



NEUROtechnology



Object recognition
for robotics and
computer vision

SentiSight SDK



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SentiSight is intended for developers who want to use computer vision-based object recognition in their applications. It enables manual and fully automatic object learning, and searching for learned objects in images from almost any camera, webcam, still picture or live video in an easy, yet versatile, way.

SentiSight is available as a software development kit that allows the development of object recognition systems for Microsoft Windows or Linux platforms.



Object Learning and Recognition Processes

Object Learning Process

In order to recognize an object in an image, the appearance of an object must first be memorized. In the learning phase, SentiSight algorithms extract specific object features from a video stream or single image and save them into what is known as an **object's model**.

In many cases there is more information in a video or single image than just the object you want SentiSight to learn, like a background, other objects in the room or a hand holding the object. Therefore, to learn an object, information about the exact location of the object in the image should be provided.

SentiSight supports 2 methods of object learning: manual and automatic.

Manual object learning is suitable for most situations. A user must perform these steps for manual object learning in the SentiSight 2.1 SDK:

1. Outline object's shape on an image by marking object's corner points to build a polygon. The image can be provided by user from image file, video file or live video stream.
2. Optionally choose more images of the object and repeat Step 1 for each image. The algorithm assists the user by estimating an approximate shape of the object if the object in an image is recognized using data from previous images. Learning the object from different sides and angles results in better recognition quality.
3. Input the learned object name (ID) into the system.

Automatic object learning is suitable for lightweight movable objects. This learning procedure is based on detecting an object by excluding a static background and object's holder (usually a hand) from an image.

A user must perform these steps for automatic object learning in the SentiSight 2.1 SDK:

1. Choose a static background (preferably smooth) and direct the camera to it.
2. Choose a holder – an object that will be used to hold and move the learned object. A user's hand can be the "holder".
3. This "holder" should be presented it to the camera first, in various poses and configurations (if it is not rigid object) so that it can be learned by SentiSight.
4. After the holder has been learned, SentiSight is ready to learn the object itself, by having the holder rotate and move the object closer and further from the camera.
5. Input the learned object name (ID) into the system.

Therefore, the automatic method requires to use live video or to provide separate videos or image sets of background, holder and object. Also, the other background elements could be learned together with the object if the object is hardly separable from the background. This can affect the ability of the algorithm to recognize the unique qualities of the object and may result in the object being misclassified with other objects that have the same background.

Manual object learning should be used for objects that cannot be moved or if there are no way to provide separate media with objects background and/or holder. Thus, automatic learning provides less amount of user interaction with the system, but it is not as precise as manual learning. Also manual learning is suitable for wider range of cases.



Object Recognition Process

Object recognition requires no user interaction apart from providing a video file with the object or pointing a camera to the scene where the learned object is presented or will appear. When the object appears in the vision field, SentiSight tries to recognize it. If the object is recognized by SentiSight, object's name (ID) and coordinates are returned.

The SentiSight algorithm creates a model with possible views from different sides, in different 3D poses and in different lighting conditions in object learning stage. This object's model improves recognition capability.

SentiSight's object recognition is comparably fast – around 10 frames per second for a single object model (320 x 240 resolution). However for tasks when an even faster response is needed, the SentiSight 2.1 library has a tracking mode that enables tracking speeds up to 20 frames per second. Tracking is initialized if an object is recognized and located, then tracks the object until it changes somewhat in appearance, at which point tracking is reinitialized by recognition. The tracking feature is sensitive to complex backgrounds, and tracking is more difficult with homogenous objects.



Algorithm Capabilities and Requirements

All performance evaluations were made using a PC with 2.4 GHz Intel Core2 Duo CPU

SentiSight is designed to be as universal as possible and is able to perform fully automatic and manual object learning. Some of the potential applications for SentiSight include security systems, vision systems for robots, machine vision (like parts recognition in production lines), search engines that recognize objects in picture files, road signs recognition, etc.

The SentiSight 2.1 algorithm has these capabilities for advanced visual-based object learning and recognition:

- **Accurate object detection.** The SentiSight algorithm is able to find out:
 - **whether** a particular object is presented in a scene;
 - **where** the object is located in the scene;
 - **how many** instances of the object are there in the scene.
- **Simultaneous multiple object recognition.** The SentiSight algorithm provides simultaneous multiple 2D and 3D object detection and recognition
- **Object evaluation.** The algorithm is also able to estimate the region an object occupies in a scene, providing additional information about the size, orientation and scale of the recognized object.
- **Fast image processing.** SentiSight can process video streams in real time, so it can be used for real-time applications.
- **Rotation and translation tolerance.** The algorithm is generally rotation and translation invariant in a plane perpendicular to the camera.
- **Free rotation tolerance.** The algorithm is invariant for rotations up to 10-15 degrees out of a plane perpendicular to the camera. Different views of an object can be added to a model to handle larger rotations.
- **Resolution and scale tolerance.** Scale (size in image) difference between object's model and object itself can be up to 2-3 times. Objects should contain enough details, and be large enough to be recognized.
- **Occlusions tolerance.** The algorithm is robust to occlusions as big as 50% of the objects size.

These conditions may alter algorithms performance:

- **Lighting conditions** (illumination, shadows and reflectance). Planar objects only have problems with reflectance. 3D objects have problems with varying lighting conditions, but constant lighting conditions do not cause many problems.
- **Transparency.** Generally transparent objects are difficult to recognize.
- **Rigidity.** The algorithm can recognize only rigid objects. At least significant part of the object should be rigid.



