



VeriFinger

12.3/MegaMatcher 12.3

Algorithm Demo

User's guide

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1 Introduction

VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo application demonstrates the advanced capabilities of Neurotechnology fingerprint recognition engine. The program is a Windows 7/8/10, Linux OS 3.10 kernel (or newer) or Mac OS X application controlled via a pull-down menu system.

The application has three operation modes:

1. Fingerprint **enrollment**. Software processes the fingerprint image, extracts features and writes them to the database.
2. Fingerprint **verification** mode. This mode performs 1:1 fingerprints matching.
3. Fingerprint **identification** mode. This mode performs 1:N fingerprint matching. Using this mode fast or full fingerprints matching can be performed.

Operation can be selected by pressing "Enroll", "Identify" or "Verify" button and providing a fingerprint image.

Neurotechnology fingerprint recognition algorithm demo shows how to considerably decrease the recognition time by stopping the fingerprint matching process when positive matching result is found (successful identification). To turn off this feature go to "Options" dialog (Tools»Options...) and select "Stop on first result".

In the application the database entries are pre-sorted using certain global features. Thereafter, matching is performed first within small part of the database entries having most similar global features to those of the test fingerprint. If matching within this group yields no positive result, then the next group with most similar global features is examined and so on, until the matching is successful or the end of the database is reached (this behavior can be changed by modifying value of "Match at most XXX% of database" in "Options" dialog). In most cases there is fairly good chance that correct match will be found already in the first group. Consequently, the number of comparisons required to achieve positive matching becomes drastically decreased, and correspondingly, the effective matching speed increases. This feature can be used with fast identification mode (in this case G is used).

1.1 System Requirements

The exact system requirements highly depends on the use scenario, some approximate minimal requirements are listed below.

Hardware requirements:

- x86 (32-bit) or x86-64 (64-bit) compatible processors.
 - AVX2 support is highly recommended. Processors that do not support AVX2 will still run the Neurotechnology algorithms, but in a mode, which will not provide the specified performance. Most modern processors support this instruction set, but please check if a particular processor model supports it.
 - The CPU plugin supports inference on Intel® Xeon® with Intel® AVX2 and AVX512, Intel® Core™ Processors with Intel® AVX2, Intel Atom® Processors with Intel® SSE.
- 2 GB of free RAM is recommended for general usage scenarios. It is possible to reduce RAM usage for particular scenarios.
- (Optionally) A webcam or IP camera or any other camera (recommended frame size: 640 x 480 pixels) for face images capturing. Neurotechnology SDK includes support modules for a list of cameras. An IP camera should support RTSP and stream video in H.264 or M-JPEG. Cameras, which can operate in near-infrared spectrum, can be also used for image capture. Any other webcam or camera should provide DirectShow, Windows Media or Media Foundation interfaces for Windows platform, GStreamer interface for Linux and Mac platforms.
- (Optionally) Fingerprint scanner. Neurotechnology SDKs includes support modules for more than 150 models of fingerprint scanners under Microsoft Windows, Linux and Mac OS X platforms. See the list of [supported fingerprint scanners](#).
- (Optionally) Iris scanner (recommended image size: 640 x 480 pixels) for iris image capture. Neurotechnology SDKs includes support modules for several iris cameras. See the list of [supported iris scanners](#).

- (Optionally) Microphone. Any microphone that is supported by the operating system can be used.

