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Biometric authentication in relation to payment systems and ATMs

A new approach for biometric verification using finger veins and the start of the proliferation of biometric incorporated ATMs

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This article discusses biometric authentification in relation to payment systems and ATMs. After a short presentation of a new biometric authentification method, it shows the start of the proliferation of biometric incorporated ATMs and gives a compact overview of possibilities for payment technologies based on biometrics.

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1 Introduction

A vision of the future where no one needs pockets to hold cards, cash and keys is coming closer.

There are already stores in Germany, the UK, and the U.S. that have implemented fingerprint technology for biometric payment [1]; [2]. Since 2006 Citibank Singapore has rolled out a biometric card payment service which is limited to Platinum card holders in Singapore [3]. Banco Azteca uses fingerprint and face recognition for customer verification in combination with a smart card in Latin America [4]. The aim is to extend the client base to those customers who have no valid passport, drivers' license or even do not know their date of birth [2]. The Mizuho Bank, Sumitomo Mitsui Banking and the Bank of Kyoto are using finger and palm vein verification as a third combined authentification method for higher security in customer verification [5]. The driver is efficiency and in the case of online payments security is the key driver [6]. Conventional authentification systems at ATMs, transactions at the point of sale, telephone banking and online banking as well as many other banking applications are vulnerable to fraud and can be secured through biometrics [7]. Although customers still have concerns about privacy, the banking sector is increasingly more and more interested in this technology.

2 A new approach

Now there is a new and even more sophisticated technology that uses finger veins for static biometric authentication. The technology was first proposed by Kono et al. and has been patented by Hitachi Ltd. (NYSE: HIT, TSE: 65010).

The approach uses near-infrared light, which is transmitted through the finger [8]. The infrared light irradiates the back of the hand and light passes through the finger. A camera located at the palm side of the hand captures the light (see figure 1) [9][10]. At near-infrared wavelengths, the haemoglobin has a lower absorbance than at visible wavelengths, but it is relatively high compared to other proteins in the tissue. As haemoglobin in the blood absorbs the infrared light, the patterns of veins in the palm side of the finger are captured as shadows [9]. Therefore, transmitting near-infrared light through a finger is suitable for the acquisition of its vein pattern [8].

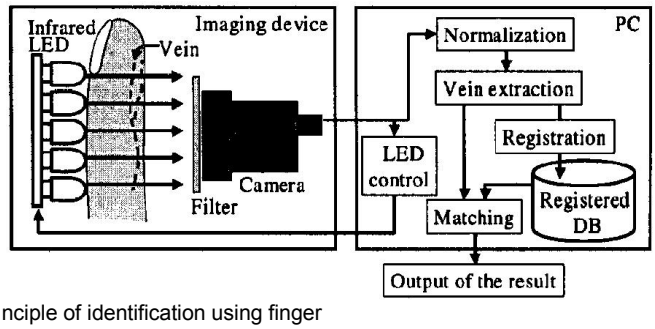

Figure 1: Principle of identification using finger

The matching can be attained by following the acquisition of the infrared image of the finger, the normalization of the image and the extraction of the finger vein patterns (see figure 2). There are two techniques currently discussed:

The first algorithm to verify the finger vein pattern is called „repeated line tracking" [9] and the second one is called „partial template method using the concept of the immune system" [11].

Figure 1: Principle of identification using finger

The solution using finger veins is contactless and therefore more hygienic [5] and not affected by dryness or roughness [12]. In Japan, finger vein recognition is preferred over fingerprint, since fingerprinting is associated with crime [12]. The vendor of the technology is claiming a false acceptance rate of 0.0001% [5], which needs to be evaluated.

However, the disadvantage is that the technology cannot be miniaturized like fingerprint recognition (matching on card). Finger vein patterns may change in the course of a human lifetime [13]. There seem to be difficulties with thicker fingers for the light penetrating the finger. Since the finger is not uniform, fluctuations in brightness occur [10]. In particular there are no further studies on a larger group with greater genetic and age variation or on finger vein pattern of children over long time periods [13]. Nevertheless, the technology is now used in the U.S. by the Shinkin Central Bank for access control purposes (only verification) [14]. In Japan finger vein recognition is widely used in the financial sector, which is one of the most successful market sectors actually for finger vein recognition [12].

