



Face identification and  
movement tracking  
for video surveillance  
systems

# SentiVeillance SDK



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## Face identification and movement tracking for video surveillance systems

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SentiVeillance SDK is designed for developing software that performs **biometric face identification** and detects **moving pedestrians or vehicles** or other objects using live video streams from high-resolution digital surveillance cameras. The SDK is used for **passive identification** – when passers-by do not make any efforts to be recognized. List of possible uses includes law enforcement, security, attendance control, visitor counting, traffic monitoring and other commercial applications.

The SentiVeillance SDK allows to create applications for Microsoft Windows and Linux platforms.

- Real time face detection template extraction and matching against watchlist database.
- Simultaneous tracking of multiple faces or objects in live video.
- Advanced moving objects detection and classification for pedestrians and vehicle tracking.
- Gender classification, age evaluation, detection of face expression, glasses and facial hair.
- Automatic operation logs and reports events, as well as enrolls new faces from video stream and adds them to watchlist automatically.
- Large surveillance systems support by connecting up to 10 cameras to a single computer & quick synchronization between networked computers.
- Available as multiplatform SDK that supports multiple programming languages.
- Ready-to-use server for integration into video management systems (VMS) optionally available.
- Reasonable prices, flexible licensing and free customer support.

See demo video:

<http://youtu.be/Jpt5jE5rwCQ>





## Features and Capabilities

The SentiVeillance 6.0 technology has these specific capabilities:

- **Real time performance.** SentiVeillance technology performs face, pedestrian or object recognition and tracking in real time.
- **Two algorithms for surveillance systems.** Depending on the surveillance system design, one of these algorithms may be used:
  - **Biometric face recognition** algorithm is based on deep neural networks and provides these capabilities for surveillance systems:
    - **Multiple face** detection, features extraction and template matching with the internal database in **real time**.
    - **Facial identification** reliability enables using **large watchlist** databases.
    - **Face tracking** is performed in all successive frames from the video source until they disappear from camera field of view. The face tracking algorithm uses dynamic face and motion prediction models that make it robust to occlusions like other objects or even other faces. The algorithm is able to continue tracking a face even when it re-appears after being fully covered by occlusions (like walls, furniture, posters etc).
    - **Gender classification** (optional) for each person in the frame.
    - **Age** determination (optional) for each person in the frame.
    - **Smile, open-mouth, closed-eyes, glasses, dark-glasses, beard and mustache** attributes detection (configurable).
  - **Motion detection and tracking** algorithm performs advanced detection of moving objects in the scene, their classification and tracking until they disappear. These features are available for surveillance systems:
    - **Object classification.** After calibration SentiVeillance allows to perform object classification based on the size and movement speed. For example, users can configure a surveillance system to determine if a tracked object is a **vehicle**, a single **pedestrian** or group of pedestrians. See <https://youtu.be/uTFqrmzf-G4>
    - **Restricted areas control.** SentiVeillance algorithm can detect and report if people or objects **enter, leave or stay in restricted areas**. The events are triggered when people or objects cross pre-defined lines or enter polygon-shaped areas. See <https://youtu.be/ui1L2gzgo9w>
    - **Tolerance to weather conditions.** The algorithm ignores rain and snow, as well as trees and bushes, which are swayed by wind.
- **Automatic operation.** A system based on SentiVeillance 6.0 SDK is able to log face appearance, disappearance and tracking. The detected faces are matched against the watchlist in the internal database and recognized faces are immediately reported to the system. The system uses face tracking for automatic enrollment from video stream and adding new facial templates to watch list on the fly.
- **Large surveillance systems support.** SentiVeillance 6.0 SDK allows to integrate its technology into surveillance systems with **multiple cameras** and **multiple data-processing nodes**. A single computer can process video data from up to **10 cameras** simultaneously. Multiple computers with running SentiVeillance software can **quickly synchronize** biometric and surveillance data between each other over the network. The synchronization can be **customized** as the SDK includes sample source code for using the communication and synchronization processes.
- **Video files processing.** SentiVeillance also accepts data from video files. The video files are processed in real time as coming from a virtual camera, therefore an hour-long video will be processed in one hour.



## SentiVeillance 6.0 SDK components

SentiVeillance 6.0 SDK is based on the SentiVeillance 6.0 technology that is specially designed for integrating biometric facial recognition into video surveillance systems. Face templates created with SentiVeillance SDK are fully compatible with VeriLook SDK and MegaMatcher SDK multi-biometric technology.