Microsoft Windows specific requirements:

- Microsoft Windows 7 / 8 / 10, 32-bit or 64-bit. Note that some fingerprint scanners are supported only on 32-bit OS or only from 32-bit applications.
- Microsoft .NET framework 4.5 or later (for .NET components usage)
- Microsoft Visual Studio 2012 or newer (for application development with C++ / C# / VB .NET)
- Sun Java 1.7 SDK or later (for application development with Java)

Linux specific requirements:

- Linux 3.10 or newer kernel (32-bit or 64-bit) is required. If a fingerprint scanner is required, note that some scanners have only 32-bit support modules and will work only from 32-bit applications.
- glibc 2.17 or newer
- GStreamer 1.10.x or newer with gst-plugin-base and gst-plugin-good is required for face capture using camera/webcam or rtsp video. GStreamer 1.4.x or newer is recommended.
- libgudev-1.0 219 or newer (for camera and/or microphone usage)
- alsa-lib 1.1.6 or newer (for voice capture)
- gcc 4.8 or newer (for application development)
- GNU Make 3.81 or newer (for application development)
- Sun Java 1.8 SDK or newer (for application development with Java)

2 Application

VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo is menu-driven software designed with intention to give the potential user a possibility to test our fingerprint image processing and recognition engine in action. Using Neurotechnology fingerprint recognition algorithm demo application mainly involves running fingerprint enrollment, enrollment with features generalization, verification and identification procedures, described below.

2.1 Windows

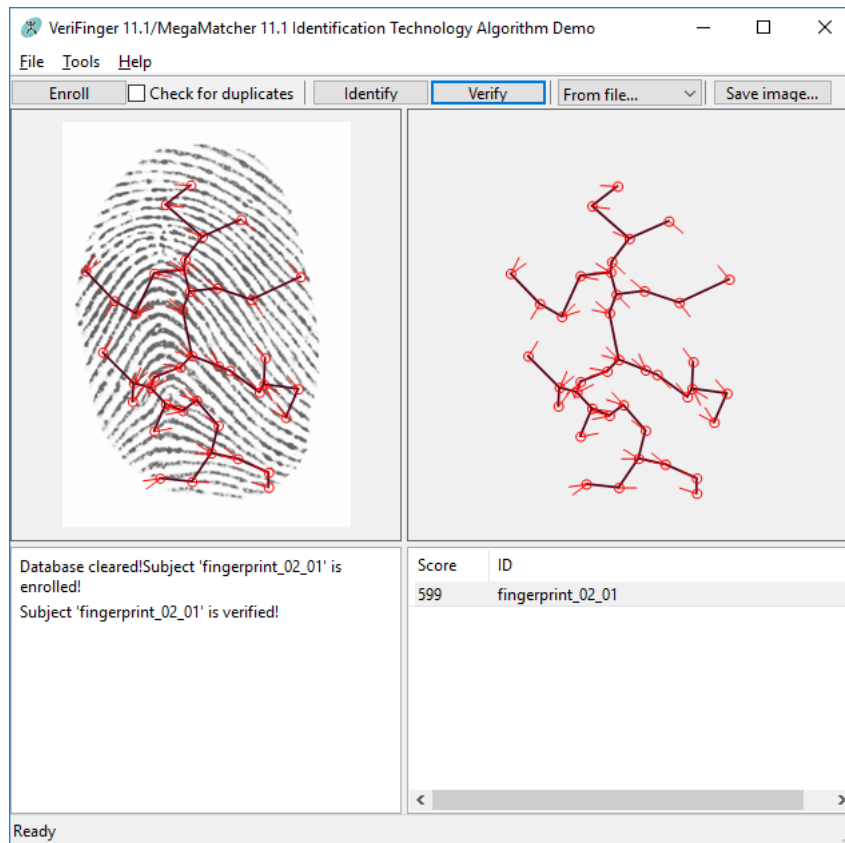
VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo application in Windows OS can be started from `FingersAlgorithmDemo.exe`.

2.1.1 Main Window

The main Neurotechnology fingerprint recognition algorithm demo window contains a menu bar and a toolbar at the top, and four child windows. During fingerprint enrollment, the top right window contains the original fingerprint image, while the top left window contains the same image after the image filtering/processing/feature extraction is shown with features and their directions marked in red by circles and lines. During fingerprint matching, the top left contains the image to be matched, while the top right window contains the image from the database it is being matched against.

In the bottom-left window, enrollment and recognition information (enrolled/recognized file name, fingerprint processing and matching times, number of samples matched, etc.) is displayed. In the bottom right window, individual matching scores between different fingerprints (in identification mode) are displayed.

The VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo application's window:



(The right upper pane shows fingerprint image from database. The upper left pane shows extracted fingerprint features.)

2.1.2 Fingerprint Input

Neurotechnology fingerprint recognition algorithm demo allows reading fingerprints from all [supported scanners](#). Before using scanner please install scanner driver provided in demo drivers directory.

Neurotechnology fingerprint recognition algorithm demo software also allows reading fingerprint images from image files (either *.bmp, *.wsq or *.tif). There is a collection of sample fingerprint images (in *.bmp format) available for download from Neurotechnology web site (<http://www.neurotechnology.com/download.html>).

Fingerprint enrollment

For the fingerprint enrollment demonstration, press "Enroll" button on the toolbar. Then, open file(s) or scan a fingerprint. To stop a long enrollment operation choose "File->Cancel".

Note: When working with a big number of image files file list can be created for later use.

Fingerprint Verification

Press "Verify" button on the toolbar and open two files or scan two images.

Fingerprint Identification

For the fingerprint identification demonstration, press "Identify" button on the toolbar. Then open file(s) or scan an image to identify.

After the identification demo application will output the record names of the most similar fingerprint together with the similarity criterion (to see all matching result deselect "Stop on first result" in Options dialog (☞ see page 5)) and various characteristics of the recognition process.

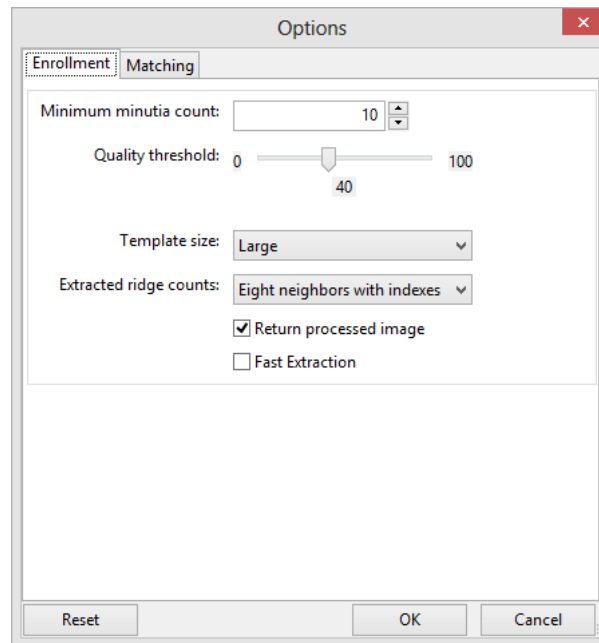
To stop lengthy enrollment or identification operations choose "File->Cancel".

Note: When working with big number of image files the file list can be created for later use.

2.1.3 Options Dialog

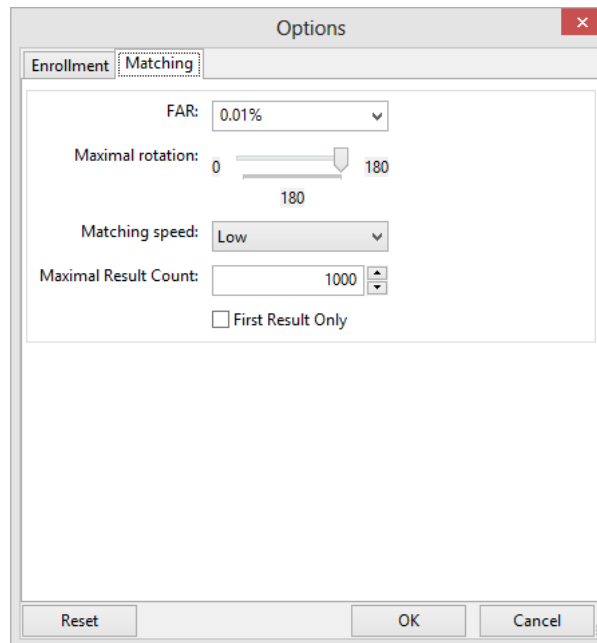
VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo allows to change various parameters of Neurotechnology fingers recognition algorithm. Algorithm parameters can be changed using Options window (*Tools->Options...*).

