



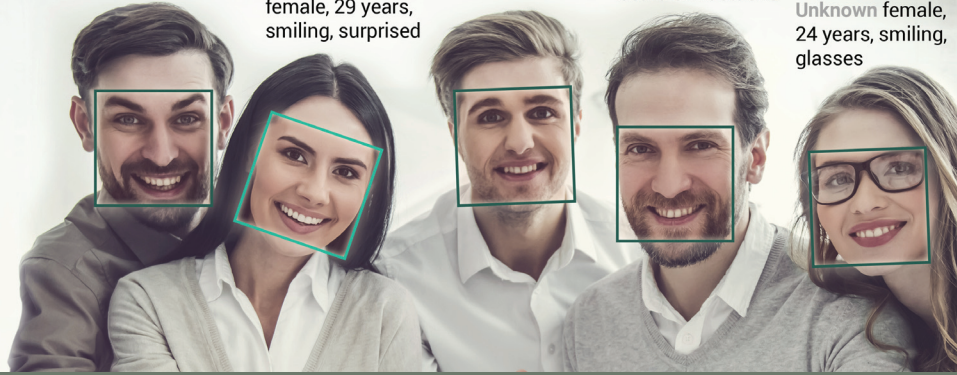
Unknown male,  
27 years,  
beard & mustache,  
happy

**Identified:**  
**Maria Taylor,**  
female, 29 years,  
smiling, surprised

Unknown male,  
24 years, neutral,  
open-mouth

Unknown male,  
32 years, smiling,  
beard & mustache

Unknown female,  
24 years, smiling,  
glasses



Face identification  
for stand-alone or  
Web solutions

**VeriLook SDK**



# VeriLook SDK

## Face identification for stand-alone or Web applications

Document updated on **April 22, 2021**

### CONTENTS

VeriLook algorithm features and capabilities . . . . .	3
Contents of VeriLook Standard SDK and Extended SDK . . . . .	4
Biometric components description. . . . .	5
Supported cameras . . . . .	11
System requirements. . . . .	12
Technical specifications. . . . .	17
Reliability tests. . . . .	19
VeriLook Demo, Trial SDK and related products. . . . .	22
Licensing VeriLook SDK . . . . .	23
Prices for VeriLook products . . . . .	25

VeriLook facial identification technology is designed for biometric systems developers and integrators. The technology assures system performance and reliability with live face detection, simultaneous multiple face recognition and fast face matching in 1-to-1 and 1-to-many modes.

VeriLook is available as a software development kit that allows development of stand-alone and Web-based solutions on Microsoft Windows, Linux, macOS, iOS and Android platforms.

- Millions of algorithm deployments worldwide over the past 17 years.
- Live face detection prevents cheating with a photo in front of a camera.
- Partially occluded faces (i.e. face mask or respirator) can be recognized.
- Simultaneous multiple face processing in live video and still images.
- Gender recognition and facial feature points extraction for each person in an image.
- Near-infrared and visible light spectrum facial images can be matched against each other.
- Webcams or other low cost cameras are suitable for obtaining face images.
- Available as multiplatform SDK that supports multiple programming languages.
- Face Verification SDK is available for developing large-scale high-security apps.
- Reasonable prices, flexible licensing and free customer support.



## VeriLook algorithm features and capabilities

The VeriLook algorithm implements advanced face localization, enrollment and matching using robust digital image processing algorithms, which are based on deep neural networks:

- **Simultaneous multiple face processing.** VeriLook 12.1 performs fast and accurate detection of multiple faces in **live video** streams and still images. All faces on the current frame are detected in **0.01 - 0.86 seconds** depending on selected values for face roll and yaw tolerances, and face detection accuracy. After detection, a set of features is **extracted** from each face into a template in 0.6 seconds. See technical specifications for more details.
- **Partially occluded faces recognition.** Persons wearing protective **facemasks** (i.e. surgical, cloth or respirators) can be recognized **without separate enrollment**.
- **Gender classification.** Optionally, gender can be determined for each person on the image with predefined degree of accuracy during the template extraction.
- **Live face detection.** A conventional face identification system can be tricked by placing a photo in front of the camera. VeriLook is able to prevent this kind of security breach by determining whether a face in a video stream or single frame is "live" or a photograph. See recommendations for live face detection in the chapters below for more details.
- **Emotions recognition.** VeriLook can be configured to recognize emotion type in a human face. Six basic emotions are analyzed: anger, disgust, fear, happiness, sadness and surprise. A confidence value for each of the basic emotions is returned for the face. Larger value for an emotion means that it seems to be more expressed in the face
- **Facial feature points.** The points can be optionally extracted as a set of their coordinates during face template extraction. Each of the **68 points** has a fixed sequence number (i.e. number 31 always corresponds to nose tip).
- **Facial attributes.** VeriLook can be configured to detect certain attributes during the face extraction – **smile, open-mouth, closed-eyes, glasses, dark-glasses, beard and mustache**.
- **Age estimation.** VeriLook can optionally estimate person's age by analyzing the detected face in the image.
- **Face image quality determination.** A quality threshold can be used during face enrollment to ensure that only the best quality face template will be stored into database.
- **Multiple samples of the same face.** Biometric template record can contain multiple face samples belonging to the same person. These samples can be enrolled from different sources and at different times, thus allowing improvement in matching quality. For example, a person might be enrolled with and without beard or mustache, etc.
- **Identification capability.** VeriLook functions can be used in 1-to-1 matching (verification), as well as 1-to-many mode (identification). The VeriLook 12.1 face template matching algorithm can compare up to 40,000 faces per second on a PC. See technical specifications for more details.
- **Features generalization mode.** This mode generates the collection of the generalized face features from several images of the same subject. Then, each face image is processed, features are extracted, and the collections of features are analyzed and combined into a single generalized features collection, which is written to the database. This way, the enrolled feature template is more reliable and the face recognition quality increases considerably.
- **Near-infrared and visible light** spectrum face images can be used for face recognition. VeriLook algorithm is able to match faces, which were captured in near-infrared spectrum, against faces, captured in visible light. See the testing results for details.



## Contents of VeriLook Standard SDK and Extended SDK

VeriLook SDK is based on VeriLook face recognition technology and is intended for biometric systems developers and integrators. The SDK allows rapid development of biometric applications using functions from the VeriLook algorithm that ensure fast and reliable face identification. VeriLook can be easily integrated into the customer's security system. The integrator has complete control over SDK data input and output.

