



NEUROtechnology



Iris identification
for PC and
Web solutions

VeriEye SDK



VeriEye SDK

Iris identification for PC and Web solutions

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VeriEye iris identification technology is intended for biometric systems developers and integrators. The technology includes many proprietary solutions that enable robust eye iris enrollment under various conditions and fast iris matching in 1-to-1 and 1-to-many modes.

VeriEye is available as a software development kit that allows development of PC- and Web-based solutions on Microsoft Windows, Linux and Mac OS X platforms.

- Rapid and accurate iris identification, proven by NIST IREX.
- Robust recognition, even with gazing-away eyes or narrowed eyelids.
- Original proprietary algorithm solves the limitations and drawbacks of existing state-of-the-art algorithms.
- Available as multiplatform SDK that supports multiple programming languages.
- Reasonable prices, flexible licensing and free customer support.



VeriEye Algorithm Features and Capabilities

All performance tests were made on a PC with Intel Core 2 processor running at 2.66 GHz.

Neurotechnology began research and development in the field of eye iris biometrics in 1994. In 2008, Neurotechnology released **VeriEye iris recognition algorithm**. The next year VeriEye was **recognized by NIST** as one of the most reliably accurate iris recognition algorithms.

The proprietary algorithm implements advanced iris segmentation, enrollment and matching using robust digital image processing algorithms:

- **Robust eye iris detection.** Irises are detected even when the images have obstructions, visual noise and different levels of illumination. Lighting reflections, eyelids and eyelashes obstructions are eliminated. Images with narrowed eyelids or eyes that are gazing away are also accepted.
- **Automatic interlacing detection and correction.** The correction results in maximum quality of iris features templates from moving iris images.
- **Gazing-away eyes.** A gazing-away iris image is correctly detected, segmented and transformed as if it were looking directly into the camera (see Figure 1).
- **Correct iris segmentation** is achieved under these conditions:
 - **Perfect circles fail.** VeriEye uses active shape models that more precisely model the contours of the eye, as iris boundaries are not modeled by perfect circles.
 - **The centers of the iris inner and outer boundaries are different** (see Figure 2). The iris inner boundary and its center are marked in red, the iris outer boundary and its center are marked in green.
 - **Iris boundaries are definitely not circles and even not ellipses** (see Figure 3) and especially in gazing-away iris images.
 - **Iris boundaries seem to be perfect circles.** The recognition quality can still be improved if boundaries are found more precisely (see Figure 4). Note these slight imperfections when compared to perfect circular white contours.
- **Fast matching.** Configurable matching speed varies from 60,000 to **800,000 comparisons per second**. See technical specifications for more details.
- **Reliability.** VeriEye 2.3 algorithm shows excellent performance when tested on all publicly available datasets. Especially good results are achieved on the recent **NIST ICE2005 Exp1** database with iris images of intentionally degraded quality (see *Reliability and Performance Tests Results* section).

Figure 1

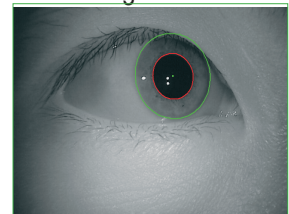


Figure 2

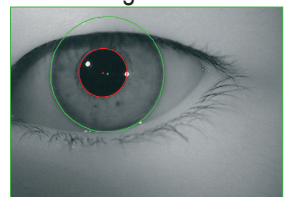


Figure 3

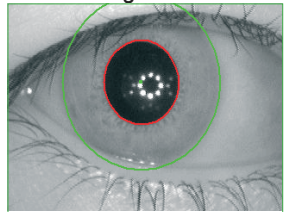
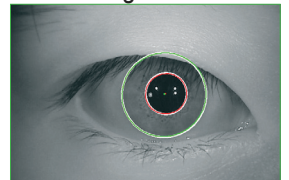


Figure 4



All iris images are taken from CASIA Iris Image Database V2.0 and CASIA Iris Image Database V3.0 collected by the Chinese Academy of Sciences Institute of Automation (CASIA) (<http://www.cbsr.ia.ac.cn/english/IrisDatabases.asp>).