Enrollment



- *Minimum minutia count* - minimum required minutia count for fingerprint to be enrolled to database.
- *Quality threshold* - controls how strict rules are applied when determining the quality of a fingerprint for extraction.
- *Template size* - size of fingerprint image templates. Can be used Large or Small template. It is recommended to use large template size.
- *Extracted ridge counts* - type of extracted ridges count.
- *Returned processed image* - type of returned image.
- *Fast extraction* – if checked, feature extraction will be performed faster, but with accuracy loss.

Matching



- *FAR* - threshold that separates identical and different fingerprints. Matching threshold is linked to false acceptance rate (FAR, different fingerprints erroneously accepted as of the same) of matching algorithm. The higher is threshold, the lower is FAR and higher FRR (false rejection rate, same fingerprints erroneously accepted as different) and vice a versa.
- *Maximal rotation* - maximal fingerprint's rotation value.
- *Matching speed* - matching speed. Can be chosen Low, Medium or High speed. Default value is *Low*.
- *Maximal results count* – maximum number of matching results returned.
- *First result only* – if checked, only the first positive result will be returned during identification.

2.2 Linux

VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo application on Linux can be started from `FingersAlgorithmDemo` file. There are separate distribution for 32 bits and 64 bits operating system. See Windows (see page 3) part to find out how to use this application.

2.3 Mac OS X

VeriFinger 12.3/MegaMatcher 12.3 Algorithm Demo application on Mac OS can be started from `FingersAlgorithmDemo.app` file. See Windows (see page 3) part to find out how to use this application.

3 Proper Use of a Fingerprint Scanner

General guidelines:

The finger should be put flat on the scanner, finger-pad down on the scanning surface.

Wait for the scanner to react to the finger and give it time to scan it. Do not remove the finger until the scanner gives a specific signal - a beep, a LED flicker, etc.

Do not move your finger or palm while the scanning is in process.

Finger position:

Do not put the finger on the scanner finger-tip down, for then the surface of the finger will not be large enough for a proper scanning to occur. For the same reason, do not put the finger on the scanner side-down. Make sure as much of the scanning surface as possible is covered by your finger-pad.

Do not put the finger upside-down (or make sure that you are holding the scanner the right side down, for that matter). Note, that the algorithm allows options for upside-down fingerprint scanning, although they may affect the FAR (false acceptance rate) or FRR (false rejection rate).

Press the finger down lightly and evenly throughout the capturing process. Use as much pressure needed to hold a piece of paper between your fingers. Pressing too hard or too light may result in an overly dark or light image.

If you are scanning a palm or a number of finger, keep the fingers as close together as possible without them actually touching each other (keep approx. 2-5 mm gaps between finger-pads).

General tips:

It is advisable to have the finger clean and neither wet nor too dry, as it all ruins scanning accuracy.

In case of an automatic fingerprint scanner please remember, that the sensor may not detect the finger when it is placed too softly or too slowly on the scanner.

If the automatic scanner does not react to the finger (LED does not turn on, the scanner does not start blinking, no sound is played, etc. - depending on the scanner model), remove the finger, wait five seconds and try again.

Make sure that the scanner itself is clean before scanning.

It is advisable to have a scan assistant, who would inform the users of how the scanner is properly used and ensure that they follow these instructions and the scanning is successful.

The pictures below depict the correct way of using the fingerprint scanner and the most common mistakes.

The correct way of using the scanner.



The incorrect ways of using the scanner.





4 Support

If you encounter problems while installing or using Neurotechnology Iris Recognition Algorithm Demo application, please contact Neurotechnology (support@neurotechnology.com) or your local distributor.

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