VeriLook SDK includes the Device Manager library that allows to perform **simultaneous capture from multiple cameras**. Integrators can write **plug-ins to support their cameras** or other devices using the plug-in framework provided with the Device Manager.

VeriLook is available as the following SDKs:

- **VeriLook 12.1 Standard SDK** is designed for PC-based, embedded or mobile biometric application development. It includes Face Matcher, Face Extractor and Face Verification component licenses, programming samples and tutorials, Device Manager library and software documentation. The SDK allows the development of biometric applications for Microsoft Windows, Linux, macOS, iOS or Android operating systems.
- **VeriLook 12.1 Extended SDK** is designed for biometric **Web-based** and network application development. It includes all features and components of the Standard SDK. Additionally, the SDK contains Face Client component licenses for PCs and mobile / embedded devices, sample client applications, tutorials and a **ready-to-use matching server** component.

The table below compares VeriLook 12.1 Standard SDK and VeriLook 12.1 Extended SDK. See the licensing model for more information on specific license types.

Component licenses that are included with a specific SDK		
	VeriLook 12.1 Standard SDK	VeriLook 12.1 Extended SDK
• Face Matcher	1 single computer license	1 single computer license
• Mobile Face Matcher	1 single computer license	1 single computer license
• Face Client		3 single computer licenses
• Mobile Face Client		3 single computer licenses
• Face Extractor	1 single computer license	1 single computer license
• Mobile Face Extractor	1 single computer license	1 single computer license
• Matching Server		+

VeriLook 12.1 SDK includes programming samples and tutorials that show how to use the components of the SDK to perform face template extraction or matching against other templates. The samples and tutorials are available for these programming languages and platforms:

Programming samples and tutorials					
	Windows 32 & 64 bit	Linux 32 & 64 bit	macOS	Android	iOS
• C/C++	+	+	+		
• Objective-C					+
• C#	+				
• Java	+	+	+	+	
• Visual Basic .NET	+				



## Biometric Components Description

### Face Matcher

The Face Matcher performs facial template matching in 1-to-1 (verification) and 1-to-many (identification) modes. Also the Face Matcher component includes **fused** matching algorithm that allows to increase template matching reliability by matching templates that contain fingerprint, face, voiceprint and/or iris records (note that matching fingerprint, irises and voiceprints requires to purchase Fingerprint Matcher, Iris Matcher and Voice Matcher components correspondingly - these components are available in *VeriFinger 12.1 SDK*, *VeriEye 12.1 SDK* and *VeriSpeak 12.1 SDK* correspondingly; see these products brochures for more information).

The Face Matcher component matches **40,000 faces per second**.

One Face Matcher license is included with VeriLook 12.1 Standard SDK and VeriLook 12.1 Extended SDK. The license can be used on Microsoft Windows, Linux x86/x86\_64 or macOS platform. More licenses for this component can be purchased any time by VeriLook 12.1 SDK customers.

### Mobile Face Matcher

The Mobile Face Matcher has the same functionality, as the Face Matcher. It matches **3,000 faces per second** and is designed to be used in **embedded** or **mobile** biometric systems, which run on ARM Linux, **Android** or **iOS** devices. The Android devices should be based on at least **Snapdragon S4** system-on-chip (**Krait 300** processor with 4 cores running at 1.51 GHz).

One Mobile Face Matcher license is included with VeriLook 12.1 Standard SDK and VeriLook 12.1 Extended SDK. The license can be used on Android, iOS or ARM Linux platform. More licenses for this component can be purchased any time by VeriLook 12.1 SDK customers.



## Face Client

The Face Client component includes the capabilities of Face Extractor component for face templates creation from facial images. It also provides advanced functionality for gender, age, emotions, face liveness and other attributes detection, checking images for ICAO compliancy, generation of token face images and image formats support based on biometric standards.

The Face Client extracts a single face template in **0.6 seconds**. The specified performance requires a **PC or laptop** with Intel **Core i7-8xxx** family processor or better.

The component can generalize a face template from several images that include the same face to improve the template's quality.

The Face Client component also allows to integrate **JPEG 2000** with Lossy and Lossless Face Profiles support into applications based on VeriLook SDK.

Device Manager software allows to perform simultaneous capture from multiple cameras. Integrators can write plug-ins to support their cameras or other devices using the plug-in framework provided with the Device Manager.

The Face Client component also includes proprietary algorithms, which provide these **advanced functionalities** after facial template extraction:

- Person's gender recognition.
- Emotions detection: confidence values returned for neutral mood, anger, disgust, fear, happiness, sadness and surprise.
- Facial feature points extraction for each person from an image.
- Age estimation for each person from an image.
- Additional face attributes detection: smile, open-mouth, blink (closed-eyes), glasses, dark-glasses, beard and mustache.
- Live face detection can be used for determining whether a face in a video stream belongs to a real human or is a photo. See recommendations for live face detection for more information.

Captured faces can be checked for compliancy with **ICAO** requirements. These requirements are checked:

- image pixelation, washed out colors;
- background uniformity (any background can be replaced with constant automatically);
- face darkness, skin tone, skin reflections, glasses reflections;
- red eyes, looking away eyes (the red eyes can be corrected automatically).





The Face Client component can provide token(1) face images compatible with the Face Image Format as in ISO/IEC 19794 standard. This face image format enables range of applications on variety of devices, including devices that have limited resources required for data storage, and improves recognition accuracy by specifying data format, scene constraints (lighting, pose), photographic properties (positioning, camera focus) and digital image attributes (image resolution, image size). The following features are available:

- Face Token Image creation from an image containing human face using eye coordinates which may be either hand marked or detected automatically using Neurotechnology face detection algorithm.
- Face is detected and eye coordinates are acquired using state-of-the-art Neurotechnology face detection and recognition algorithm.
- Geometrical face image normalization according to the proportions and photographic properties, which are specified in ISO/IEC 19794 standard.
- Intelligent image padding algorithm for cutting off parts of Face Token Image as specified in ISO/IEC 19794 standard.
- Evaluation of the created token face image for the following quality criteria suggested in ISO/IEC 19794 standard:
  - Background uniformity – the background in the token face image should be uniform, not cluttered.
  - Sharpness – the token face image should not be blurred.
  - Too light or too dark images – the token face image should not be too dark or too light.
  - Exposure range of an image – the token face image should have a reasonable exposure range to represent as much details of the subject in the image as possible.
- Evaluation of the token face image quality based on suggestions of ISO/IEC 19794 standard (using the quality criteria above)