SentiVeillance 6.0 SDK includes Device Manager library for Microsoft Windows and Linux that allows to perform **simultaneous capture from multiple cameras**.

Components	Microsoft Windows	Linux
• SentiVeillance 2-camera component	1 single computer license	
• SentiVeillance 10-camera component	optionally available	
• Face Extractor component	1 single computer license	
• Device manager library	+	+
<b>Programming tutorials</b>		
• C++	+	+
• C#	+	
• Visual Basic .NET	+	
<b>Programming tutorials</b>		
• C	+	+
• C#	+	
• Java	+	+
<b>Documentation</b>		
• SentiVeillance 6.0 SDK documentation	+	



## SentiVeillance 2-camera component

The SentiVeillance 2-camera component is designed for using in small-scale video surveillance systems with several cameras. The component performs real-time detection and tracking of all detected faces from **up to 2 live video streams**. The component installations can be run on several computers distributed over network and **synchronize** data between themselves.

The SentiVeillance component is able to track multiple faces simultaneously and match them with faces from internal database (i.e. a watch-list of suspects or a list of company employees). New faces may be enrolled to the database either automatically or manually from image files. Person's gender can be optionally determined for each person in a frame.

The **C# and VB .NET samples** from the SDK shows how to use the component.

One SentiVeillance 2-camera component license is included with SentiVeillance 6.0 SDK. More licenses for this component can be purchased any time by SentiVeillance 6.0 SDK customers.

## SentiVeillance 10-camera component

The SentiVeillance 10-camera component is designed for using in large surveillance systems with multiple cameras and has the same functionality as the SentiVeillance 2-camera component. It supports input from up to **10 live video streams** on the same PC or server. The component installations can be run on several computers distributed over network and **synchronize** data between themselves.

The SentiVeillance 10-camera component licenses can be purchased any time by SentiVeillance 6.0 SDK customers.

## Face Extractor component

The Face Extractor creates face templates from face images. The component is intended for enrolling faces from **still images** into a surveillance system and provides its functionality for reasonable price.

The component extracts a single face template in 1.34 seconds. The specified performance requires a PC or laptop with at least Intel Core 2 Q9400 (2.67 GHz) processor.

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

One Face Extractor license is included with SentiVeillance 6.0 SDK. More licenses for this component can be purchased any time by SentiVeillance 6.0 SDK customers.

## Device Manager library

Device Manager library works under Microsoft Windows and Linux and provides functionality for **simultaneous capture from multiple cameras**. The library supports a range of high-resolution digital surveillance cameras and other cameras that provide DirectShow interface for Windows platform, or GStreamer interface for Linux platform.

The list of supported cameras is available below in the "System Requirements" section.

The Device Manager includes a plug-in framework that allows integrators to **write plug-ins to support their cameras** using the provided API. The SentiVeillance SDK documentation contains the detailed information and samples.

A **video file** can be also used as a data source for SentiVeillance. The input from the file is processed as coming from a virtual camera, thus the video is processed in real-time.



## Basic Recommendations for SentiVeillance Usage

Face recognition accuracy of SentiVeillance heavily depends on the quality of a face image in a frame. There are some basic recommendations and constraints when using face recognition applications based on SentiVeillance SDK.

### General recommendations

- **Image quality during enrollment is important**, as it influences the quality of the face template. Enrollment from **photo** or **video** stream is possible.
  - **Several images during enrollment** are recommended for better facial template quality which results in improvement of recognition accuracy and reliability.
  - Additional enrollments may be needed when **facial hair** style changes, especially when beard or mustache is grown or shaved off.
- **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.
- **1 MegaPixel** or better camera resolution is recommended for face enrollment and recognition. Make sure that **native** resolution is provided by a camera, as some cameras or webcams may **scale up** native images to higher resolution without image quality improvement.

### Face posture

The SentiVeillance face recognition engine has certain tolerance to face posture:

- head **roll** (tilt) –  $\pm 15$  degrees.
- 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) –  $\pm 45$  degrees from frontal position (configurable).
  - **$\pm 15$  degrees default** value is the fastest setting which is usually sufficient for most near-frontal face images.
  - **30 degrees difference** between a face template in a database and a face image from camera is **acceptable**.
  - Several views of the same face can be enrolled to the database to cover the whole  $\pm 45$  degrees yaw range from frontal position.