Contents of VeriEye 2.3 Standard SDK and Extended SDK

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

VeriEye is available as the following SDKs:

- **VeriEye 2.3 Standard SDK** is intended for PC-based biometric application development. It includes Iris Matcher and Extractor component licenses, programming samples and tutorials, eye iris scanner support modules and software documentation. The SDK allows the development of biometric applications for Microsoft Windows, Linux or Mac OS X operating systems.
- **VeriEye 2.3 Extended SDK** is intended for biometric **web-based** and network application development. It includes all features and components of the Standard SDK. Additionally, the SDK contains Iris Client component licenses, sample client applications, tutorials and a **ready-to-use matching server** component.

The table below compares VeriEye 2.3 Standard SDK and VeriEye 2.3 Extended SDK.

	VeriEye 2.3 Standard SDK	VeriEye 2.3 Extended SDK
Component licenses that are included with a specific SDK		
• Iris Extractor	1 license	1 license
• Iris Client		3 licenses and 1 concurrent license
• Iris Matcher	1 license	1 license
• Matching Server		+
Additional component licenses that can be purchased by specific SDK customers		
• Iris Extractor	+	+
• Iris BSS		+
• Iris Client		+
• Iris Matcher	+	+

VeriEye 2.3 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:

	Micorsoft Windows 32 & 64 bit	Linux 32 & 64 bit	Mac OS X
Programming samples			
• C/C++	+	+	+
• C#	+		
• Sun Java 2	+		
• Visual Basic .NET	+		
• Delphi	+		
Programming tutorials			
• C	+	+	+
• C#	+		
• Visual Basic .NET	+		
• Delphi	+		



Biometric Components Description

Iris Extractor

Iris Extractor creates iris templates from eye images.

See “technical specifications” section for the template extraction speed, the size of iris template and the requirements for image size, illumination and camera resolution.

One Iris Extractor license is included with VeriEye 2.3 Standard SDK and VeriEye 2.3 Extended SDK. More licenses for this component can be purchased any time by VeriEye 2.3 SDK customers.

Iris BSS (Biometric Standards Support)

The Iris BSS (Biometric Standards Support) component allows to integrate support for eye iris image format standards and additional image formats with new or existing biometric systems based on VeriEye SDK.

These biometric standards are supported:

- **BioAPI 2.0** (ISO/IEC 19784-1:2006) (Framework and Biometric Service Provider for iris identification engine)
- **ISO/IEC 19794-6:2005** (Iris Image Data)
- **ANSI/INCITS 379-2004** (Iris Image Interchange Format)

Iris BSS component also allows to integrate **JPEG 2000** image format support into applications based on the VeriEye SDK.

Licenses for the Iris BSS component can be purchased anytime by VeriEye 2.3 Extended SDK customers.

Iris Client

The Iris Client component is a combination of the Iris Extractor and Iris BSS components. It is intended for the systems that need to support all functionality of the mentioned components on the same PC. Using these licenses allows to optimize component license costs as well as reduce license management.

Three non-concurrent licenses and one concurrent license for the Iris Client component are included with VeriEye 2.3 Extended SDK. More non-concurrent and concurrent licenses for this component can be purchased any time by VeriEye 2.3 Extended SDK customers.

Iris Matcher

The Iris Matcher performs eye iris template matching in 1-to-1 (verification) and 1-to-many (identification) modes. Also the Iris Matcher component includes fused matching algorithm that allows to increase template matching reliability by:

- matching templates that contain 2 iris records;
- matching templates that contain fingerprint, face and/or iris records (note that matching fingerprints and faces requires Fingerprint Matcher and Face Matcher components correspondingly - see *VeriFinger SDK* and *VeriLook SDK* brochures for more information);

“Technical specifications” and “reliability and performance tests” sections contain information about the template matching speeds and recognition quality in different scenarios.