*Note: Token in this context is used as “symbolic image, good enough image for machine recognition.” Token Image as in ISO/IEC19794-5: “A Face Image Type that specifies frontal images with a specific geometric size and eye positioning based on the width and height of the image. This image type is suitable for minimizing the storage requirements for computer face recognition tasks such as verification while still offering vendor independence and human verification (versus human examination which requires more detail) capabilities.”*



The Face Client component allows to integrate support for facial image format standards with new or existing biometric systems based on VeriLook SDK. These biometric standards are supported:

- **BioAPI 2.0 (ISO/IEC 19784-1:2006)** (Framework and Biometric Service Provider for Face Identification Engine)
- **CBEFF V1.2 (ANSI INCITS 398-2008)** (Common Biometric Exchange Formats Framework)
- **CBEFF V2.0 (ISO/IEC 19785-1:2006 with Amd. 1:2010, 19785-3:2007 with Amd. 1:2010)** (Common Biometric Exchange Formats Framework)
- **CBEFF V3.0 (ISO/IEC 19785-3:2015)** (Common Biometric Exchange Formats Framework)
- **ISO/IEC 19794-5:2005** (Biometric Data Interchange Formats - Face Image Data)
- **ISO/IEC 19794-5:2011** (Biometric Data Interchange Formats - Face Image Data)
- **ANSI/INCITS 385-2004** (Face Recognition Format for Data Interchange)
- **ANSI/NIST-CSL 1-1993** (Data Format for the Interchange of Fingerprint, Facial, & SMT Information)
- **ANSI/NIST-ITL 1a-1997** (Data Format for the Interchange of Fingerprint, Facial, & SMT Information)
- **ANSI/NIST-ITL 1-2000** (Data Format for the Interchange of Fingerprint, Facial, & SMT Information)
- **ANSI/NIST-ITL 1-2007** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)
- **ANSI/NIST-ITL 1a-2009** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)
- **ANSI/NIST-ITL 1a-2011** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)
- **ANSI/NIST-ITL 1a-2011 Update:2013 Edition 2** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)
- **ANSI/NIST-ITL 1a-2011 Update:2015** (Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information)

All functionalities of the Face Client component can be used from **C/C++**, **C#** and **Java** applications on all supported platforms. **.NET** wrappers of Windows libraries are provided for **.NET** developers.

Three licenses for the Face Client component are included with VeriLook 12.1 Extended SDK. The licenses can be used on Microsoft Windows, Linux x86/x86\_64 or macOS platform. More licenses for this component can be purchased any time by VeriLook 12.1 Extended SDK customers.

## Mobile Face Client

The Mobile Face Client component has the same functionality as the Face Client and is designed to run on **Android** or **iOS** or ARM Linux devices. The Android devices should be based on at least **Snapdragon S4** system-on-chip (**Krait 300** processor with 4 cores running at 1.51 GHz). The component extracts a single face template in **1.34 seconds**.

Three licenses for the Mobile Face Client component are included with VeriLook 12.1 Extended SDK. The licenses can be used on Android, iOS or ARM Linux platform. More licenses for this component can be purchased any time by VeriLook 12.1 Extended SDK customers.





## Face Extractor

Face Extractor creates face templates from face images. The Extractor can generalize a face template from several images that include the same face to improve the template's quality.

Device Manager software allows to perform **simultaneous capture from multiple cameras**. Integrators can write **plug-ins to support their cameras** or other devices using the plug-in framework provided with the Device Manager.

The component extracts a single face template in **1.34 seconds**. The specified performance requires a **PC or laptop** with Intel **Core i7-8xxx** family processor or better.

One Face Extractor license is included with VeriLook 12.1 Standard SDK and VeriLook 12.1 Extended SDK. The license can be used on Microsoft Windows, Linux x86/x86\_64 or macOS platform. More licenses for this component can be purchased any time by VeriLook 12.1 SDK customers.

## Mobile Face Extractor

The Embedded Face Extractor has the same functionality as the Face Extractor and is designed to be run on Android or iOS or ARM Linux devices. The Android devices should be based on at least Snapdragon S4 system-on-chip (Krait 300 processor with 4 cores running at 1.51 GHz). The component extracts a single face template in 1.34 seconds.

One Mobile Face Extractor license is included with VeriLook 12.1 Standard SDK and VeriLook 12.1 Extended SDK. The license can be used on Android, iOS or ARM Linux platform. More licenses for this component can be purchased any time by VeriLook 12.1 SDK customers.



## Matching Server

The Matching Server is ready-to-use software intended for building moderate size web-based and other network-based systems like local single- or multi-biometric identification system. The Server software runs on a server PC and allows to perform the biometric template matching on server side using Face Matcher component.

**Fused multi-biometric matching** can be enabled by running components for fingerprint, face and iris matching on the same machine.

**Client communication module** that allows sending a task to the Matching Server, querying status of the task, getting the results and removing the task from server, is included with MegaMatcher 12.1 SDK, VeriFinger 12.1 SDK, VeriLook 12.1 SDK, VeriSpeak 12.1 SDK and VeriEye 12.1 SDK. This module hides all low level communications and provides high-level API for the developer.

The components and database support modules with source codes included for Matching Server component are listed in the table below. Custom modules for working with other databases can also be developed by integrator and used with the Matching Server software.

The table below shows what components are available with Matching Server software.

Components	Microsoft Windows 32 & 64 bit	Linux 32 & 64 bit	macOS
• Matching server software	+	+	+
• Server administration tool API	+	+	
<b>Database support modules</b>			
• Microsoft SQL Server	+		
• PostgreSQL	+	+	
• MySQL	+	+	
• Oracle	+	+	
• SQLite	+	+	+
<b>Programming samples</b>			
• C# client	+		
• Visual Basic .NET client	+		
• Java web client	+	+	+
<b>Programming tutorials</b>			
• C/C++	+	+	
• C#	+		
• Visual Basic .NET	+		

The Matching Server component requires a **special license** that allows to run the component on all machines that run the fingerprint, face, iris or palm print matching components obtained by an integrator. The Matching Server software is included with VeriLook 12.1 Extended SDK.

Also the Matching Server component is included with these Neurotechnology SDKs (see their brochures for more info):

- MegaMatcher 12.1 Standard or MegaMatcher 12.1 Extended SDK;
- VeriFinger 12.1 Extended SDK;
- VeriEye 12.1 Extended SDK.
- VeriSpeak 12.1 Extended SDK.



