

Study Project Proposal

Evaluating Multi-Modal Biometrics Systems: Concepts of Operation and Methods of Performance Evaluation

1. Source of the Proposed Study Project

1.1. Title

Evaluating Multi-Modal Biometrics Systems: Concepts of Operation and Methods of Performance Evaluation

1.2. Date Submitted

March 17, 2003

1.3. Proposer

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2. Process Description for the Proposed Project

2.1 Project Type

This is a Study Project.

2.2 Type of Document

This Study Project is expected to result in a Project Report.

2.3 Definition of Concepts and Special Terms

The following definitions are taken, in part, from the **Biometric Evaluation Methodology Supplement, Version 1.0**, August 2002.

Biometric Algorithm – A subcomponent of a Biometric System that may include the extraction and comparison of biometric data.

Biometric System – An automated system capable of capturing a biometric sample from an end user, extracting biometric data from the sample, comparing the data with one or more reference templates, deciding on how well they match, and indicating whether or not an identification or verification of identity has been achieved.

Biometric Performance Metric – a quantifiable assessment of the speed, accuracy or other characteristic of a Biometric Algorithm or System.

False Accept Rate (FAR) - The probability that a biometric system will incorrectly identify an individual, or will fail to reject an impostor. For a positive (verification) system, it can be estimated from: (the number of false acceptances)/(the number of impostor verification attempts).

False Match Rate (FMR) – The rate for incorrect positive matches by the matching algorithm for single **template comparison attempts**. For a **biometric system** that uses just one **attempt** to decide acceptance, **FMR** is the same as **FAR**. When multiple attempts are combined in some manner to decide acceptance, **FAR** is more meaningful at the system level than **FMR**.

False Non-Match Rate (FNMR) – The rate for incorrect negative matches by the matching algorithm for single template comparison attempts. For a biometric system that uses just one attempt to decide acceptance, FNMR is the same as FRR. When multiple attempts are combined in some manner to decide acceptance, FRR is more meaningful at the system level than FNMR.

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False Reject Rate (FRR) - The probability that a biometric system will fail to identify a genuine enrollee. For a positive (verification) system, it can be estimated from: (the number of false rejects)/(the number of enrollee verification attempts).

Failure To Enroll Rate (FTE) – The failure to enroll rate is the proportion of the user population for whom the biometric system is unable to generate reference templates of sufficient quality. It is the equivalent of FTA for the enrollment process, and depends on the procedures used in enrollment (which may differ from the procedures for later identification). It includes those who, for physical or behavioral reasons, are unable to present the required biometric feature.

Multi-Modal Biometric System - A biometric system that uses information from different biometric characteristics, e.g. fingerprint and facial image *or* fingerprints from two separate fingers.

2.4 Expected Relationship with approved Reference Models, Architectures, etc.
None

2.5 Recommended INCITS Development Technical Committee
INCITS Technical Committee M1 – Biometrics

2.6 Anticipated Frequency and Duration of Meetings
Unknown.

2.7 Target date for Initial Public Review
It is estimated that the draft document would be ready for submission to INCITS within three months of initiation, or in July 2003.

2.8 Estimated Useful Life of Standard
There is no known limitation on the useful life of the proposed standard.

3. Business Case for Developing the Proposed Standard

3.1 Description

This proposed Study Project would define and specify methods of evaluating multi-modal biometric systems, in particular categorizing various terms and concepts of operation in multi-modal biometric systems. The proposed Study Project would also specify methods evaluating performance in multi-modal biometric systems.

3.2 Existing Practice and the Need for Standard Concepts of Operation and Performance Evaluation Methods

Currently, the vast majority of biometric deployments are mono-modal, utilizing only one biometric technology for verification and identification. The concept of operations for mono-modal biometric systems are commonly known and understood. Further, the industry is coming to agreement on matters of terminology and common standards for many elements of mono-modal biometric systems, including performance testing.

There is currently a need for similar efforts in the area of multi-modal biometric systems, those that utilize information from different biometric characteristics, e.g. fingerprint and facial image, or fingerprints from two separate fingers. Many of the assumptions, concepts of operations, and performance metrics associated with mono-modal biometric systems are incommensurate or In applications such as border entry/exit, access control, civil identification, and network security, multi-modal biometric systems are looked to as a means of (1) reducing false non-match and false match rates, (2) providing a secondary means of enrollment, verification, and identification if

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sufficient data cannot be acquired from a given biometric sample, and (3) combating attempts to spoof biometric systems through non-live data sources such as fake fingers. However, there is insufficient common understanding of (1) the terminology used in reference to multi-modal biometric systems, (2) the concepts of operation of multi-modal biometrics systems, and (3) methods of evaluating the performance of multi-modal biometric systems. Without a standard means of evaluating such systems, a disjunction may arise between vendor and deployer expectations. With regard to performance, the use of multi-modal biometric systems may impact deployer decisions as relate to FAR, FRR, FMR, FNMR, and FTE.

