

Comparative Biometric Testing

Functional Requirements for Test Applications

Version 1.32

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Revision History

Version	Date	Changes
1.2	November 2005	Base version
1.3	May 2006	Added clarification to Overview; added notes to requirements lists; added quality check text;
1.31	10 March 2009	Added recommendation that CBT Comparison Application operate on Windows 2003 Server; renamed to "Functional Requirements for Test Applications" for clarity; changed chart description from ROCs to DETs
1.32	1 April 2008	Changed feature sample to sample feature

Overview

This document outlines functional requirements for three separate applications that IBG develops to execute Comparative Biometric Testing (CBT):

- **CBT Enrollment Application**
- **CBT Recognition Sample Capture Application**
- **CBT Comparison Application**

Systems tested in CBT are evaluated through applications that IBG designs, develops, and integrates by means of vendor-provided software development kits. This document provides vendors with an overview of the functions that IBG implements in each of the three applications. Vendors are asked to review this document to facilitate discussions with IBG on integration of their hardware and software product into the CBT test environment. Modifications to off-the-shelf capture and comparison applications may be required for certain test functions, e.g. to save images or to release scores from non-matching comparisons. Vendor hardware and software must be made to function for each of the three applications in order to execute the test.

IBG works with vendors to ensure that implementation of the CBT Test Applications is sufficient to enable testing while remaining faithful to native device functions and capabilities.

CBT Enrollment Application

Overview

The CBT Enrollment Application generates enrollment templates for all test subjects, with the exception of those unable to enroll. Enrollment templates are subsequently used as the basis of offline comparison against recognition samples. IBG analyzes results from the CBT Enrollment Application to generate failure to enroll rates (FTE) and enrollment transaction durations.

IBG executes two separate enrollment transactions for each Test Subject. IBG uses externally-linked identifiers to associate the Test Subject's two enrollments.

Certain modalities and systems allow enrollment of multiple instances, such as two fingerprints or two irises. In this case enrollment requirements are modified to collect enrollments from multiple instances in a single transaction. In most cases no more than two separate instances are enrolled.

Functional Requirements

The CBT Enrollment Application executes or enables the following functions:

1. Allows operator to enter a 6-digit Test Subject Identifier through a GUI, using an IBG-provided barcode reader.
2. Allows operator to hit "OK" button to begin enrollment transaction.
3. Provides a GUI through which enrollment progress can be monitored, if applicable.
4. Creates an enrollment template for each instance in each enrollment transaction.
5. Saves this template to a database on a local or network PC.

NOTE: For some technologies, multiple enrollment templates are created for each test subject. IBG works with vendors to maintain their native template-generation capabilities while still effecting 1:1 offline matching.

NOTE: Save enrollment templates to the storage apparatus in a fashion that does not impact recognition sample capture duration, e.g. subsequent to each transaction.

6. Records the number of presentations required to enroll, if this number is variable.

NOTE: If all enrollment transactions always require the same number of presentations, then this does not need to be recorded.

7. Terminates the enrollment transaction after 60 seconds if the system cannot successfully enroll a Test Subject.
8. Automatically triggers an Additional Effort enrollment transaction for test subjects unable to enroll successfully (through failure to enroll or time out).

NOTE: The application presents the message "Unable to enroll in first transaction. Please press OK to proceed to Additional Effort enrollment". The operator clicks "OK" and the application proceeds with a second enrollment transaction for this same Test Subject. This Additional Effort enrollment transaction is identical to the standard enrollment transaction.

9. Indicate to the operator that an enrollment transaction is completed and whether enrollment was completed successfully.

10. Record the duration of each enrollment transaction.

NOTE: Enrollment transaction duration is measured from the point at which the operator hits "OK" in the CBT Enrollment Application to (1) successful creation of an enrollment template; OR (2) attempt time out; OR (3) application declares that the test subject cannot enroll.