## Supported Cameras

These cameras are supported by VeriLook SDK:

- Any **webcam** or camera that is accessible using:
  - **DirectShow**, **Windows Media** or **Media Foundation** interfaces for Microsoft Windows platform.
  - **GStreamer** interface for Linux or Mac platforms.
- Any built-in **smartphone** or **tablet** camera that is supported by iOS or Android OS. The camera should have at least 0.3 MegaPixel (640 x 480 pixels) resolution.
- Any **IP camera**, that supports **RTSP** (Real Time Streaming Protocol):
  - Only **RTP over UDP** is supported.
  - **VLC** framework can be optionally used for reading video streams.
  - **H.264/MPEG-4 AVC** or **Motion JPEG** should be used for encoding the video stream.
- These advanced cameras are supported:
  - Akiyama Akys-10 Biometric Camera
  - CMITech EMX-30 – face & iris camera (Microsoft Windows only)
  - Iris ID iCAM R100 and iCAM TD100 – face & iris cameras (Microsoft Windows only)
  - VistaFA2 / VistaFA2E / VistaEY2 face & iris cameras (Microsoft Windows only)
- These models of **still cameras** are supported:
  - Canon EOS family still cameras (Microsoft Windows only; the supported camera models are EOS M50, EOS 2000D, EOS 4000D, EOS M100, EOS 6D Mark II, EOS 200D, EOS 77D, EOS 800D, EOS M6, EOS M5, EOS 5D Mark IV, EOS-1D X Mark II, EOS 80D, EOS 1300D, EOS M10, EOS 5DS, EOS 5DS R, EOS 760D, EOS 750D, EOS 7D Mark II)
  - Nikon DSLR still cameras (Microsoft Windows only; a specific camera model should support video capture)
  - Fujifilm X-T2 still camera (Microsoft Windows only)
- Cameras, which can operate in **near-infrared** spectrum, can be used for image capture. VeriLook algorithm is able to match faces, captured in near-infrared spectrum, against faces, captured in visible light. See the VeriLook algorithm testing results for details.
- Integrators can also write **plug-ins to support their cameras** using the plug-in framework provided with the Device Manager from the VeriLook SDK.

A **video file** can be also used as a data source for face capture on VeriLook based application.



## System requirements

There are specific requirements for each platform which will run VeriLook-based applications.

### Microsoft Windows platform requirements

- Microsoft Windows 7 / 8 / 10.
- PC or laptop with **x86-64 (64-bit)** compatible processors.
  - 2 GHz or better processor is recommended.
  - x86 (32-bit) processors can still be used, but the algorithm will not provide the specified performance.
  - **AVX2 support is highly recommended.** Processors that do not support AVX2 will still run the VeriLook 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.
- **at least 2 GB of free RAM is recommended** for general usage scenarios. It is possible to reduce RAM usage for particular scenarios.
- A **camera** or **webcam**. See the previous chapter for more details.
- **Database engine** or connection with it. VeriLook templates can be saved into any DB (including files) supporting binary data saving. VeriLook Extended SDK contains the following support modules for Matching Server on Microsoft Windows platform: **Microsoft SQL Server, MySQL, Oracle, PostgreSQL** and **SQLite**.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriLook Extended SDK). VeriLook SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- Microsoft **.NET framework 4.5** or newer (for .NET components usage).
- One of following **development environments** for application development:
  - Microsoft Visual Studio 2012 or newer (for application development under C/C++, C#, Visual Basic .Net)
  - Java SE JDK 8 or newer.



## Android platform requirements

- A smartphone or tablet that is running **Android 5.0 (API level 21)** OS or newer.
  - If you have a custom Android-based device or development board, contact us to find out if it is supported.
- ARM-based **1.5 GHz processor recommended** for face processing in the specified time. Slower processors may be also used, but the face processing will take longer time.
- At least **1 GB of free RAM** should be available for the application. Additional RAM is required for applications that perform 1-to-many identification, as all biometric templates need to be stored in RAM for matching.
- Any smartphone's or tablet's **built-in camera** which is supported by Android OS. The camera should have at least 0.3 MegaPixel (640 x 480 pixels) resolution.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriLook Extended SDK). VeriLook SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- **PC-side development** environment requirements:
  - Java SE JDK 8 (or higher)
  - AndroidStudio 4.0 IDE
  - AndroidSDK 21+ API level
  - Gradle 6.1.1 build automation system or newer
  - Android Gradle Plugin 4.0.0
  - Internet connection for activating VeriLook component licenses

## iOS platform requirements

- One of the following devices, running **iOS 11.0** or newer:
  - **iPhone 5S** or newer iPhone.
  - **iPad Air** or newer iPad models.
- At least **1 GB of free RAM** should be available for the application. Additional RAM is required for applications that perform 1-to-many identification, as all biometric templates need to be stored in RAM for matching.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriLook Extended SDK). VeriLook SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- **Development environment** requirements:
  - a Mac running macOS 10.12.6 or newer.
  - Xcode 9.x or newer.



## macOS platform requirements

- A Mac running **macOS 10.12.6** or newer.
  - 2 GHz or better processor is recommended.
  - **AVX2 support is highly recommended.** Processors that do not support AVX2 will still run the VeriLook 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.
- **at least 2 GB of free RAM is recommended** for general usage scenarios. It is possible to reduce RAM usage for particular scenarios.
- A **camera or webcam**. See the previous chapter for more details.
- **Database engine** or connection with it. VeriLook templates can be saved into any DB (including files) supporting binary data saving. VeriLook Extended SDK contains **SQLite** support modules for Matching Server on macOS platform.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriLook Extended SDK). VeriLook SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- Specific requirements for **application development**:
  - XCode 6.x 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.
  - GNU Make 3.81 or newer (to build samples and tutorials development)
  - Java SE JDK 8 or newer.





## Linux x86 / x86-64 platform requirements

- **Linux 3.10 kernel** or newer is required.
- PC or laptop with **x86-64 (64-bit)** compatible processors.
  - 2 GHz or better processor is recommended.
  - x86 (32-bit) processors can still be used, but the algorithm will not provide the specified performance.
  - **AVX2 support is highly recommended.** Processors that do not support AVX2 will still run the VeriLook 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.
- **at least 2 GB of free RAM is recommended** for general usage scenarios. It is possible to reduce RAM usage for particular scenarios.
- A **camera** or **webcam**. See the previous chapter for more details.
- glibc 2.17 library 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.
- **Database engine** or connection with it. VeriLook templates can be saved into any DB (including files) supporting binary data saving. VeriLook Extended SDK contains **MySQL, Oracle, PostgreSQL** and **SQLite** support modules for Matching Server on Linux x86 / x86-64 platforms.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriLook Extended SDK). VeriLook SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- Specific requirements for **application development**:
  - gcc 4.8 or newer
  - GNU Make 3.81 or newer
  - Java SE 8 JDK or newer.



