

# Algorithm

Last Updated Tuesday, 02 October 2007

Innovatrics fingerprint recognition algorithm (Overview ) consists of two main parts: extractor and matcher.  
Feature Extractor

Extractor takes as input raw fingerprint image and encodes it in specific fingerprint template. It supports not only images from various fingerprint sensors (optical, capacitive, thermal,...) at different resolutions (250 DPI, 500 DPI,...) but the extractor is also optimized for inked and rolled images used in criminal applications.

The feature extractor was designed to work well with low quality and partial fingerprint images. The quality of fingerprint images can be degraded due to noisy sensor, finger humidity, low/high pressure during acquisition. The algorithm is able to considerably enhance the overall image quality and to fix possible defects in a way that these will not alter recognition process. These advanced image enhancement techniques have direct impact on overall system's accuracy.

Examples of image enhancement

Matcher

Matcher's purpose is to compare two fingerprint templates - matcher doesn't work with fingerprint images but only with resulting templates. Matcher produces similarity score which says whether two fingerprint templates represent the same finger or not.

Verification process - 1:1 comparison

Innovatrics matching algorithm can equally perform a high-speed identification search. Identification can be seen as a generalization of verification, the goal of an identification process is to find a person in a database containing multiple identities (1:N search). The database size can be variable - from a few hundreds to tens of millions templates can be stored in the database depending on the application.

Identification - 1:N search

## Matching speed

Innovatrics matching algorithm performs extremely well in identification tasks due to extraordinary matching speed that can achieve up to 600.000 matchings per second. Furthermore, identification process is fully scalable, for example with 17 PCs we would overpass 10 million matchings per second.

Most importantly, matching algorithm achieves such a high matching speed without considerably degrading recognition accuracy. Please consider the following graph for further details:

Speed / Accuracy graph

\* Tests were performed on a single Pentium IV 3.2 GHz processor PC and fingerprint database with 640x480 500dpi resolution images from Cross Match scanner.

Accuracy

Our matching algorithm uses internally developed search technique called ElasticMatch™; that ensures high accuracy and one of the industry lowest error rates.

This technological leadership was demonstrated at a worldwide fingerprint algorithm competition - FVC2004. At this competition, our original algorithm won one bronze and two gold medals in the Open Category. Our original approach to fingerprint recognition led to accuracy results that clearly distinguished us from other competitors.

Results at FVC2004, DB2

\* source: <http://bias.csr.unibo.it>

The above graph shows ROC curve that plots False Non Match Rate (FNMR) against False Match Rate (FMR) in logarithmic scale. FNMR and FMR rates are used to measure performance of biometric systems. Innovatrics accuracy results correspond to the blue highlighted curve (identifier P039, corresponding to Jan Lunter, the author of the

original algorithm). Curve that is closer to the axes corresponds to lower error rates and higher accuracy.

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#### Overview

Innovatrics owns a state-of-the-art fingerprint recognition algorithm, which has proven to have many unique features.

This algorithm introduces unprecedented speed boost and achieves up to 600.000 matchings per second on a standard single processor PC.

The algorithm's accuracy, top-ranked by Fingerprint Verification Competition 2004 guarantees one of the lowest error rates encountered in the fingerprint recognition industry.

IEngine also supports and accepts minutiae based standards, such as ANSI/INCITS 378-2004 and ISO/IEC SC37/19794-2. This standard support gives our partners the ability to pursue government opportunities. It also guarantees high level of interoperability between different fingerprint scanners.