One Iris Matcher license is included with VeriEye 2.3 Standard SDK and VeriEye 2.3 Extended SDK. More licenses for this component can be purchased any time by VeriEye 2.3 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 Iris 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 4.0 SDK, VeriFinger 6.3 SDK, VeriLook 5.0 SDK and VeriEye 2.3 SDK. This module hides all low level communications and provides high-level API for the developer.

Source code of **sample web server software** is included with the Matching Server. The web server software accepts biometric templates from a web client application, sends them to Matching Server for matching and returns matching results to the client application. The web server is stand-alone and does not require any third-party web server software (like Apache or Microsoft IIS).

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	Mac OS X
• Matching server software	+	+	+
• Server administration tool API	+	+	
• Source code of sample web server software	+		
Database support modules			
• Microsoft SQL Server	+		
• PostgreSQL	+	+	
• MySQL	+	+	
• Oracle	+	+	
• SQLite	+	+	+
Programming samples			
• C# client	+		
• Sun Java 2 web client	+		
Programming tutorials			
• C/C++	+	+	
• C#	+		

The Matching Server component requires a special one-time 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 VeriEye 2.3 Extended SDK.

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

- MegaMatcher 4.0 Standard or MegaMatcher 4.0 Extended SDK;
- VeriFinger 6.3 Extended SDK;
- VeriLook 5.0 Extended SDK.



Supported Iris Cameras

The table below explains which iris scanners are supported under different versions of Microsoft Windows.

	Microsoft Windows XP		Microsoft Windows Vista		Microsoft Windows 7	
	32 bit	64 bit	32 bit	64 bit	32 bit	64 bit
• Cross Match I Scan 2	+		+			
• IrisGuard IG-AD100	+		+		+	
• VistaFA2 / VistaFA2E iris & face cameras	+	+	+	+	+	+
• VistaMT Multimodal Biometric Device	+	+	+	+	+	+



System Requirements

- **PC with x86 (32bit) or x86-64 (64bit) compatible processors or Mac with x86 or PowerPC compatible processors.** 2GHz or better processor is recommended.
- **At least 128 MB 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. For example, **50,000 templates** (each containing 2 iris records) require about **230 MB of additional RAM**.
- **Free space on hard disk drive (HDD):**
 - at least 1 GB required for the development.
 - 100 MB required for VeriEye components deployment.
 - Additional space would be required in these cases:
 - VeriEye does not require the original eye iris image to be stored for the matching; only the templates need to be stored. However, storing eye iris images on hard drive for the potential future usage is recommended.
 - Usually a database engine runs on a separate computer (back-end server). However, DB engine can be installed on the same computer for standalone applications. In this case HDD space for templates storage must be available. For example, 50,000 templates (each containing 2 iris records) stored using a relational database would require about 280 MB of free HDD space. Also, the database engine itself requires HDD space for running. Please refer to HDD space requirements from the database engine providers.
- **Eye iris scanner.** VeriEye SDK includes support modules for several scanners under Microsoft Windows platform. See previous section for the list of supported iris scanners.
- **Database engine** or connection with it. VeriEye templates can be saved into any DB (including files) supporting binary data saving. VeriEye Extended SDK contains the following support modules for Matching Server:
 - Microsoft SQL Server (only for Microsoft Windows platform);
 - PostgreSQL (Microsoft Windows and Linux platform);
 - MySQL (for Microsoft Windows and Linux platforms);
 - Oracle (for Microsoft Windows and Linux platforms);
 - SQLite (for all platforms).
- **Network/LAN connection (TCP/IP)** for client/server applications. Also, network connection is required for using Matching Server component (included in VeriEye Extended SDK). Communication with Matching Server is not encrypted therefore, if communication must be secured, a dedicated network (not accessible outside the system) or a secured network (such as VPN; VPN must be configured using operating system or third party tools) is recommended.