## ARM Linux platform requirements

We recommend to contact us and report the specifications of a target device to find out if it will be suitable for running VeriLook-based applications.

There is a list of common requirements for ARM Linux platform:

- A device with ARM-based processor, running **Linux 3.2 kernel** or newer.
- ARM-based **1.5 GHz processor recommended** for face processing in the specified time. .
  - **ARMHF architecture (EABI 32-bit hard-float ARMv7)** is required.
  - Lower clock-rate processors may be also used, but the face processing will take longer time
- At least **1 GB of free RAM** should be available for the application. Additional RAM is required for applications that perform 1-to-many identification, as all biometric templates need to be stored in RAM for matching.
- A **camera or webcam**. See the previous chapter for more details.
- glibc 2.17 library 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.
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching server component (included in VeriLook Extended SDK). VeriLook SDK does not provide communication encryption with the Matching server, therefore, integrators should secure the communication by themselves.
- **Development environment** requirements:
  - gcc 4.8 or newer
  - GNU Make 3.81 or newer
  - Java SE 8 JDK or newer.



## Technical Specifications

- General recommendations for facial recognition:
  - Face recognition accuracy of the VeriLook algorithm heavily depends on the quality of a face image. Image quality during enrollment is important, as it influences the quality of the face template.
  - 32 pixels is the recommended minimal distance between eyes for a face on image or video stream to perform face template extraction reliably. 64 pixels or more recommended for better face recognition results. Note that this distance should be native, not achieved by resizing an image.
  - Several images during enrollment are recommended for better facial template quality which results in improvement of recognition quality and reliability.
  - Additional enrollments may be needed when facial hair style changes, especially when beard or mustache is grown or shaved off.
  - Persons wearing face masks or respirators can be recognized without separate enrollment. Face quality check should be disabled for this scenario.
- The face recognition engine has certain tolerance to face posture:
  - head roll (tilt) –  $\pm 180$  degrees (configurable);  $\pm 15$  degrees default value is the fastest setting which is usually sufficient for most near-frontal face images.
  - head pitch (nod) –  $\pm 15$  degrees from frontal position. The head pitch tolerance can be increased up to  $\pm 25$  degrees if several views of the same face that covered different pitch angles were used during enrollment.
  - head yaw (bobble) –  $\pm 90$  degrees from frontal position (default value). Smaller yaw tolerance values are not recommended to be used except if the target system does not meet the system requirements. Several views of the same face can be enrolled to the database to cover the whole  $\pm 90$  degrees yaw range from frontal position.
- Face liveness check:
  - A stream of consecutive images (usually a video stream from a camera) or a single image (in some modes) is required for the live face detection.
  - When the liveness check is enabled, it is performed by the face engine before feature extraction. If the face in the stream or frame fails to qualify as “live”, the features are not extracted.
  - Only one face should be visible in these frames.
  - Users can enable these liveness check modes:
    - Active – the engine requests the user to perform certain actions like blinking or moving one’s head. All requested actions should be performed to pass the liveness check. This mode can work with both colored and grayscale images. 5 frames per second or better frame rate required.
    - Passive – the engine analyzes certain facial features while the user stays still in front of the camera for a short period of time. Colored images are required for this mode. 10 frames per second or better frame rate is required. Better score is achieved when users do not move at all.
    - Passive then active – the engine first tries the passive liveness check, and if it fails, tries the active check. This mode requires colored images.
    - Simple – the engine requires user to turn head from side to side while looking at camera. This mode can work with both colored and grayscale images. 5 frames per second or better frame rate recommended.
    - Single frame passive – the engine uses a neural network to estimate if a face image is not inserted in front of a camera using a paper photo or smartphone screen. This mode does not need any interaction from the user.



VeriLook 12.1 face detection algorithm can run in maximal speed or maximal accuracy modes. The face detection times in the table below are provided for 640 x 480 pixels images as ranges, where the smallest time corresponds to the **maximal speed** mode, and the largest time – to the **maximal accuracy**. The head pitch tolerance in the table below is always  $\pm 15^\circ$ . The head yaw tolerance in the table below is always  $\pm 90^\circ$ .

VeriLook 12.1 face detection algorithm performance for all faces in a frame on PC-based systems (milliseconds)	
Roll tolerance	Intel Core i7-8xxx
$\pm 15^\circ$	37
$\pm 45^\circ$	38
$\pm 180^\circ$	56

VeriLook biometric template extraction and matching algorithm is designed to run on **multi-core processors** allowing to reach maximum possible performance on the used hardware. Face template extraction is performed after all faces are detected in a frame. The template extraction time does not depend on image size.

VeriLook 12.1 face engine specifications				
	Android-based platform <sup>(1)</sup>		PC-based platform <sup>(2)</sup>	
	Mobile Face Extractor	Mobile Face Client	Face Extractor	Face Client
Template extraction components				
Template extraction time (seconds)	1.34	1.20	1.34	0.60
Template matching components	Mobile Face Matcher		Face Matcher	
Template matching speed (faces per second)	3,000		40,000	
Single face record size in a template (bytes)	194 or 322 (configurable)			

(1) Requires to be run on Android devices based on at least Snapdragon S4 system-on-chip with Krait 300 processor (4 cores, 1.51 GHz).

(2) Requires to be run on PC or laptop with Intel Core i7-8xxx family processor or better to reach the specified performance.



