Dynamic Signature

Introduction

"Dynamic Signature" is a biometric modality that uses, for recognition purposes, the anatomic and behavioral characteristics that an individual exhibits when signing his or her name (or other phrase). [1,2.] Dynamic Signature devices should not be confused with electronic signature capture systems that are used to capture a graphic image of the signature and are common in locations where merchants are capturing signatures for transaction authorizations.

Data such as the dynamically captured direction, stroke, pressure, and shape of an individual's signature can enable handwriting to be a reliable indicator of an individual's identity (i.e., measurements of the captured data, when compared to those of matching samples, are a reliable biometric for writer identification.)

History

The first signature recognition system was developed in 1965.[3] Dynamic signature recognition research continued in the 1970s focusing on the use of static or geometric characteristics (what the signature looks like) rather than dynamic characteristics (how the signature was made).[4] Interest in dynamic characteristics surged with the availability of better acquisition systems accomplished through the use of touch sensitive technologies.[4,5] In 1977, a patent was awarded for a "personal identification apparatus" that was able to acquire dynamic pressure information.[6]

Approach

Dynamic signature recognition uses multiple characteristics in the analysis of an individual's handwriting. These characteristics vary in use and importance from vendor to vendor and are collected using contact sensitive technologies, such as PDAs or digitizing tablets.[5]

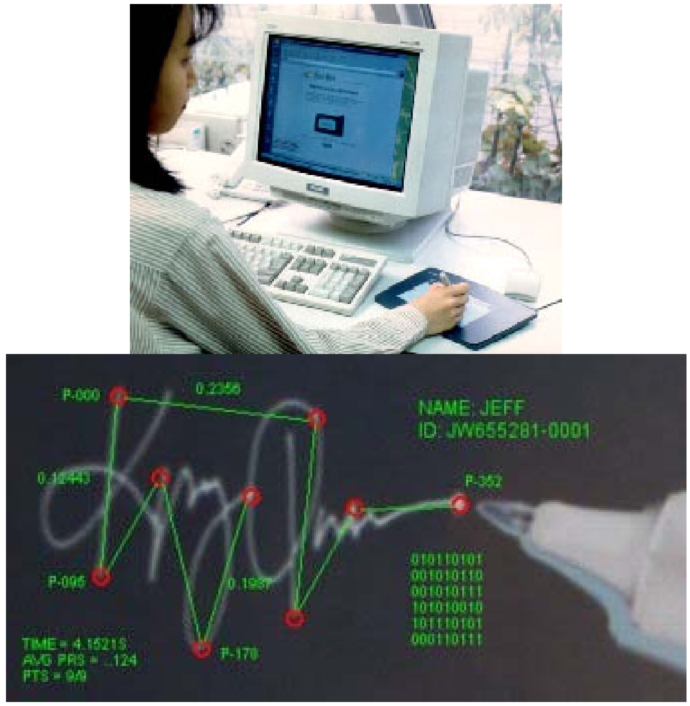

Figure 1: Dynamic Signature Depiction: As an individual signs the contact sensitive tablet, various measurements are observed and processed for comparison.[1,2]

Most of the features used are dynamic characteristics rather than static and geometric characteristics, although some vendors also include these characteristics in their analyses. Common dynamic characteristics include the velocity, acceleration, timing, pressure, and direction of the signature strokes, all analyzed in the X, Y, and Z directions. Figure 2 illustrates these recorded dynamic characteristics of a signature. The X and Y position are used to show the changes in velocity in the respective directions (indicated by the white and yellow lines) while the Z direction (red line) is used to indicate changes in pressure with respect to time.