3 Biometrics in banking and finance

Biometric authentification has become more and more popular in the banking and finance sector. The use of biometric technologies at ATMs, POS terminals and online-banking is currently only used in very small projects with few users except in Japan. Since August 2005 Japanese banks have had to replace customer losses from improper cash withdrawals by law unless culpable behaviour can be proved against the customer [15]. Actually there are more than 40 Japanese banks using palm-vein recognition at more than 19,000 ATMs. More than 600,000 customers of the Tokyo Mitsubishi Bank UFJ are using biometric verification at ATMs. Another bloc of financial companies, which have adopted a technology that uses the pattern of veins in a person's fingertips, including Sumitomo Mitsui Banking Corp., Mizuho Bank and Japan Post, will also accept interbank ATM users [16].

The Columbian Bancafe bank is introducing fingerprint scanning across its entire ATM network, designed by NCR Corporation (NYSE: NCR) [17].

In 2007 the Brazilian „Bradesco" bank will implement this system with 25,000 ATMs [15]. The difference between biometrics in the banking and finance sector and other applications is that the storage of identification information in a central database is in conflict with data privacy protection laws. The better solution would be a verification in which the biometric data can be stored encrypted on a smart card.

4 Biometrics at Point of Sales

There are several projects with biometric payment systems at the point of sales, e.g. in the UK, Germany and in the U.S. Thriftway and Kroger, both supermarket and foodstores, are using a fingerprint payment technology [2]. Another system is used by the Co-op in the UK, where the biometric authentification is combined either with the telephone number or the date of birth [1]. The San Francisco based supplier of this technology is Pay by Touch. The company has been financed with US$130m of venture capital by two hedge funds [18] and it snapped up its main rival BioPay in 2005 for US$82m after lawsuits concerning patents [19]. In Germany various EDEKA consumer markets and a few school cafeterias have implemented a payment system called digiPROOF [20]. The system used in school cafeteria has led to controversy in Germany as it may affect data privacy laws [20].

Pay By Touch has introduced an online biometric authentification service, where the user's fingerprint is combined and encrypted with the unique device ID before it is sent to the authentification server called TrueMe (verification) [21]. This system can be used for online-payment, online-banking, online-broking and other password-protected web sites and services.

5 Combination with smart cards

MasterCard estimates that adding smartcard-based biometric authentication to a POS credit card payment will decrease fraud by 80% [7]. The combination with smart cards supports privacy protection and increases security and trust [2]. The use of smart cards in combination with biometric authentication makes the storage of biometric data in a central database obsolete. The use of a central database using identification methods results in higher error rates depending on the number N of biometric templates [22]. Therefore the combination with smart cards using verification decreases the probability of a false identification and gives the user more privacy having his biometric data in his hands, which also increases the trust in the technology [2]. Using smart cards with an integrated RFID-chip in passports, for example, is seen as critical as persons can be tracked and biometric and personal data can be read out from a distance without the knowledge of the user [23]. When implementing a biometric system in a huge system environment, the use of established components and solutions is recommended [23]. For the roll-out of a biometric smart card-based payment system and ATM network an integrated sophisticated security concept needs to be developed. The system of biometric passports, for example, has an insufficient security concept [23].

6 Conclusion

In authentification replacing the combination of possession (cards) and knowledge (pins) with only biometrics for more convenience does not automatically lead in a higher security level. One-factor authentification for security purposes is not state-of-

the-art and should not be surreptitious reintroduced through biometrics.

> The optimal application of biometric authentification in the financial industry still requires at least one more authentification method that e.g. combines with knowledge and/or possession features or that demands two biometric features.

There are early signs that there will be a huge market growth for biometrics with respect to payment systems and the banking sector overall. More than half of the customers across Europe would be willing to switch their accounts to financial institutions that offer biometric authentification services [24]. The example of biometric aided ATMs in Japan is the start of a proliferation of biometric technologies in the banking sector. There is a high potential for biometrics in combination with smart cards. In the near future there will be more and more impact on the finance and banking sector in relation to biometric technologies. Anyway there are challenges, in particular the huge investment in the IT infrastructure at ATMs and POS terminals and the lack of interoperability of biometric technologies. Concerning legal aspects the data privacy protection laws in Europe have to be taken into account [23].

> Thus creating a central database with biometric data would be quite critical under privacy laws in relation to payment systems and ATMs. Therefore, biometric authentification should be combined with smart cards in order to fulfil the high expectations in biometric technologies in the finance and banking sector.

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