## Reliability Tests

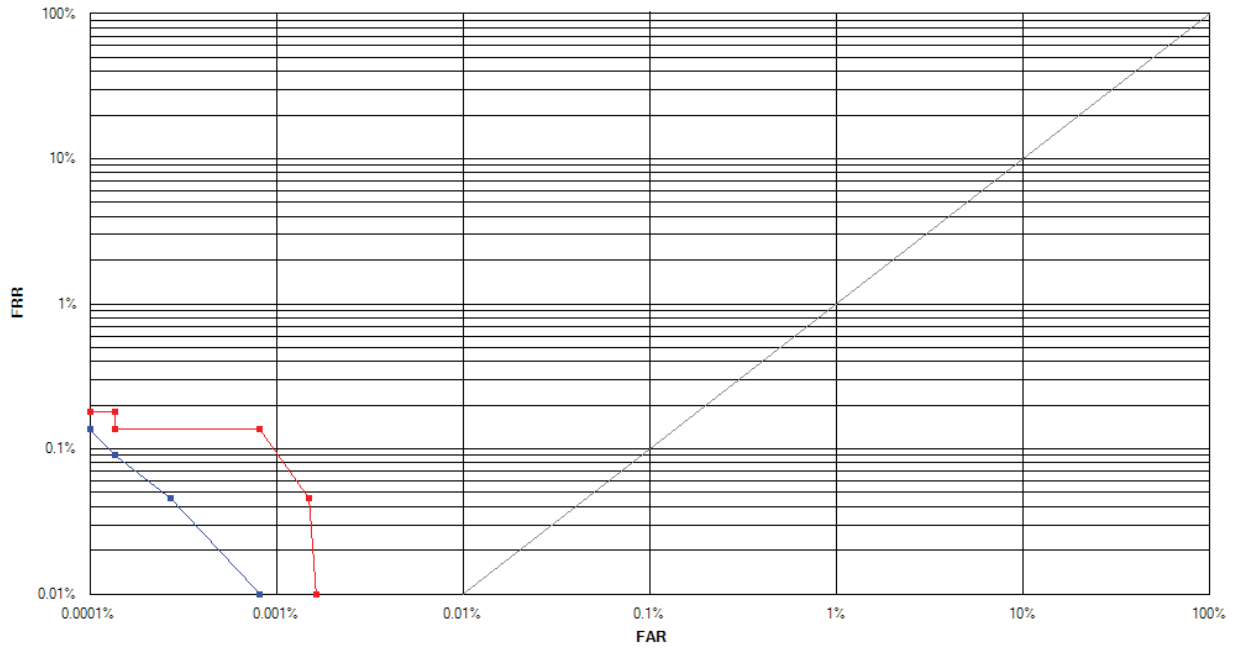
We present the testing results to show the VeriLook 12.1 algorithm template matching reliability evaluations. The following **public datasets** were used:

- NIST Special Database 32 - Multiple Encounter Dataset (MEDS-II). - <https://www.nist.gov/itl/iad/ig/sd32.cfm>
  - All full-profile face images from the dataset were removed because they are not supported by VeriLook SDK. This resulted in 1,216 images of 518 persons.
- University of Massachusetts Labeled Faces in the Wild (LFW). - <https://vis-www.cs.umass.edu/lfw/>
  - According to the original protocol, only 6,000 pairs (3,000 genuine and 3,000 impostor) should be used to report the results. But recent algorithms are “very close to the maximum achievable by a perfect classifier” [[http://people.cs.umass.edu/~elm/papers/LFW\\_survey.pdf](http://people.cs.umass.edu/~elm/papers/LFW_survey.pdf)]. Instead, as Neurotechnology algorithms were not trained on any image from this dataset, verification results on matching each pair of all 13,233 face images of 5,729 persons were chosen to be reported.
  - All identity mistakes, which had been mentioned on the LFW website, were fixed. Also, several not mentioned issues were fixed.
  - Some images from the LFW dataset contained multiple faces. The correct faces for assigned identities were chosen manually to solve these ambiguities.
- CASIA NIR-VIS 2.0 Database. - <https://www.cbsr.ia.ac.cn/english/NIR-VIS-2.0-Database.html>
  - The dataset contains face images, which were captured in visible light (VIS) and near-infrared (NIR) spectrums. According to the original protocol, VeriLook algorithm testing used VIS images as gallery, and NIR images as probe.
  - According to the original protocol, the dataset is split into two parts – View1 intended for algorithm development and View2 for performance evaluation. Neurotechnology algorithms were not trained on any image from this dataset. Only View2 part with 12,393 NIR images and 2,564 VIS images was used for face verification evaluation.
  - The non-cropped images (640 x 480 pixels) from the dataset were used for VeriLook algorithm testing.

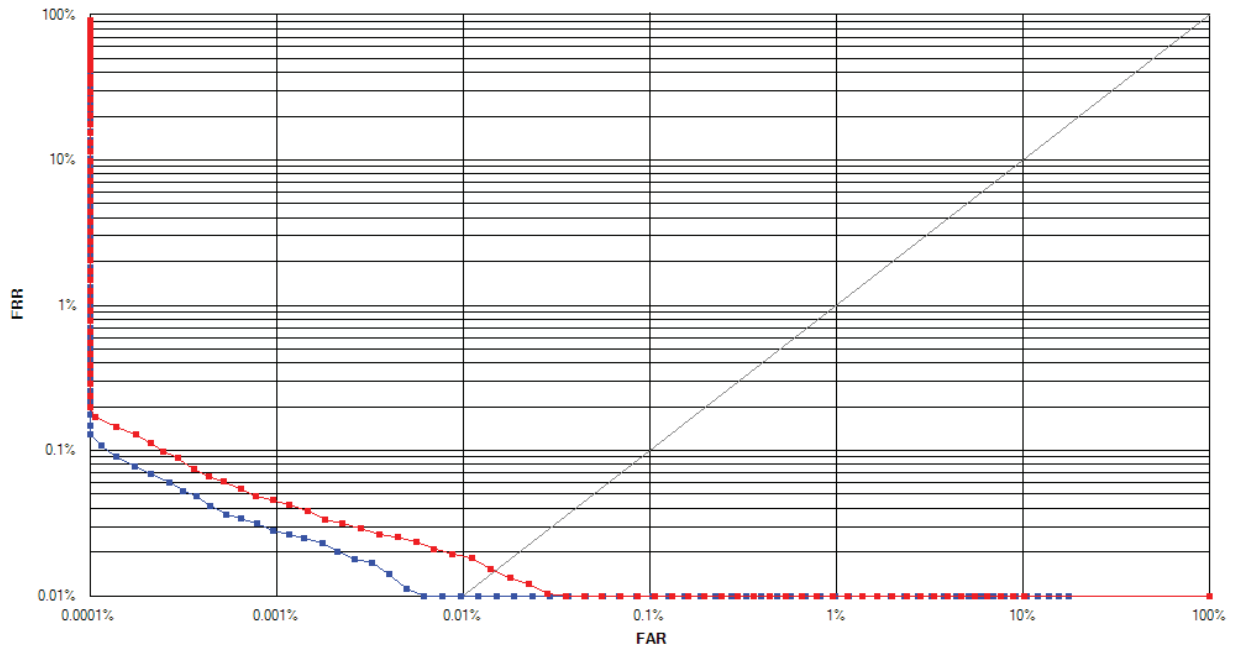
Two experiments were performed with each dataset:

- **Experiment 1** maximized **matching accuracy**. VeriLook 12.1 algorithm reliability in this test is shown on the ROC charts as **blue** curves.
- **Experiment 2** maximized **matching speed**. VeriLook 12.1 algorithm reliability in this test is shown on the ROC charts as **red** curves.