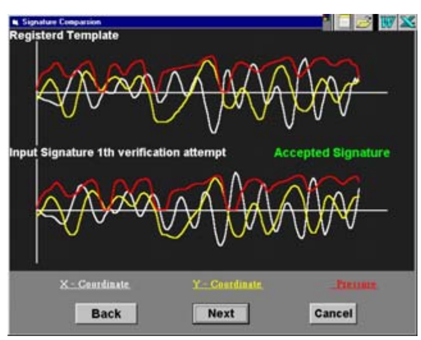

Figure 2: Graphic Depiction of Dynamic Signature Characteristics.[1]

Some dynamic signature recognition algorithms incorporate a learning function to account for the natural changes or drifts that occur in an individual's signature over time.[1]

The characteristics used for dynamic signature recognition are almost impossible to replicate. Unlike a graphical image of the signature, which can be replicated by a trained human forger, a computer manipulation, or a photocopy, dynamic characteristics are complex and unique to the handwriting style of the individual. Despite this major strength of dynamic signature recognition, the characteristics historically have a large intra-class variability (meaning that an individual's own signature may vary from collection to collection), often making dynamic signature recognition difficult. Recent research has reported that static writing samples can be successfully analyzed to overcome this issue.

United States Government Evaluations

In 1991, the Sandia National Laboratories produced A Performance Evaluation of Biometric Identification Devices (http://infoserve.sandia.gov/cgi-bin/techlib/access-control.pl/1991/910276.pdf), a report that evaluates the relative performance of multiple biometric devices, including dynamic signature.[7] In 1999, "Report of Biometrics In-House Test (http://www.epa.gov/cdx/cromerrr/propose/biometric_dmr-rpt.pdf)," an operational pilot in New York State sponsored by the Environmental Protection Agency[7], evaluated the interoperability of signature recognition hardware with existing user drivers and operating systems[8] and found numerous interoperability problems. Even though these tests represent the most recent government evaluations of notable scale, the information cannot be considered conclusive because of the age of the tests.

Standards Overview

Numerous activities regarding the interoperability of biometrics are ongoing at both the national and international level. On the national level, ANSI INCITS 395-2005 specifies a data interchange format for representation of digitized sign or signature data, for the purposes of biometric enrollment, verification or identification through the use of Raw Signature/Sign Sample Data or Common Feature Data. The data interchange format is generic, in that it may be applied and used in a wide range of

application areas where electronic signs or signatures are involved. No application-specific requirements or features are addressed in this standard.[9] At the international level, there are two corresponding documents currently in draft format: ISO/IEC FCD 19794-7: Information technology – Biometric data interchange formats – Part 7: Signature/sign time series data[10] and ISO/IEC WD 19794-11: Information technology – Biometric data interchange formats – Part 11: Signature/Sign Processed Dynamic Data.[11]

Summary

Dynamic signature verification is a biometric that can be easily integrated into existing systems because of the availability and prevalence of signature digitizers and the public's acceptance of the characteristic collection. On the downside, signature recognition can only be used for verification purposes and intra-class variability can cause non-ideal performance for some applications. A need for continued improvements in current products will help drive the development and application of this technology.

Document References

[1] "Biometric Signature Verification," Cyber-SIGN <http://www.cybersign.com/techoverview_what.htm>.

[2] "Signature Recognition," GAITS: Global Analytic Information Technology Services 8 August 2005 <http://www.gaits.com/biometrics_signature.asp>.

[3] A. J. Mauceri, "Feasibility Studies of Personal Identification by Signature Verification," Report no. SID 65 24 RADC TR 65 33, Space and Information System Division, North American Aviation Co., Anaheim, USA, 1965.

[4] G. Lorrette, "Handwriting Recognition or Reading? Situation at the Dawn of the 3rd Millennium," Universite de Rennesl, Advances in Handwriting Recognition, ed. Seong-Whan Lee (Singapore: World Scientific Publishing, 1999) 4-5.

[5] Marc Gaudreau, "On the Distinction between Biometric and Digital Signatures," CIC Enterprise Solutions <http://www.cic.com/enterprise/whitepapers/whitepaper5.asp>.

[6] John D. Woodward, Jr., Nicholas M. Orlans, and Peter T. Higgins. Biometrics (New York: McGraw Hill Osborne, 2003).