NOTE: If the Test Subject required an Additional Effort transaction to enroll, transaction durations for the standard and the Additional Effort enrollment transactions are recorded separately.

11. Save the image(s) used to create enrollment templates, if applicable.

NOTE: Modalities such as fingerprint and face recognition may be more likely to support this capability than modalities such as hand geometry.

12. Record failures to enroll.

NOTE: A failure to enroll only occurs once the Test Subject has failed both the standard and the Additional Effort enrollment transactions.

13. Record enrollment quality statistics for successful enrollments, if available.

14. Record statistics on why enrollment failed, if available.

CBT Recognition Sample Capture Application

Overview

The CBT Recognition Sample Capture Application acquires recognition samples in a format suitable for subsequent offline 1:1 matching against enrollment templates. IBG analyzes recognition sample capture attempts and transactions to generate FTA and transaction durations. A total of nine recognition samples are captured in the course of three separate recognition sample capture transactions. Actual sample-to-template comparison does not occur in this application; it occurs within the CBT Comparison Application.

When IBG designs CBT Recognition Sample Capture Applications, it typically utilizes a recognize or verify call that (1) activates the capture device and (2) captures one or more samples suitable for matching. Depending on the system, quality check mechanisms may need to be invoked separately. Quality checks may be necessary to ensure that the captured data is of sufficient quality. This is typically the most difficult design element, as capture devices vary in their handling of recognition sample capture. For example, a device may continuously capture and compare images until a match is found. A device may also invoke different matching algorithms at different points in the capture sequence. A more difficult case may be if capture parameters change based on feedback from the matching algorithm, e.g. low scores. For devices in which real-time comparison is continuous, the objective is to capture the image array in a native fashion and to emulate real-time comparison through the CBT Comparison Application.

Also, certain modalities and systems allow for recognition through multiple instances, such as two fingerprints or two irises. In this case recognition sample capture requirements are modified to collect recognition samples from multiple instances. In most cases no more than two separate characteristics are acquired for recognition.

Functional Requirements

The CBT Recognition Sample Capture Application executes or enables the following functions:

1. Allows operator to enter a 6-digit Test Subject Identifier through a GUI, using an IBG-provided barcode reader.
2. Provides a GUI through which recognition sample capture progress can be monitored, if applicable.

NOTE: This GUI may or may not be viewed by the test subject, depending on the device.

3. Allows operator to click "OK" button to start Recognition Sample Capture Transaction 1, Attempt 1.
4. Acquires and saves one recognition sample for Recognition Sample Capture Attempt 1.

NOTE: Depending on the system, the data object saved may be one or more of the following: a raw image, a processed image, or a sample feature. The sample feature may or may not be structured in the same fashion as an enrollment template. The minimum requirement is that whatever data object is saved must be capable of being compared in an offline fashion against an enrollment template.

NOTE: When available, and to the degree that impact on recognition sample capture duration can be minimized, both image and sample feature should be saved on each attempt. Modalities such as fingerprint and face recognition may be more likely to support this capability than modalities such as hand geometry.

NOTE: For certain types of systems (e.g. face recognition), the sample captured and saved with each attempt may be an array of samples. The sample array resulting from a recognition sample capture attempt is saved in the same fashion as an atomic sample.

5. Saves samples to the storage apparatus in a fashion that does not impact recognition sample capture duration, e.g. subsequent to each transaction.
6. After the first recognition sample is captured, prompts operator to click "OK" to proceed to Recognition Sample Capture Attempt 2.
7. After the second recognition sample is captured, prompts operator to click "OK" to proceed to Recognition Sample Capture Attempt 3.
8. Terminates the recognition capture attempt after 30 seconds if the system cannot successfully acquire a given recognition sample (measured from the point at which the operator clicks "OK").