- **Microsoft Windows specific requirements:**

- Microsoft Windows 2000/XP/2003/2008/Vista/7, 32-bit or 64-bit. 32-bit platform is recommended for applications with iris scanners, as most scanners have only 32-bit support modules.
- Microsoft .NET framework 2.0 or newer (for .NET components usage).
- One of following development environments for application development:
 - Microsoft Visual Studio 2005 SP1 or newer (for development under C/C++, C#, Visual Basic .Net);
 - Sun Java 1.5 SDK or later;
 - Microsoft Visual Basic 6;
 - Delphi 7.

- **Linux specific requirements:**

- Linux 2.6 or newer kernel, 32-bit or 64-bit.
- glibc 2.3.6 or newer.
- GTK+ 2.10.x or newer libs and dev packages (to run SDK samples and applications based on them).
- GCC-4.0.x or newer (for application development).
- GNU Make 3.81 or newer (for application development).
- Sun Java 1.5 SDK or later (for application development with Java).
- pkg-config-0.21 or newer (optional; only for Matching Server database support modules compilation).

- **Mac OS X specific requirements:**

- Mac OS X (version 10.4 or newer).
- XCode 2.4 or newer (for application development).



Technical Specifications

All specifications are given for Intel Core2 processor with 4 cores running at 2.66 GHz.

All iris templates should be loaded into RAM before identification, thus the maximum iris template database size is limited by the amount of available RAM.

VeriEye iris template matching algorithm can use more than one processor core on **multi-core processors** allowing to increase template matching speed. The template matching speeds in the table below are given as a range, where the smaller number means matching speed using **1 processor core**, while the larger number means matching speed using all **4 processor cores**.

VeriEye 2.3 algorithm technical specifications		
	Maximized matching accuracy	Maximized matching speed
Minimal radius of circle containing full iris texture	64 pixels	
Recommended iris image capture spectral region	Near-infrared	
Iris template extraction time (for 640 x 480 pixels iris images)	0.13 - 0.17 seconds	
Matching speed ($\pm 15^\circ$ iris rotation tolerance; Irises per second)	60,000 - 240,000	200,000 - 800,000
Matching speed ($\pm 30^\circ$ iris rotation tolerance; Irises per second)	36,000 - 144,000	120,000 - 480,000
Template size	2,328 bytes	



Reliability and Performance Tests Results

All tests were performed on Intel Core2 processor with 4 cores running at 2.66 GHz.

We present the testing results to show how VeriEye 2.3 technical specifications correspond the practical algorithm's performance and reliability evaluations. Iris images from several **standard databases** were used for testing, thus the testing results can be compared with testing results of other algorithms. All databases contained iris images with 640 x 480 pixels size.

Iris image databases used for VeriEye 2.3 algorithm testing			
Database name	Images quantity	Persons quantity	Unique eye quantity
ICE2005 Exp1 iris image database (Right Iris)	1,425	124	124
University of Notre Dame, ND-IRIS-0405	64,980	356	712
University of Bath, IRISDB1600 ⁽¹⁾	24,361	624	1,231

(1) The full IRISDB1600 database contains 31,997 images (image size 1280x960 pixels), representing 799 unique persons and 1,598 unique irises. A subset used in this test was preprocessed similar to NIST IREX experiments (www.nist.gov/itl/iad/ig/irexi.cfm):

- (a) Images were downsampled to 640x480 via 2x2 neighborhood averaging.
- (b) All images containing irises with diameters larger than 340 pixels were removed.

Two tests were performed with each database:

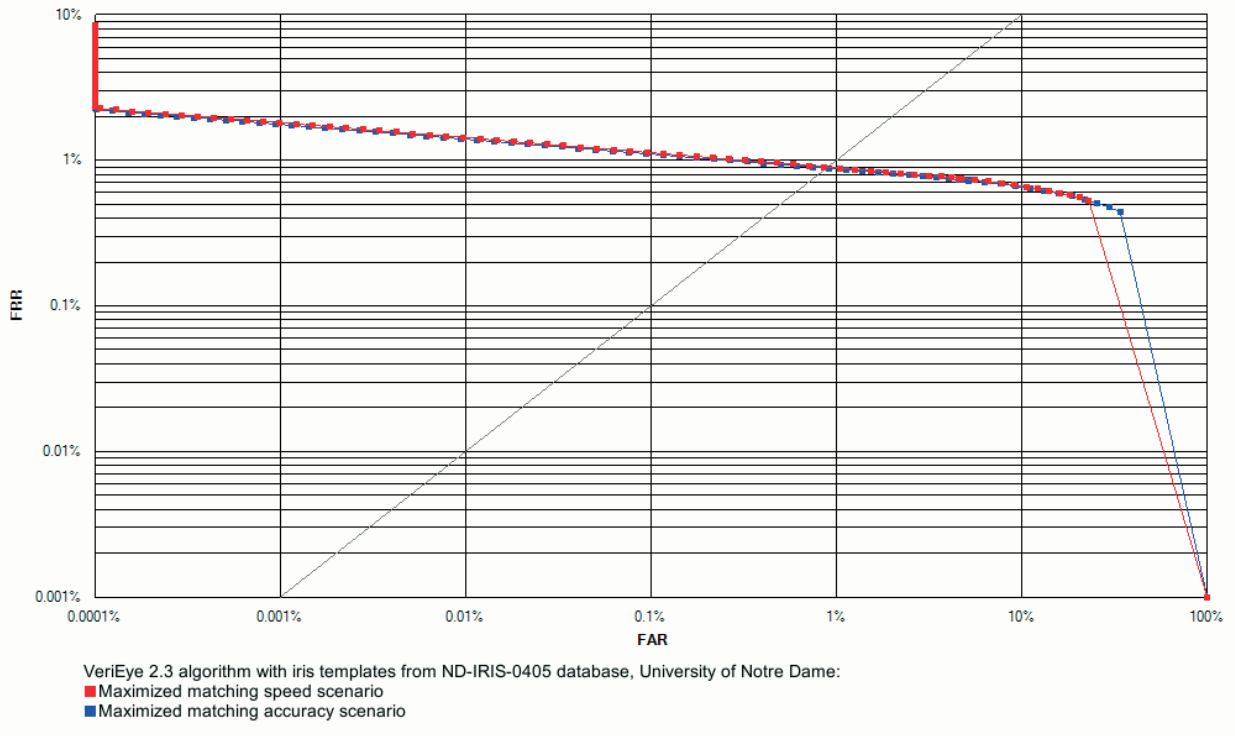
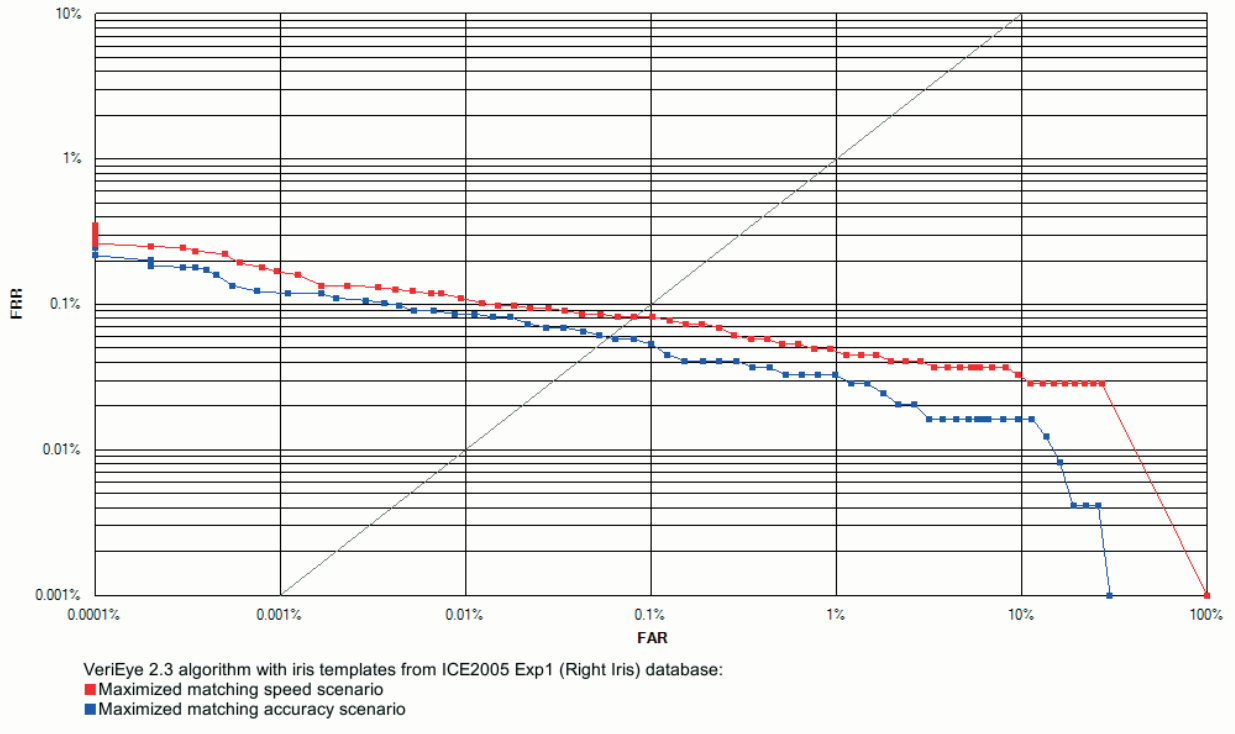
- **Test 1** maximized **matching accuracy**. VeriEye 2.3 algorithm reliability in this test is shown as **blue curves** on the ROC charts.
- **Test 2** maximized **matching speed**. VeriEye 2.3 algorithm reliability in this test is shown as **red curves** on the ROC charts.