[7] James Holmes, Larry Wright, and Russell Maxwell, "A Performance Evaluation of Biometric Identification Devices," Sandia National Laboratories 1991 <http://infoserve.sandia.gov/cgi-bin/techlib/access-control.pl/1991/910276.pdf>.

[8] "Report of Biometric In-house Test" 30 September 1999 <http://www.epa.gov/cdx/cromerrr/propose/biometric_dmr-rpt.pdf>.

[9] ANSI INCITS 395-2005, Information technology - Biometric Data Interchange Formats - Signature/Sign Data, 2005.

[10] ISO/IEC FCD 19794-7: Information technology – Biometric data interchange formats – Part 7: Signature/sign time series data.

[11] ISO/IEC WD 19794-11: Information technology – Biometric data interchange formats – Part 11: Signature/Sign Processed Dynamic Data.

About the National Science and Technology Council

The National Science and Technology Council (NSTC) was established by Executive Order on November 23, 1993. This Cabinet-level Council is the principal means within the executive branch to coordinate science and technology policy across the diverse entities that make up the Federal research and development enterprise. Chaired by the President, the membership of the NSTC is made up of the Vice President, the Director of the Office of Science and Technology Policy, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other White House officials.

A primary objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in a broad array of areas spanning virtually all the mission areas of the executive branch. The Council prepares research and development strategies that are coordinated across Federal agencies to form investment packages aimed at accomplishing multiple national goals. The work of the NSTC is organized under four primary committees; Science, Technology, Environment and Natural Resources and Homeland and National Security. Each of these committees oversees a number of sub-committees and interagency working groups focused on different aspects of science and technology and working to coordinate the various agencies across the federal government. Additional information is available at www.ostp.gov/nstc.

About the Subcommittee on Biometrics

The NSTC Subcommittee on Biometrics serves as part of the internal deliberative process of the NSTC. Reporting to and directed by the Committee on Homeland & National Security and the Committee on Technology, the Subcommittee:

- Develops and implements multi-agency investment strategies that advance biometric sciences to meet public and private needs;
- 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.

Additional information on the Subcommittee is available at www.biometrics.gov.

Subcommittee on Biometrics

Co-chair: Duane Blackburn (OSTP)

Co-chair: Chris Miles (DOJ)

Co-chair: Brad Wing (DHS)

Executive Secretary: Kim Shepard (FBI Contractor)

Department Leads

Mr. Jon Atkins (DOS)

Dr. Sankar Basu (NSF)

Mr. Duane Blackburn (EOP)

Ms. Zaida Candelario (Treasury)

Dr. Joseph Guzman (DoD)

Dr. Martin Herman (DOC)

Ms. Usha Karne (SSA)

Dr. Michael King (IC)

Mr. Chris Miles (DOJ)

Mr. David Temoshok (GSA)

Mr. Brad Wing (DHS)

Mr. Jim Zok (DOT)

Communications ICP Team

Champion: Kimberly Weissman (DHS US-VISIT)

Members & Support Staff:

Mr. Richard Bailey (NSA Contractor)

Mr. Duane Blackburn (OSTP)

Mr. Jeffrey Dunn (NSA)

Ms. Valerie Lively (DHS S&T)

Mr. John Mayer-Splain (DHS US-VISIT Contractor)

Ms. Susan Sexton (FAA)

Ms. Kim Shepard (FBI Contractor)

Mr. Scott Swann (FBI)

Mr. Brad Wing (DHS US-VISIT)

Mr. David Young (FAA)

Mr. Jim Zok (DOT)

Special Acknowledgements

The Communications ICP Team wishes to thank the following external contributors for their assistance in developing this document:

- Kelly Smith, BRTRC, for performing background research and writing the first draft
- The Standards ICP Team and Dr. Kathryn Taylor for reviewing the document and providing numerous helpful comments

Document Source

This document, and others developed by the NSTC Subcommittee on Biometrics, can be found at www.biometrics.gov.