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D8.2. A set of standards stemming from the application of multi-modal biometrics on mobile devices

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List of definitions & abbreviations

Abbreviation	Definition
AFIS	Automated Fingerprint Identification System
NIST	National Institute of Standards and Technology

Executive Summary

Reviewing a set of standards stemming from the application of multimodal biometrics on mobile devices is the main contribution of D8.2. The WP8 will closely analyse and follow the regulation and standards in European landscape on the use of the secure technologies for BCPs. The particular focus in this deliverable is on multimodal biometrics, mobile devices and existing standards connecting the two. These standards are part of the available security and privacy standards in the EU landscape for BCPs. The EU data protection rules both from the legal and the ethical perspectives will also apply here. BCP related standards should be strong, interoperable, trustworthy and transparent.

The standard that is related to multimodal and other multibiometric fusion is ISO\IEC TR 24722.

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1. Introduction

In this deliverable, we focus on defining the standards stemming from application of multi modal biometrics on mobile devices. In this document conventional biometric modalities are face, voice, finger, iris, retina, hand geometry and signature or sign. Unconventional biometric types are keystroke, Lip movement, gait, vein, DNA, ear, foot and scent.

1.1 Related terminology

Biometrics is defined as biological and behavioural characteristic of an individual that can be detected and from which distinguishing, repeatable biometric features can be extracted for the purpose of automated recognition of individuals.

Biometric modality is the biometric characteristic which is used in a biometric process.

Biometric process is an automated process using one or more biometric characteristics of a single individual for the purpose of enrolment, verification and identification.

Biometric fusion is the combination of information from multiple sources e.g. sensors, modalities, algorithms, instances or presentations.

2. Single biometric process for verification and identification

Single biometric process and its building blocks are shown in Figure 1. A sample taken using a sensor device is provided into a feature extraction module which extracts features from the sample such as minutiae. This is a representation form for matching the sample with the stored template. A match score is generated out of the matching process. The score is entered into a decision module for example by applying thresholding to decide whether there is a match between the sample and the template. The outcome decision is a binary one which is either match or non-match.

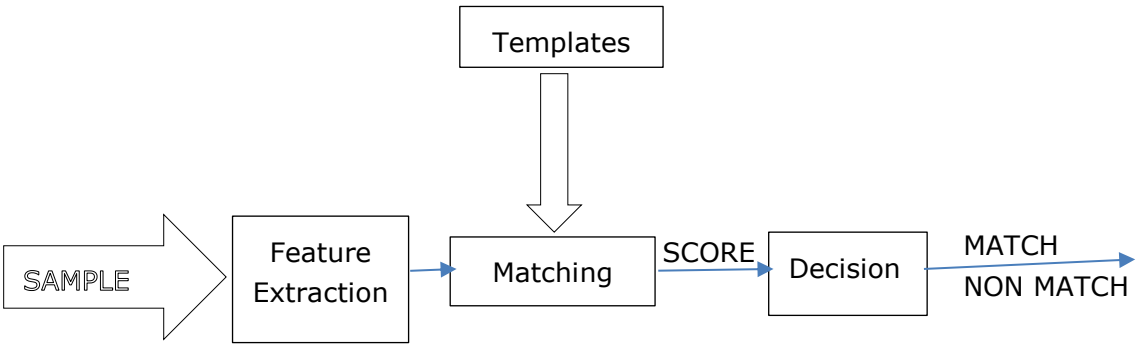

Figure 1 Single biometric process

3. Multibiometric systems for verification and identification

Multimodality refers to combining more than one modality, sensor, instance, algorithm for making biometric based identification or verification decisions. Such combining process is also called as fusing.

3.1 System design considerations and trade-offs

Considerations related to system design are improved performance, Accuracy, System speed and throughput, Robustness, Resource requirements, Acceptability, Circumvention, Ease of use, Operational cost, Environmental flexibility, Population flexibility

3.2 Combination techniques

3.2.1 Single biometric fusion

There has been no use of multiple modalities in AFIS. However, the existing forms of fusion based on single modality, namely fingerprint has been as follows:

- Creating an image fusion from series of frames from a live scan device
- Fusing templates in the use of multiple feature extraction algorithms on fingerprint images
- Fusing all ten fingerprints from both hands which is called multi-instance fusion
- Using rolled and slapped images of the same finger in multi-presentation fusion.