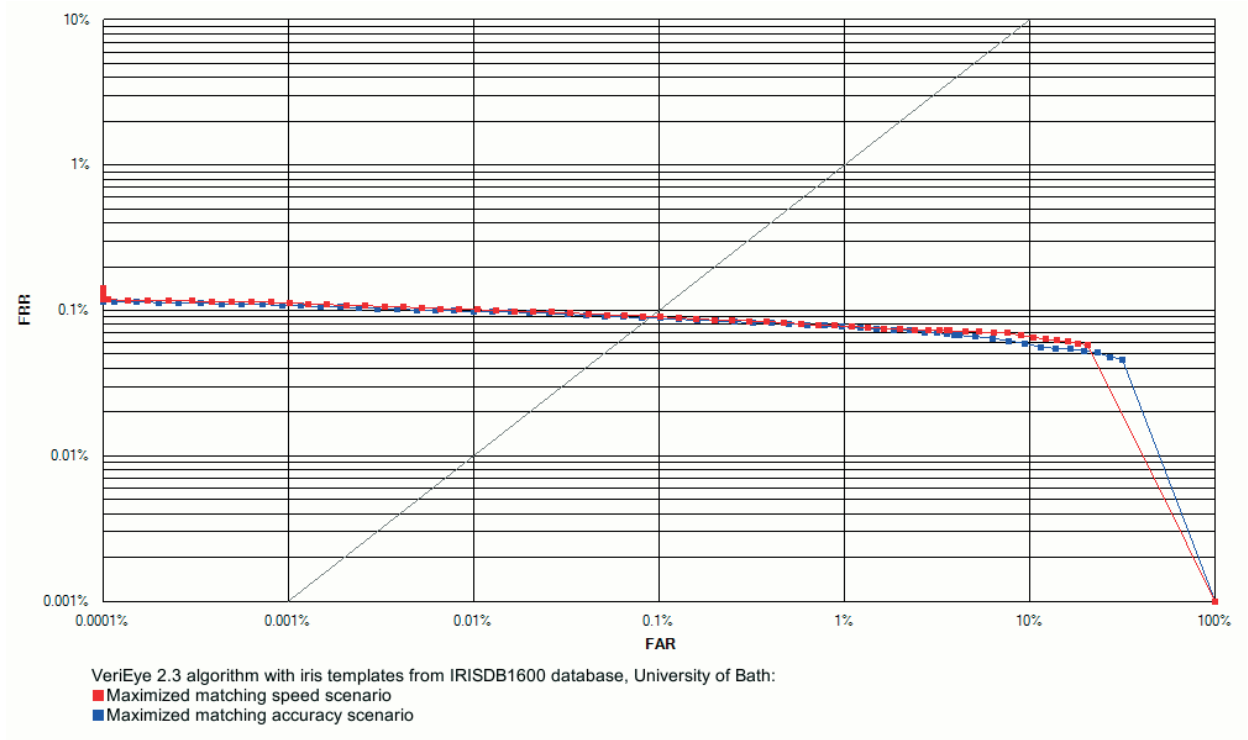
The iris rotation tolerance was set to $\pm 15^\circ$ in all tests.