Receiver operation characteristic (**ROC**) curves are usually used to demonstrate the recognition quality of an algorithm. ROC curves show the dependence of false rejection rate (**FRR**) on the false acceptance rate (**FAR**). Equal error rate (**EER**) is the rate at which both FAR and FRR are equal. The ROC charts and the testing results are available on the next pages.

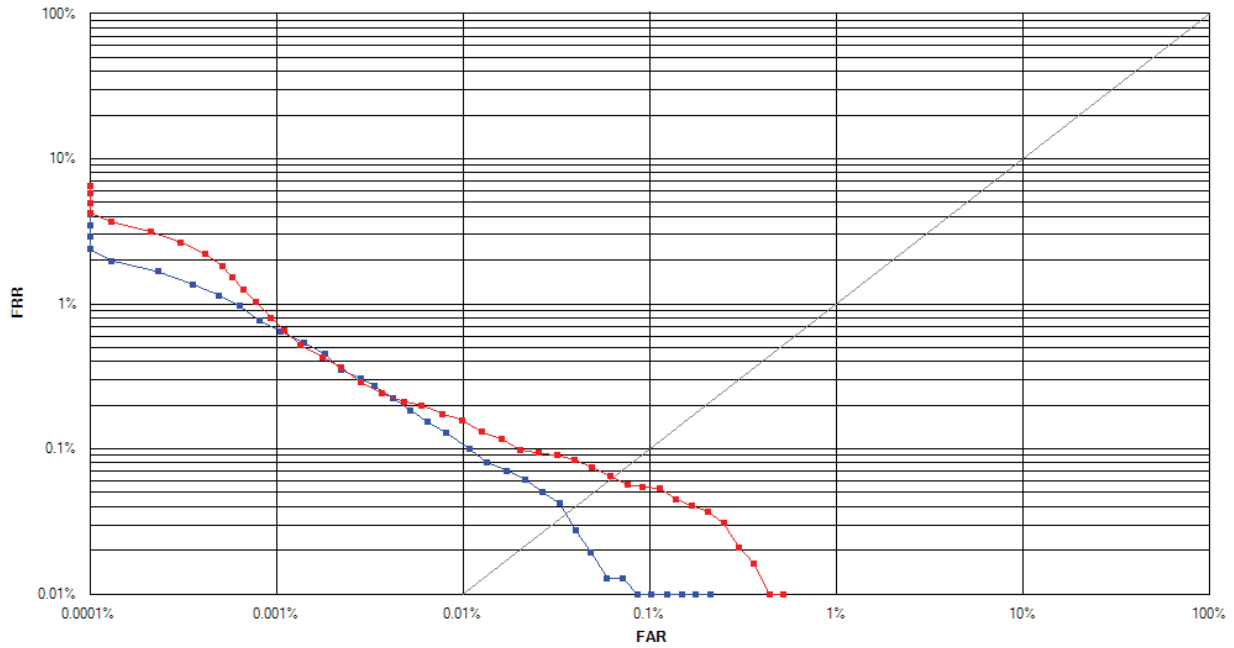


VeriLook 12.1 SDK matching engine with face templates from NIST Multiple Encounter Dataset (MEDS-II):  
 ■ Experiment 1, maximized matching accuracy scenario  
 ■ Experiment 2, maximized matching speed scenario



VeriLook 12.1 SDK matching engine with face templates from the University of Massachusetts Labeled Faces in the Wild (LFW) dataset:  
 ■ Experiment 1, maximized matching accuracy scenario  
 ■ Experiment 2, maximized matching speed scenario





VeriLook 12.1 SDK matching engine with face templates from the CASIA NIR-VIS 2.0 dataset (captured in visible light and near-infrared spectrums):  
 ■ Experiment 1, maximized matching accuracy scenario  
 ■ Experiment 2, maximized matching speed scenario

VeriLook 12.1 algorithm testing results with face images from public datasets						
	MEDS-II		LFW		NIR-VIS 2.0	
	Exp. 1	Exp. 2	Exp. 1	Exp. 2	Exp. 1	Exp. 2
Image count	1216		13233		14957	
Subject count	518		5729		725	
Session count	1 - 18		1 - 530		4	
Image size (pixels)	variable		250 x 250		480 x 640	
Template size (bytes)	322	322	322	322	322	322
EER	0.0228 %	0.0234 %	0.0080 %	0.0147 %	0.0375 %	0.0629 %
FRR at 0.1 % FAR	0.0000 %	0.0000 %	0.0029 %	0.0041 %	0.0081 %	0.0549 %
FRR at 0.01 % FAR	0.0000 %	0.0000 %	0.0078 %	0.0194 %	0.1291 %	0.1581 %
FRR at 0.001 % FAR	0.0000 %	0.1361 %	0.0281 %	0.0454 %	0.7649 %	0.8020 %



## VeriLook Demo, Trial SDK and Related Products

VeriLook **algorithm demo** application and VeriLook **30-day SDK Trial** are available for downloading at [www.neurotechnology.com/download.html](http://www.neurotechnology.com/download.html).

These products are related to VeriLook SDK (see the corresponding product brochure for more information):

- **Face Verification SDK** – for developing of lightweight high-security applications, designed for large-scale deployment.
- **SentiVeillance Server** – ready-to-use software for easy integration of biometric face identification and person tracking into **video management systems (VMS)**.
- **SentiVeillance SDK** – allows to create software for performing biometric face identification and pedestrian or vehicle or other object motion tracking using live video streams from high-resolution **digital surveillance cameras**. SentiVeillance component is capable of performing **automatic multiple face tracking, enrollment and matching** against database.
- **SentiMask SDK** – 3D face tracking for augmented reality apps and digital characters control.
- **MegaMatcher SDK** – for development of AFIS or multi-biometric face, fingerprint, iris, voiceprint and palm print identification products.
- **MegaMatcher On Card SDK** – a product for fingerprint, iris and face matching on smart cards.
- **NCheck Bio Attendance** – an end-user employee attendance management application designed as **ready-to-use time and attendance system** with biometric face, fingerprint and iris identification; VeriLook facial recognition algorithm is used in the application for checking person identity.



