines (VTMs) (self-service banking systems) with finger vein

authentication at Getin Bank, the retail arm of Getin Noble Bank, a major Polish bank, in February 2014. Hitachi also received an order from ITCARD S.A., a major operator of ATMs, in May 2014 for a large number of finger vein authentication readers for use in ATMs, and plans to supply the devices progressively.

CONCLUSIONS

In the future, Hitachi is planning the global deployment of the technology in the form of a new service model that includes the (online/offline) issuing and management of digital signatures based on finger vein authentication readers built into SIM-based smartcard reader/writers. In addition to acting as a one-stop provider of biometric authentication, PKI authentication, and the associated operation and management systems, and preventing identity fraud and other misuse through the sharing of identity devices (a problem for PKI authentication), Hitachi will also contribute to the comprehensive provision of safe, secure, and convenient information security platforms that provide simple ways for anyone to implement or use robust authentication.

REFERENCES

(1) Finger Vein Authentication Technology, Hitachi, http://www.hitachi.co.jp/products/it/veinid/global/index.html
(2) "Barclays First in UK to Launch New Biometric Reader for Customers, Hitachi's Finger Vein Authentication Technology Set to Revolutionise Account Security in UK Banking," Hitachi News Release (Sep. 2014), http://www.hitachi.com/New/cnews/month/2014/09/140905.html
(3) "Major Polish Financial Institution, Getin Bank, Launches Self-service Banking System with Hitachi Finger Vein Authentication System," Hitachi News Release (Feb. 2014), http://www.hitachi.co.jp/New/cnews/month/2014/02/0227b.html in Japanese.
(4) "Hitachi Europe Wins Order for 1,730 Finger Vein Authentication Readers from Major Polish ATM Operator, ITCARD," Hitachi News Release (May 2014), http://www.hitachi.co.jp/New/cnews/month/2014/05/0514a.html in Japanese.

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