Template matching was performed using **all 4 cores** of the processor.

VeriEye 2.3 algorithm testing results				
		ICE2005 Exp1	ND-IRIS-0405	Bath IRISDB1600
Average template extraction speed (milliseconds)		138	139	138
Template matching speed (irises per second)	Test 1	273028	278556	281012
	Test 2	788540	788528	835268
FRR at 0.001 % FAR	Test 1	0.123 %	1.774 %	0.109 %
	Test 2	0.168 %	1.810 %	0.114 %

Receiver operation characteristics (**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**).







VeriEye Demo, Trial SDK and Related Products

VeriEye **algorithm demo** application and VeriEye **30-day SDK Trial** are available for downloading at www.neurotechnology.com/download.html.

These products are related to VeriEye SDK:

- **MegaMatcher SDK** – intended for development of AFIS or multi-biometric iris, fingerprint and face identification products. See “MegaMatcher SDK” brochure for more information.
- **MegaMatcher Accelerator 3.0** – a solution for building the server-side part of a large-scale multi-biometric system; available in Standard and Extended versions; a single MegaMatcher Accelerator Standard matches **50 million irises per second** and Extended matches **200 million irises per second**. See “MegaMatcher Accelerator” brochure for more information.



Licensing VeriEye SDK

To develop a product based on VeriEye 2.3 technology, an integrator should obtain VeriEye 2.3 Standard SDK (EUR 589) or VeriEye 2.3 Extended SDK (EUR 1399).

Integrators can develop only an end-user product using VeriEye SDK and sell/install the product to their own customers. If the integrator wants to develop and sell a VeriEye based development tool (with API, programming possibilities, programming samples, etc.), he/she will need a permission from Neurotechnology and shall sign a special VAR agreement.

To deploy the product that was developed with VeriEye 2.3 SDK, the integrator should obtain only additional VeriEye 2.3 component licenses for product installations. Also the additional VeriEye 2.3 component licenses may be required during development of the product. The additional VeriEye 2.3 component licenses can be obtained by VeriEye 2.3 SDK customers at any time.

The table below lists the components of VeriEye 2.3 SDK and shows the availability of the additional component licenses for the customers of VeriEye 2.3 Standard SDK and VeriEye 2.3 Extended SDK:

	VeriEye 2.3 Standard SDK	VeriEye 2.3 Extended SDK
• Iris Extractor	+	+
• Iris BSS		+
• Iris Client		+
• Iris Matcher	+	+

A license for a VeriEye component is required for each PC or each server CPU that runs this component. The following license types are available:

- Single computer license.
- Concurrent network license.
- Enterprise license.

VeriEye 2.3 Standard SDK includes:

- 1 Iris Extractor license.
- 1 Iris Matcher license.

VeriEye 2.3 Extended SDK includes:

- 1 Iris Extractor license.
- 3 Iris Client licenses.
- 1 Iris Client concurrent license.
- 1 Iris Matcher license.
- Matching Server license.

Please also refer to MegaMacher 4.0, VeriFinger 6.3, VeriLook 5.0, VeriEye 2.3 SDK License Agreement on Neurotechnology web site for all licensing terms and conditions.



