Hand Geometry

Introduction

Hand geometry recognition is the longest implemented biometric type, debuting in the market in the late 1980s. The systems are widely implemented for their ease of use, public acceptance, and integration capabilities. One of the shortcomings of the hand geometry characteristic is that it is not highly unique, limiting the applications of the hand geometry system to verification tasks only.

History

Hand geometry systems have the longest implementation history of all biometric modalities. David Sidlauskas developed and patented the hand geometry concept in 1985[1] and the first commercial hand geometry recognition systems became available the next year.[2] The 1996 Olympic Games implemented hand geometry systems to control and protect physical access to the Olympic Village.[2] Many companies implement hand geometry systems in parallel with time clocks for time and attendance purposes. Walt Disney World has used a similar "finger" geometry technology system for several years to expedite and facilitate entrance to the park and to identify guests as season ticket holders to prevent season ticket fraud.[3]

Approach

The devices use a simple concept of measuring and recording the length, width, thickness, and surface area of an individual's hand while guided on a plate (Figure 1). Hand geometry systems use a camera to capture a silhouette image of the hand (Figure 2).

The hand of the subject is placed on the plate, palm down, and guided by five pegs that sense when the hand is in place.

Figure 1: Bottom View.[4]

The resulting data capture by a Charge-Coupled Device (CCD) camera of the top view of the hand including example distance measurements.

Figure 2: Silhouette of Hand Image.[4]

The image captures both the top surface of the hand and a side image that is captured using an angled mirror (Figure 3). Upon capture of the silhouette image, 31,000 points are analyzed and 90 measurements are taken; the measurements range from the length of the fingers, to the distance between knuckles, to the height or thickness of the hand and fingers (Figure 4).[2] This information is stored in nine bytes of data, an extremely low number compared to the storage needs of other biometric systems.[2]

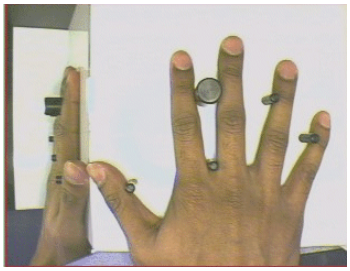

Figure 3: Hand Including Mirror Image as Seen by the CCD Camera.[5]

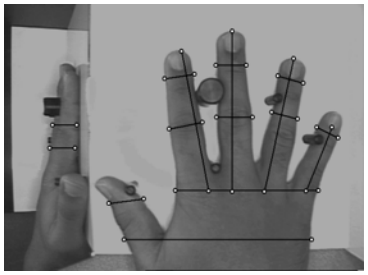

Figure 4: Example Distance Measurements.[5]

The enrollment process of a hand geometry system typically requires the capture of three sequential images of the hand, which are evaluated and measured to create a template of the user's characteristics. Upon the submission of a claim, the system recalls the template associated with that identity; the claimant places his/her hand on the plate; and the system captures an image and creates a verification template to compare to the template developed upon enrollment. A similarity score is produced and, based on the threshold of the system, the claim is either accepted or rejected.

United States Government Evaluations

The US government has sponsored two evaluations of hand geometry technology. The 1996 Evaluation of the INSPASS Hand Geometry Data determined the effect of a threshold on system operation[6], established false accept and false reject rates as a function of the threshold, and presented an estimate of the Receiver Operating Characteristics (ROC) curve for the INSPASS system.[6] The evaluators noted that an estimate was the best that could be achieved with the available data.[6] A 1991 Performance Evaluation of Biometric Identification Devices evaluated the relative performance of multiple biometric devices, including hand geometry.[7]

Standards Overview

Standards development efforts focusing on hand geometry technology, on both the national and international levels, are intended to accelerate the development of interoperable authentication-based security solutions. ANSI INCITS 396-2005 Hand Geometry Interchange Format defines the data interchange format for storing, recording, and transmitting hand geometry information collected from the hand silhouette.[8] It defines both content and format of the data for exchange as well as the units used for the measurement of the hand geometry data.[8] This national standard corresponds to ISO/IEC CD (Committee Draft) 19794-10 Biometric Interchange Format – Part 10, Hand Geometry Silhouette Data on the international standards level (ISO/IEC).[9] The international standard is still in draft format and has not yet been approved as an official standard.

Summary

Hand geometry recognition systems are widely used for applications in physical access, attendance tracking, and personal verification. They have found a sustainable market niche through use in security and accountability applications. Their ease of use, stand-alone capabilities, and small data requirements make them a popular choice for those in need of verification systems.

Document References

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[3] "Finger Scanning at Disney Parks Causes Concern," 15 July 2005 <http://www.local6.com/news/4724689/detail.html>.

[4] "Hand Geometry and Handwriting," GlobalSecurity.org 27 April 2005 <http://www.globalsecurity.org/security/systems/hand.htm>.

[5] Arun Ross, Anil Jain, and Sharat Pankanti, "A Hand Geometry-Based Verification System" <http://biometrics.cse.msu.edu/hand_proto.html>.

[6] James Wayman, ed., "National Biometric Test Center Collected Works," San Jose State University, August 2000 <http://www.engr.sjsu.edu/biometrics/nbtccw.pdf>.

[7] James Holmes, Larry Wright, and Russell Maxwell, "A Performance Evaluation of Biometric Identification Devices," Sandia National Laboratories, June 1991

<http://infoserve.sandia.gov/cgi-bin/techlib/access-control.pl/1991/910276.pdf>.

[8] "Information Technology – Hand Geometry Format for Data Interchange," ANSI INCITS 396-2005 <http://www.ncits.org/scopes/1643.htm>.

[9] "Information Technology - Biometric data interchange formats – Part 10: Hand Geometry Silhouette Data," ISO/IEC CD 19794-10 <http://www.ncits.org>.

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- Coordinates biometrics-related activities that are of interagency importance;
- Facilitates the inclusions of privacy-protecting principles in biometric system design;
- Ensures a consistent message about biometrics and government initiatives when agencies interact with Congress, the press and the public;
- Strengthen international and public sector partnerships to foster the advancement of biometric technologies.

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