## Licensing VeriLook SDK

### Product Development

An integrator should obtain either a VeriLook 12.1 Standard SDK (EUR 339) or VeriLook 12.1 Extended SDK (EUR 859) to develop a end-user product based on VeriLook technology. The SDK needs to be purchased just once and may be used for all projects and by all the developers within the integrator's company.

See the "Contents of VeriLook Standard SDK and Extended SDK" chapter (page 4) for the list of component licenses included with VeriLook 12.1 Standard and VeriLook 12.1 Extended SDK.

Integrators can obtain additional component licenses if more component licenses are required for the development process.

### Product Deployment

To deploy their developed products, an integrator need obtain licenses of components for every **computer or device**, where component will be installed together with integrator's product. See Product Advisor to find out what specific components will be needed for the deployment of your system. Integrators can purchase additional VeriLook component licenses if required at anytime.

### License activation options

The components are copy-protected. The following license activation options are available:

- **Serial numbers** are used to activate licenses for particular VeriLook components on particular computer or device. The activation is done via the Internet or by email. After activation the network connection is not required for single computer license usage.
 

Notes:

  1. Activation by serial number is **not suitable for ARM-Linux** platform, except BeagleBone Black and Raspberry Pi 3 devices..
  2. Activation by serial number is **not suitable for virtual environments**.
- **Internet activation.** A special **license file** is stored on a computer or a mobile or embedded device; the license file allows to run particular VeriLook components on that computer or device after **checking** the license over the Internet. **Internet connection** should be available periodically for a short amount of time. A single computer license can be **transferred** to another computer or device by moving the license file there and waiting until the previous activation expires.
- **Volume License Manager.** Licenses may be stored in a volume license manager **dongle**. License activation using volume license manager may be performed without connection to the Internet and is suitable for virtual environments. Volume license manager is **used on site by integrators or end users** to manage licenses for VeriLook components in the following ways:
  1. **Activating single computer licenses** – An installation license for a VeriLook component will be activated for use on a particular computer. The number of available licenses in the license manager will be decreased by the number of activated licenses. .
  2. **Managing single computer licenses via a LAN or the Internet** – The license manager allows the management of installation licenses for VeriLook components across multiple computers or mobile/embedded devices in a LAN or over the Internet. The number of managed licenses is limited by the number of licenses in the license manager. No license activation is required and the license quantity is not decreased. Once issued, the license is assigned to a specific computer or device on the network.
  3. **Using license manager as a dongle** – A volume license manager containing at least one license for a VeriLook component may be used as a dongle, allowing the VeriLook component to run on the particular computer where the dongle is attached.



## Licenses Validity

All SDK and component licenses are perpetual and do not have expiration. There are no annual fee or any other fees except license purchasing fee. It is possible to move licenses from one computer or device to another. Neurotechnology provides a way to renew the license if the computer undergoes changes due to technical maintenance.

## Licensing Agreement

The Licensing Agreement ([https://neurotechnology.com/mm\\_120\\_sla.html](https://neurotechnology.com/mm_120_sla.html)) contains all licensing terms and conditions.

Note that you unambiguously accept this agreement by placing an order using Neurotechnology online ordering service or by email or other means of communications. Please read the agreement before making an order.

## Other licensing options

- **VAR License.** The above described licensing model is intended for **end-user** product developers. Integrators who want to develop and sell a VeriLook-based development tool (with API, programming possibilities, programming samples, etc.), must obtain permission from Neurotechnology and **sign** a special VAR agreement. For more information please contact us.
- **Enterprise License.** The VeriLook enterprise license allows an **unlimited use** of VeriLook components in end-user products for a specific territory, market segment or project. Specific restrictions would be included in the licensing agreement. The enterprise license price depends on the application size and the number of potential users of the application within the designated territory, market segment or project. For more information please contact us.



## Prices for VeriLook products

- The prices are **effective September 29, 2020**. The prices may change in the future, so please **download and review the latest version** of the brochure before making an order.
- Quantity discounts do not accumulate over time, prices do not include local import duties or taxes.
- Customers with Solution Partner status are eligible for product discounts.

VeriLook SDK	
VeriLook 12.1 Standard SDK	€ 339.00
VeriLook 12.1 Extended SDK	€ 859.00

Face components for PCs (prices per single computer license)			
Quantity	Face Client <sup>(1)</sup>	Face Extractor	Face Matcher
1 - 9	€ 60.00	€ 20.00	€ 25.00
10 - 19	€ 44.00	€ 15.00	€ 18.00
20 - 49	€ 39.00	€ 13.00	€ 16.00
50 - 99	€ 34.00	€ 11.00	€ 14.00
100 - 199	€ 30.00	€ 10.00	€ 12.50
200 - 499	€ 27.00	€ 9.00	€ 11.00
500 - 999	€ 24.00	€ 8.00	€ 10.00
1000 - 1999	€ 21.00	€ 7.00	€ 9.00
2000 and more	Please contact us for more information		

Face components for Android, iOS and ARM Linux (prices per single computer license)			
Quantity	Mobile Face Client <sup>(1)</sup>	Mobile Face Extractor	Mobile Face Matcher
1 - 9	€ 27.00	€ 9.00	€ 11.00
10 - 19	€ 20.00	€ 6.50	€ 8.00
20 - 49	€ 18.00	€ 5.80	€ 7.10
50 - 99	€ 15.00	€ 5.10	€ 6.20
100 - 199	€ 13.50	€ 4.60	€ 5.60
200 - 499	€ 12.00	€ 4.10	€ 5.00
500 - 999	€ 10.50	€ 3.60	€ 4.40
1000 - 1999	€ 9.50	€ 3.20	€ 3.90
2000 and more	Please contact us for more information		

License management	
Volume license manager	€ 16.00

(1) These components are not available for VeriLook Standard SDK customers.

VeriLook products can be ordered:

- online, at [www.neurotechnology.com/cgi-bin/order.cgi](http://www.neurotechnology.com/cgi-bin/order.cgi)
- via a local Neurotechnology distributor; the list of distributors is available at [www.neurotechnology.com/distributors.html](http://www.neurotechnology.com/distributors.html)