NOTE: The application logs the time-out event in order to calculate attempt-level FTA

9. Proceeds to the next operator-triggered Recognition Sample Capture.
10. Saves each of the three recognition samples that comprise Recognition Sample Capture Transaction 1 with a unique Recognition Sample Identifier based on the 6-digit Test Subject ID, the transaction number (1-3), and the attempt number (1-3).

EXAMPLE: Test Subject 012345 may have three recognition samples captured within Recognition Sample Capture Transaction 1: 012345-1-1, 012345-1-2, and 012345-1-3. A null value is saved for cases in which the recognition sample was not successfully acquired such that each Test Subject has nine database entries.

NOTE: Recognition Sample Capture Transaction 1 is complete once three recognition samples have been captured or once some combination of three successful and failed recognition sample capture attempts have occurred.

NOTE: For devices in which different types of data objects are saved with each attempt (e.g. both images and feature vectors), as well as for devices that save sample arrays as opposed to single samples, further system-specific naming convention elements must be defined.

11. Indicates to the operator that Recognition Sample Capture Transaction 1 is completed.
12. Allows operator to hit "OK" button to start Recognition Sample Capture Transaction 2.
13. Captures three recognition samples (e.g. images, templates, features) within Recognition Sample Capture Transaction 2, following steps 4 through 11 above.
14. Saves each of the three recognition samples that comprise Recognition Sample Capture Transaction 2 with a unique Recognition Sample Identifier linked to the Test Subject Identifier.

EXAMPLE: Test Subject 012345 may have three recognition samples captured within Recognition Sample Capture Transaction 1: 012345-2-1, 012345-2-2, and 012345-2-3.

15. Indicates to the operator that Recognition Sample Capture Transaction 2 is completed.
16. Repeats steps 12 through 15 for Recognition Sample Capture Transaction 3, incrementing the naming convention to indicate that the samples captured are from the third transaction.
17. Records the duration of each recognition attempt.

NOTE: Recognition attempt duration is measured from the point at which the operator hits OK in the CBT Recognition Sample Capture Application to (1) successful capture of a recognition sample;

OR (2) application time out; OR (3) application declares that the sample is of insufficient quality to acquire. Recognition attempt duration is used to calculate recognition transaction duration.

15. Records instances of failure to enroll declared for reasons other than time-out (see step 8 above).
16. Records reasons for recognition sample capture attempt failure, if available.
17. Records recognition sample quality statistics for successful captures, if available.

CBT Comparison Application

Overview

The CBT Comparison Application generates and records similarity scores from each recognition sample-enrollment template comparison. IBG analyzes genuine and impostor similarity scores from each attempt and transaction to generate FNMR-FMR at the attempt and transaction levels, as well as to generate DETs. FTA and/or FTE may also be generated during matching attempts.

In order to conduct the volume of comparisons involved in CBT, it is helpful for recognition sample pre-processing steps to be implemented. For example, features might be extracted from a sample in bulk prior to exhaustive cross-comparison. This reduces the computational demand on the CBT Matching Application. Also, to support the matching volumes, recognition samples (or features thereof) are typically loaded into RAM.

The CBT Comparison Application should also operate on Windows 2003 Server, either 32- or 64-bit.

Functional Requirements

The CBT Comparison Application executes or enables the following functions:

1. Compares each recognition sample against each enrollment template.

NOTE: Depending on FTE as well as the final number of Test Subjects recruited, approximately 1000-1500 enrollment templates are collected.

NOTE: Depending on FTA as well as the final number of Test Subjects recruited, approximately 4500-6570 recognition samples are collected.

2. Records comparison scores resulting from each comparison along with the Recognition Sample Identifier and Test Subject Identifier.
3. Writes similarity scores to a database.

NOTE: IBG exports these scores into its own data analysis application.

4. Records a null value and/or error code for comparisons in which matching of the recognition sample to the enrollment template failed to generate a similarity score.

NOTE: Depending on the functions of the CBT Recognition Sample Capture Application, failures to acquire based on recognition sample quality may not be discernible until this point.