Categories of multi-modal biometric systems with dissimilar concepts of operations as well as dissimilar methods of evaluating performance include, but are not limited to, the following (note that the following categories are not exclusive or parallel: e.g. a system may be both contingent and synchronous, a system may or may not utilize result fusion):

Synchronization

- *Synchronous multi-modal biometric systems*, those which acquire biometric samples from different biometric characteristics at the same time
- *Asynchronous multi-modal biometric systems*, those which acquire biometric samples from different biometric characteristics at different times

Contingency

- *Contingent multi-modal biometric systems*, in which the use of a second (or third, etc.) biometric characteristic is contingent on the results of verification or identification through a first biometric characteristic
- *Non-contingent multi-modal biometric systems*, in which the use of a second (or third, etc.) biometric characteristic occurs regardless of the results of verification or identification through a first biometric characteristic

Identification Functionality

- *Identification enrollment multi-modal biometric systems*, those which acquire biometric samples from different biometric characteristics for the purpose of utilizing both characteristics for 1:N enrollment searches
- *Identification multi-modal biometric systems*, those which acquire biometric samples from different biometric characteristics but only utilize one biometric for 1:N enrollment search

Verification Functionality

- *Transactional multi-modal biometric systems*, those which utilize different biometric characteristics during verification
- *Non-duplicate detection enrollment multi-modal biometric systems*, those which utilize only one of multiple biometric characteristics available during verification, with the decision on which characteristic to utilize varying on a transactional basis

Result Fusion

- *Result Fusion multi-modal biometric systems*, in which the match results from separate comparisons of different biometric characteristics are assessed through intelligent scoring mechanisms in order to improve on the simple combination of probabilities that result from the two separate match results.

Source Fusion

- *Source Fusion multi-modal biometric systems*, in which biometric samples (e.g. identifiable images, voice patterns) are combined in order to create a new biometric sample inclusive of data from both samples; this new sample is generally processed through a different algorithm than either source samples.

Each of these categories, as well as each combination of various categories, may feature a different concept of operations and method of assessing performance. This can complicate system procurement, deployment, and evaluation.

By conducting a Study Report on the topic of evaluating multi-modal biometric systems, we will:

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- Define and specify methods of evaluating multi-modal biometric systems, inclusive of categorizing various concepts of operation in multi-modal biometric systems.
- Specify methods of evaluating performance in multi-modal biometric systems.
- Specify a prioritization and conditionality hierarchy through which multiple aspects of a multi-modal biometric system can be assessed
- Increase understanding of multi-modal biometric systems both within the biometric community and among biometric deployers
- Increase the range of information available to government and commercial entities
- Encourage continued research into multi-modal biometric systems

The proposed Study Area does not intend to address the use of non-biometric authentication methods, such as passwords or token, in conjunction with biometric technologies. It is further anticipated that the standard will not address automated fingerprint identification systems (AFIS), those that utilize multiple fingerprints from the same individual to increase accuracy via algorithms designed to optimize data acquired from multiple prints.

3.3 Implementation Impacts of the Proposed Study Project

3.3.1 Development Costs

Labor is expected to total approximately 3 staff months.

3.3.2 Impact on Existing or Potential Markets

It is expected that the improved understanding and assessment capabilities made possible through the Study Project relative to multi-modal biometric system will result in increased adoption of biometrics and in more effective use of biometric technologies.

3.3.3 Costs and Methods for Conformity Assessment

The cost and method for conformity assessment is not known at this time.

3.3.4 Return on Investment

There is no known data to make such an assessment.

3.4 Legal Considerations

3.4.1 Patent Assertions

There are no currently known relevant patents. Determination of any patents relevant to this proposed Study Project will be dependent on the definitions and concepts of operation of the multi-modal biometric systems.

3.4.2 Dissemination of the Study Project

Drafts of this Study Project will be distributed electronically. There may be distribution constraints as this document reaches different stages of development and processing within INCITS and ISO/IEC JTC1.

4. Related Standards Activity

4.1 Existing Standards

- Common Biometric Exchange Format (CBEFF) NISTIR 6529-2001
- ANSI/INCITS 358-2002 Information Technology – BioAPI Specification

4.2 Related Standards Activity

- M1 Task Group for Biometric Performance Testing and Reporting
- M1 Task Group for Application Profiles