Eventually different types of fusion aim at an increase both in accuracy and efficiency.

3.2.2 Multibiometric fusion

There are two fusion approaches: serial and parallel. In serial fusion (Figure 1), each additional biometric is fused at a serial step. In parallel fusion (Figure 2), all biometrics are fused and matched at the same time.

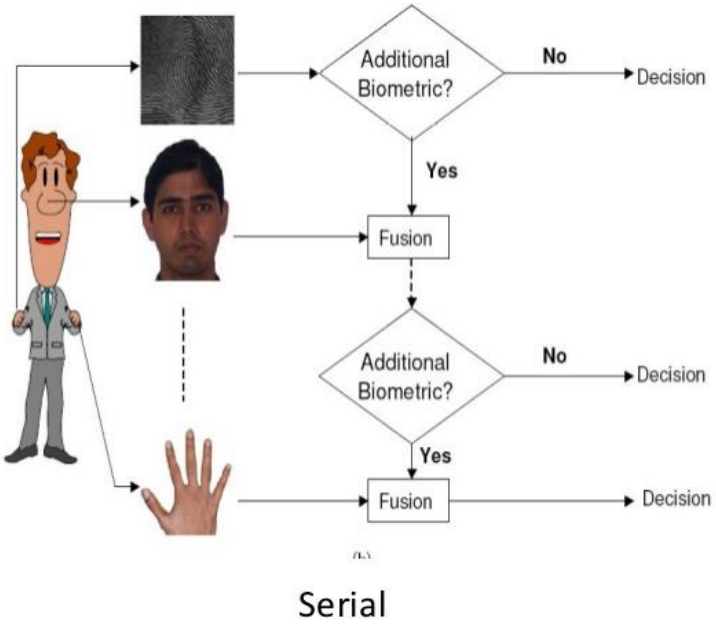

Figure 2 Serial multibiometric fusion

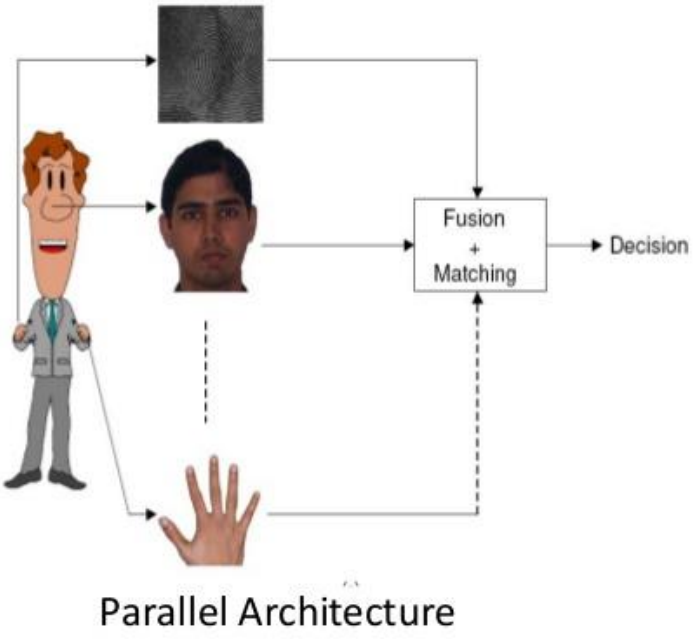

Figure 3 Parallel multibiometric fusion

3.3 Levels of multibiometric fusion

A single biometric process has been shown in Figure 1. While fusing biometrics, the fusion may take place at different levels: decision, score, feature and sample.

3.3.1 Decision level

Single biometric processes output separate binary results and these results are combined using such as an AND or OR algorithm to provide a single decision of match or non-match.

3.3.2 Score level

Single biometric processes output separate scores from separate matching modules and these scores are fused into a single score. The score then is fed into the decision module in order to output a match or non-match decision.

3.3.3 Feature level

Single biometric processes extract separate features for separate samples and these features are fused to create a single feature vector which is further fed into the matching module.

3.3.4 Sample level

Separate samples are combined together to produce a single sample which is then fed into the feature extraction module.

4. Standards

4.1 Record formats

Biometric record formats defined in SC 37/WG 2 are examples of this standards.

