Vascular Pattern Recognition

Introduction

Vascular Pattern Recognition, also commonly referred to as Vein Pattern Authentication, is a fairly new biometric in terms of installed systems. Using near-infrared light, reflected or transmitted images of blood vessels of a hand or finger are derived and used for personal recognition. Different vendors use different parts of the hand, palms, or fingers, but rely on a similar methodology. Researchers have determined that the vascular pattern of the human body is unique to a specific individual and does not change as people age. Claims for the technology include that it:

- **is difficult to forge** — Vascular patterns are difficult to recreate because they are inside the hand and, for some approaches, blood needs to flow to register an image.
- **is contact-less** — Users do not touch the sensing surface, which addresses hygiene concerns and improves user acceptance.
- **has many and varied uses** — It is deployed in ATMs, hospitals, and universities in Japan. Applications include ID verification, high security physical access control, high security network data access, and POS access control.
- **is capable of 1:1 and 1:many matching** — Users' vascular patterns are matched against personalized ID cards/smart cards or against a database of many scanned vascular patterns.

History

Potential for the use of this technology can be traced to a paper prepared in 1992 by Dr. K. Shimizu[1], in which he discussed optical trans-body imaging and potential optical CT scanning applications. In 1996, author Yamamoto K[2], in conjunction with K. Shimizu, presented another paper in which the two discussed research they had undertaken since the earlier paper.

The first research paper about the use of vascular patterns for biometric recognition was published in 2000.[3] This paper describes the technology that uses the subcutaneous blood vessel pattern in the back of the hands and that was to become the first

commercially available vascular pattern recognition system in 2000. Additional research has further improved the technology.[4,5,6] The introduction of this technology inspired additional research and commercialization into finger- and palm-based systems.[7,8]

Approach

Vascular pattern in the back of hands

Near-infrared rays generated from a bank of light emitting diodes (LEDs) penetrate the skin of the back of the hand. Due to the difference in absorbance of blood vessels and other tissues, the reflected near-infrared rays produce an image on the sensor. The image is digitized and further processed by image processing techniques producing the extracted vascular pattern. From the extracted vascular pattern, various feature data such as vessel branching points, vessel thickness, and branching angles are extracted and stored as the template.

Vascular pattern in fingers

The basic principle of this technology is shown in Figures 1 & 2. Near-infrared rays generated from a bank of LEDs penetrate the finger or hand and are absorbed by the hemoglobin in the blood. The areas in which the rays are absorbed (i.e., veins) appear as dark areas similar to a shadow in an image taken by a Charge-Coupled Device (CCD) camera. Image processing can then construct a vein pattern from the captured image. Next this pattern is digitized and compressed so that it can be registered as a template.

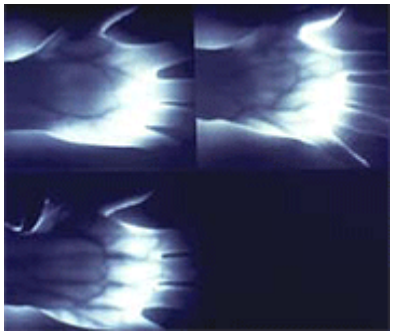


Figure 1. Transmittance Images of a Hand.[9]

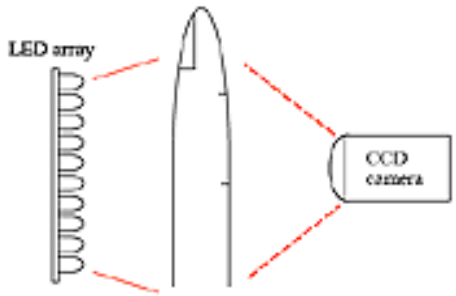
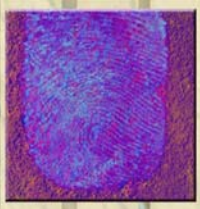


Figure 2. Principle of Transmittance Imaging.[9]



United States Government Evaluations

The US Government has not performed technology evaluations of vascular pattern recognition biometrics at this time.

Summary

Vascular pattern recognition has gained sponsorship from companies that have developed reputations for developing products that compete successfully in global markets. There appears to be some testing and validation by third parties. Standards work will need to be accomplished before this technology can grow to broader acceptance.

Document References

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[3] Sang-Kyun Im, Hyung-Man Park, Young-Woo Kim, Sang-Chan Han, Soo-Won Kim, and Chul-Hee Kang, “Biometric Identification System by Extracting Hand Vein Patterns,” Journal of the Korean Physical Society, Vol. 38, No. 3, March 2001: 268-272.

[4]Sang-Kyun Im, Hwansoo Choi, and Suwon Kim, "Design for an Application Specific Processor to Implement a Filter Bank Algorithm for Hand Vascular Pattern Verification,” J. of Korean Physics Society, 2002, Vol. 41: 461-467.

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[7] Y. Taka, Y. Kato, and K. Shimizu, “Transillumination Imaging of Physiological Functions by NIR Light,” World Congress on Medical Physics and Biomedical Engineering 2000, CD-ROM, 4982-14105.

[8] "New Biometric Technologies Get Beneath the Surface," IDNewswire, 14 October 2005, Vol. 4, No. 18, <http://www.cardtechnology.com/article.html?id=20051026CTDMQSN1>.

[9] Xin Wang, Kozo Sushita and Koichi Shimizu, "Our Breakthrough Technology" <http://www.iaccess-systems.com/bloodvessel.htm>.