## System Requirements and Supported Cameras

- **PC or server with x86-64 (64-bit) compatible processor:**
  - **3 GHz** or better processor with 4 processor cores is recommended for systems with 1 or 2 cameras connected to the same PC or server. Systems with more cameras will need a graphical processing unit (see below).
  - **SSE2 support is required.** Processors that do not support SSE2 cannot run the SentiVeillance algorithm. Please check if a particular processor model supports SSE2 instruction set.
  - At least **2 processor cores** are required to process surveillance data from **one camera** with several faces in a frame. If there are more than 2 cameras in a surveillance system, several networked PCs or a multi-processor server will be required to process data from the cameras.
  - If **large number of faces in a frame** is expected, more processor cores, more powerful processor or even multi-processor server may be required to process surveillance data and keep the acceptable performance.
- A **graphical processing unit (GPU)** is needed for surveillance system with **more than 2 cameras** connected to the same PC or server.
  - **NVIDIA GeForce GTX 1080** GPU or better is recommended for systems with up to 10 cameras.
  - **1 GB of vRAM** is recommended for any amount of cameras.  
**2 GB of vRAM** is recommended if monitor is used.
  - **Compute Capability 3.5** or better should be supported by the GPU.
  - **CUDA 8.0** toolkit or newer is required
  - **cuDNN 7** library is required.
- At least **8 GB of RAM**.
- A **high-resolution digital camera**. The camera resolution may vary depending on the actual application. The recommended resolution is about 1 Megapixel, as processing video from cameras with higher resolution will require more free RAM and more powerful processor to keep the acceptable frame rate. These supported cameras are suitable for using with SentiVeillance 6.0 SDK:
  - 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 specific high-resolution cameras are also supported:
    - **Axis M1114** camera (Microsoft Windows and Linux)
    - **Basler BIP2-1600-25c-DN** IP camera (Microsoft Windows and Linux)
    - **Cisco 4500 IP** camera (Microsoft Windows only)
    - **Mobotix S14D** and **Mobotix DualNight M12 IP** camera (Microsoft Windows and Linux)
    - **PIXORD N606** camera (Microsoft Windows and Linux)
    - **Prosilica GigE Vision** camera (Microsoft Windows and Linux)
    - **Sony SNC-CS50** camera (Microsoft Windows and Linux)
    - **Uniview IPC2322EBR-DPZ28** camera
  - Any other high-resolution digital camera that is accessible using:
    - **DirectShow** interface for Microsoft Windows platform
    - **GStreamer** interface for Linux platform.

*Continued on the next page*



- Any **other device support can be added by customers** using the provided Device Manager **plug-in framework**. Please refer to the SentiVeillance SDK documentation for the detailed information.
- Microsoft Windows specific:
  - Microsoft Windows Vista / 7 / 8 / 10 / Server 2008 / Server 2008 R2 / Server 2012.
  - Microsoft .NET framework 3.5 or newer (for .NET components usage).
  - Microsoft DirectX 9.0 or later.
  - Microsoft Visual Studio 2012 or newer (for application development under C/C++, C#, VB .Net)
  - Sun Java 1.6 SDK or later (for application development with Java)
- Linux specific:
  - Ubuntu 16.04 OS
  - glibc 2.11.3 or newer
  - GStreamer 1.2.2 or newer with gst-vaapi plugins installed for hardware accelerated video decoding
  - libgudev-1.0 164-3 or newer
  - wxWidgets 3.0.0 or newer libs and dev packages (to build and run SDK samples and applications based on them)
  - Sun Java 1.6 SDK or later (for application development with Java)





## Technical Specifications

SentiVeillance SDK includes separate algorithms for biometric face recognition and motion detection and tracking. Depending on the surveillance system design, one of these algorithms may be used. Below are specifications for these algorithms.

### Technical Specifications for Biometric Face Recognition Algorithm

**4 % of the frame's larger side** (at least 32 pixels) is the minimal recommended **distance between eyes** for a face on video stream or image to perform reliable face tracking and template extraction. The speeds of face tracking, template extraction and matching against a watchlist database are dependent on actual **size of a face** in a frame, not on the size of the whole frame.

SentiVeillance has certain tolerance to face posture that assures face detection and tracking:

- head **roll** (tilt) –  $\pm 15$  degrees from frontal positions.
- head **pitch** (nod) –  $\pm 15$  degrees from frontal position.
- head **yaw** (bobble) –  $\pm 45$  degrees from frontal position.