4.2 Framework

The BioAPI framework defined in SC 37/WG is an example of this type of standard.

4.3 Application Profile

The SC 37/WG4 project on ILO (International Labour Organization) Seafarer is an example of this type of standard

4.4 Conformance Testing Methodology (CTM)

Conformance Testing (CT) is used to measure if an implementation follows a standard by achieving conformance to the standard's technical description; as such in the area of biometrics CT is utilized for evaluation if a biometric product o system satisfies the requirements of one or more of the standardized biometric data interchange formats. The system being tested is for its conformance is known as an implementation under test (IUT) whereas the data package containing biometric data that claims to be in the form prescribed by a specific biometric data interchange format standard are called Biometric Data Interchange Record (BDIR).

During the last 15 years effort has been given towards standardizing CT methodologies (CTM) to be used in the biometrics application area. Two main outcomes were delivered by INCITS M1 and ISO/IEC JTC 1/SC 37. More specifically the former has defined the following:

- NSI INCITS 423.1: 2008 is a Generalized CTM
- ANSI INCITS 423.2: 2008 is a CTM for ANSI INCITS 378: 2004 – Finger Minutiae Format for Data Interchange
- ANSI INCITS 423.3: 2009 is a CTM for ANSI INCITS 377:2004 – Finger Pattern Data Interchange Format
- ANSI INCITS 423.4: 2009 is a CTM for ANSI INCITS 381-2004 – Finger Image Based Data Interchange Format

All of these standards can be found in the ANSI eStore [1].

Regarding of ISO/IEC the following CTMs have been defined:

- ISO/IEC 29109-1: 2009 Generalized CTM
- ISO/IEC 29109-2: 2010 CTM for Finger Minutiae data format
- ISO/IEC 29109-4: 2010 CTM for Finger Image data format
- ISO/IEC 29109-5: 2012 CTM for Face Image data format
- ISO/IEC 29109-6: 2011 CTM for Iris Image data format
- ISO/IEC 29109-7: 2011 CTM for Signature/Sign Time Series data format
- ISO/IEC 29109-8: 2011 CTM for Finger Pattern Skeletal data format

- ISO/IEC 29109-9: 2011 CTM for Vascular Image data format
- ISO/IEC 29109-10: 2010CTM for Hand Geometry data format

A revision project has led to a “second generation” of ISO/IEC 19794 standards that do not have corresponding ISO/IEC 29109 parts. The CTMs for the “second generation” of ISO/IEC 19794 standards are being specified for each part as an amendment of the base standard. These are:

- ISO/IEC 19794-2: 2011/Amd 1 CTM for Finger minutia data format
- ISO/IEC 19794-5: 2011/Amd 1 CTM for Face image data format
- ISO/IEC 19794-6: 2011/Amd 1 CTM for Iris image data format
- ISO/IEC 19794-8: 2011/Amd 1 CTM for Finger pattern skeletal data format
- ISO/IEC 19794-11: 2013/Amd 1 CTM for Signature/sign processed dynamic data format
- ISO/IEC 19794-13 /Amd 1 CTM for Voice data format
- ISO/IEC 19794-14:2013/Amd 1 CTM for DNA data format
- ISO/IEC 19794-1:2011 / Amd 1: 2013 Generalized CTM
- ISO/IEC 19794-4:2011/Amd 1: 2013 CTM for Finger image data format
- ISO/IEC 19794-9:2011/Amd 1: 2013 CTM for Vascular image data format

All these are accessible in [2].

In the SMILE context, we will follow the ISO/IEC guidelines for implementing a CTM regarding the utilize biometrics such as the face, iris and fingerprints. Further to that we will take into consideration the technical guidelines proposed from the Federal Office Information Security used in Germany [3].

References

[1] American National Standards Institute. (2013). eStandards Store. Website URL: http://webstore.ansi.org/

[2] ISO/IEC JTC 1/SC 37, Biometrics. Website URL: https://www.iso.org/committee/313770/x/catalogue/

[3] BSI TR-03122 Conformance Test Specification for Technical Guideline TR-03121 Biometrics for Public Sector Applications, Website URL: https://www.bsi.bund.de/EN/Publications/TechnicalGuidelines/TR03122/BSITR03122.html