Single computer license

A single computer license allows to install and run a VeriEye 2.3 component installation on a single Personal Computer or on one Server CPU. The component license will not be lost if computer will be reinstalled.

The following license management options are available:

- license activation online by communicating with Neurotechnology's server;
- license activation by email;
- license activation using volume license manager;
- license management using volume license manager on LAN or Internet.

Single computer license activated over Internet or by email is not suitable for virtual environments. Volume license manager used as a dongle or license management over network would be required.

Concurrent network licenses

Iris Client concurrent license allows to install Iris Client component on an unlimited number of computers. An application should obtain Iris Client license for capturing process and to perform template creation (extraction). In average this takes 10-20 seconds and after this time the license can be released to be available for another user. Even one Iris Client concurrent license can be shared among tens of users.

This type of licensing is especially useful for web-based software.

The allowed number of simultaneously running Iris Client component instances is limited by the number of obtained concurrent licenses. Additional licenses can be obtained at any time.

The following license management options are available:

- License management by storing a file with a concurrent license on one PC connected to LAN or Internet. The file with the concurrent license is send by email after purchasing the license.
- License management using volume license manager on LAN or Internet.

VeriEye 2.3 enterprise license

VeriEye enterprise license allows an **unlimited use** of VeriEye components in the end-user products in the certain territory, market segment or project. These limitations would be included in the licensing agreement.

For more information please contact us.



Volume license manager

Volume license manager is **used on site by integrators or end users** to manage obtained licenses for VeriEye 2.3 components. It consists of license management software and a dongle, which are used to store the number of obtained licenses. An integrator or an end-user can use the volume license manager in the following ways:

- **Activating the single computer licenses.** An installation license for a VeriEye 2.3 component will be activated for using on a particular computer. The license quantity for the VeriEye component in the license manager will be decreased by the amount of activated licenses.
- **Managing the single computer or concurrent licenses on LAN or Internet.** The license manager allows to manage installation licenses for VeriEye components across the computers on LAN or Internet. The number of managed licenses for a VeriEye component is limited by the number of licenses in the license manager. No license activation is needed and the license quantity is not decreased. Once issued, the license is assigned to certain computer on the network.
- **Using a license manager as a dongle.** The volume license manager containing at least one license for a VeriEye 2.3 component can be used as a dongle that allows to run VeriEye 2.3 component installation on a particular computer.

Additional VeriEye 2.3 component installation licenses for the license manager can be purchased anytime. Neurotechnology will generate a special update file and send it to you. Then you will just have to enter the file to the license manager to add these purchased licenses.



Prices for VeriEye Products

- The prices are **effective from January 10, 2011**. 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.
- The prices do not include any local import duties or taxes.
- Product shipping cost depends on delivery country
- Our customers can gain a discount for our products by getting the Solution Partner status.

VeriEye SDK

VeriEye 2.3 Standard SDK	€ 589.00
VeriEye 2.3 Extended SDK	€ 1,399.00

Iris Client component concurrent licenses

Price per license	€ 1,200.00
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Iris components (prices per single computer license)

Quantity	Iris Extractor	Iris Client ⁽¹⁾	Iris Matcher
1-9	€ 99.00	€ 101.00	€ 124.00
10-19	€ 72.00	€ 74.00	€ 90.00
20-49	€ 64.00	€ 65.00	€ 80.00
50-99	€ 56.00	€ 57.00	€ 70.00
100-199	€ 50.00	€ 51.00	€ 63.00
200-499	€ 45.00	€ 46.00	€ 56.00
500-999	€ 40.00	€ 41.00	€ 49.00
1000-1999	€ 35.00	€ 36.00	€ 44.00
2000-3999	€ 32.00	€ 32.00	€ 40.00
4000-7999	€ 29.00	€ 29.00	€ 36.00
8000 and more	Please contact us for more information		

(1) Iris Client component is not available for VeriEye Standard SDK customers.

License management

Volume license manager	€ 16.00
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VeriEye enterprise license

VeriEye 2.3 enterprise license	Please contact us for more information
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VeriEye products can be ordered:

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