The performance specifications are provided for Intel **Core i7-4771** processor, running at **3.5 GHz** clock rate, and **1920 x 1080 pixels** videos.

SentiVeillance 6.0 biometric face recognition algorithm technical specifications	
Frame rate when tracking up to 5 faces	More than 25 frames per second
Face watch-list database matching time <sup>(1)</sup>	Less than 0.5 second
Single face record size in a template (kilobytes)	5.0 or 7.0 (configurable)
Maximum watch-list database size	Limited by amount of <b>free RAM</b>

(1) up to 20,000 face records in the database; larger database yields slower response time. Note that each person may be represented by several records in the database with different appearance variations, different capture angles etc.

### Technical Specifications for Motion Detection and Tracking Algorithm

**40 x 40 pixels** is the **minimal moving object size** for its detection and tracking. The pedestrians or moving objects **tracking performance** is dependent on actual **size of an object** in a frame, not on the size of the whole frame.

The performance specifications are provided for Intel **Core i7-4771** processor, running at **3.5 GHz** clock rate, and **1920 x 1080 pixels** videos.

SentiVeillance 6.0 motion detection and tracking algorithm technical specifications	
Frame rate when tracking up to 3 pedestrians	More than 30 frames per second
Frame rate when tracking up to 4 cars and occasional pedestrians	More than 27 frames per second



## SentiVeillance SDK Trial, Algorithm Demo and Related Products

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

These products are related to SentiVeillance SDK:

- **SentiVeillance Server** – ready-to-use software for easy integration of biometric face identification and person tracking into video management systems (VMS).
- **VeriLook SDK** - a software development kit that allows development of PC- and Web-based solutions on Microsoft Windows, Linux and Mac OS X platforms. See “VeriLook SDK” brochure for more information.
- **MegaMatcher SDK** – for development of AFIS or multi-biometric face, fingerprint, iris and palm print identification products. See “MegaMatcher SDK” brochure for more information.
- **SentiSight SDK** – for development of general object recognition and tracking products. See “SentiSight SDK” brochure for more information.



## Licensing SentiVeillance SDK

### Product Development

An integrator should obtain SentiVeillance 6.0 SDK (EUR 790) to develop an end-user product based on SentiVeillance 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 "SentiVeillance 6.0 SDK components" chapter (page 4) for the list of component licenses included with SentiVeillance 6.0 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 needs to obtain licenses of components for every **computer or device**, where the component will be installed together with the integrator's product. Integrators can purchase additional SentiVeillance 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 SentiVeillance 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.  
Note: 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 SentiVeillance 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 SentiVeillance components in the following ways:
  1. **Activating single computer licenses** – An installation license for a SentiVeillance 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 SentiVeillance 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 SentiVeillance component may be used as a dongle, allowing the SentiVeillance 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 ([http://neurotechnology.com/sentiveillance\\_sdk\\_sla.html](http://neurotechnology.com/sentiveillance_sdk_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 SentiVeillance-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 SentiVeillance enterprise license allows an **unlimited use** of SentiVeillance 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 SentiVeillance SDK

- The prices are **effective March 21, 2017**. 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.
- Product shipping costs depend on delivery country
- Customers with Solution Partner status are eligible for product discounts.

### SentiVeillance SDK

SentiVeillance 6.0 SDK	€ 790.00
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### Component installation licenses (prices per single computer license)

Quantity	SentiVeillance 2-camera component	SentiVeillance 10-camera component	Face Extractor
1 - 9	€ 270.00	€ 2,950.00	€ 20.00
10 - 19	€ 200.00	€ 2,140.00	€ 15.00
20 - 49	€ 180.00	€ 1,920.00	€ 13.00
50 - 99	€ 155.00	€ 1,700.00	€ 11.00
100 - 199	€ 140.00	€ 1,495.00	€ 10.00
200 - 499	€ 125.00	€ 1,330.00	€ 9.00
500 - 999	€ 110.00	€ 1,165.00	€ 8.00
1000 - 1999	€ 99.00	€ 1,045.00	€ 7.00
2000 - 3999	€ 88.00	€ 940.00	€ 6.40
4000 - 7999	€ 79.00	€ 840.00	€ 5.80
8000 and more	Please contact us for more information		

### License management

Volume license manager	€ 16.00
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### SentiVeillance SDK enterprise license

SentiVeillance 6.0 SDK enterprise license	Please contact us for more information
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SentiVeillance SDK and related 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)