Contents of SentiSight 2.1 SDK

SentiSight 2.1 SDK is intended for developers who want to use computer vision-based object recognition in their applications. The SDK allows rapid development of computer vision-based object recognition systems using functions from the SentiSight library for **Microsoft Windows** or **Linux** platforms. Developers have complete control over SDK data input and output; therefore SDK functions can be used in connection with most cameras (including webcams), with any database and with any user interface.

SentiSight 2.1 SDK distribution package contains:

	Microsoft Windows	Linux
Components		
• SentiSight 2.1 installation license	1 license	
• Camera Manager library	+	+
Programming samples		
• C++	+	+
• C#	+	
Programming tutorials		
• C/C++	+	+
• C#	+	
Documentation		
• SentiSight 2.1 SDK documentation	+	



System Requirements

- PC with at least **1 GHz x86** processor that **supports SSE2***.
- At least **256 MB** of free RAM.
- Optional camera or webcam. These cameras are supported by SentiSight:
 - Any **webcam** or camera that is accessible using:
 - **DirectShow** interface for Microsoft Windows platform
 - **Video4Linux** interface for Linux platform.
 - **QuickTime** interface for Mac platform.
 - Also these specific models of **high-resolution** cameras are supported:
 - Axis M1114 camera (Microsoft Windows only)
 - Cisco 4500 IP camera (Microsoft Windows and Linux)
 - Mobotix DualNight M12 IP camera (Microsoft Windows and Linux)
 - PiXORD N606 camera (Microsoft Windows and Linux)
 - Prosilica GigE Vision camera (Microsoft Windows and Linux)
 - VistaFA2 / VistaFA2E face & iris cameras (Microsoft Windows only)
 - VistaMT Multimodal Biometric Device (Microsoft Windows only)
 - Microsoft Windows specific:
 - Microsoft Windows 2000/XP/2003/2008/Vista/7.
 - Microsoft DirectX 9.0 or later.
 - Linux specific:
 - Linux (based on glibc 2.5 or newer).
 - Video4linux.

* Processors that do NOT support SSE2 cannot run the SentiSight 2.1 algorithm. Please check if a particular processor model supports SSE2.



Reliability Tests and Technical Specifications

All performance evaluations were made using a PC with 2.4 GHz Intel Core2 Duo CPU

SentiSight 2.1 was tested with object images from many cameras. At 0.1% False Acceptance Rate (FAR), the recognition rate is from 70% to more than 99% depending on object structural appearance, transparency, etc. For objects with well defined internal structure, the recognition rate is 98% - 99% at 0.1% FAR.

SentiSight 2.1 Algorithm Technical Specifications	
Recommended image size for real time operation on modern processor	320 x 240 pixels
Static Background Extraction/Object mask separation (320 x 240 image size)	20 frames/sec
Learning: Processing of single objects' frame (320 x 240 image size)	0.05 sec.
Learning: Generalization time (for 100 frames of object)	6 sec.
Recognition speed from image frame for single object model (including processing of the image)	~ 10 frames/sec.
Recognition speed from image model for single object model (excluding processing of the image)	~ 20 models/sec



SentiSight Algorithm Demo and Trial SDK

Sentisight **algorithm demo** applications for Microsoft Windows and Linux platforms, and SentiSight **30-day SDK Trial** are available for downloading at www.neurotechnology.com/download.html.



Licensing SentiSight SDK

To **develop** a product based on SentiSight 2.1 technology, an integrator should obtain SentiSight 2.1 SDK.

Integrators can develop only an **end-user** product using SentiSight 2.1 SDK and sell/install the product to their own customers. If the integrator wants to develop and sell a SentiSight 2.1 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 SentiSight 2.1 SDK, the integrator should obtain only additional SentiSight 2.1 component licenses for product installations. Also the additional SentiSight 2.1 component licenses may be required during development of the product. The additional SentiSight 2.1 component licenses can be obtained by SentiSight 2.1 SDK customers at any time.

A license for SentiSight 2.1 is required for **each PC or each server CPU** that runs a SentiSight-based application. The following license types are available:

- Single computer license.
- Enterprise license.

SentiSight 2.1 SDK includes one SentiSight 2.1 installation license.

Please also refer to SentiSight SDK Software 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 SentiSight 2.1 installation on a single Personal Computer or on one Server CPU. The 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.

SentiSight 2.1 Enterprise License

SentiSight 2.1 enterprise license allows an unlimited use of SentiSight 2.1 engine in the end-user products in the certain territory, market segment or project. These limitations would be included in the licensing agreement.

Each SentiSight 2.1 installation requires activation. SentiSight 2.1 enterprise license customers receive software tools that allow to activate an unlimited number of SentiSight 2.1 installations without any communication with Neurotechnology.

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 SentiSight. 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 SentiSight 2.1 will be activated for using on a particular computer. The license quantity in the license manager will be decreased by the amount of activated licenses.
- Managing the single computer licenses on LAN or Internet. The license manager allows to manage installation licenses for SentiSight 2.1 across the computers on LAN or Internet. The number of managed licenses 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 SentiSight 2.1 can be used as a dongle that allows to run SentiSight 2.1 installation on a particular computer.

Additional SentiSight 2.1 installation licenses for the license manager can be purchased anytime. Neurotechnology will generate a special update code and send it to you. Then you will just have to enter the code to the license manager to add these purchased licenses.



Prices for SentiSight products

- The prices are **effective from January 29, 2010**. 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 taxes.
- Product shipping cost depends on delivery country
- Our customers can gain a discount for our products by getting the Solution Partner status.

SentiSight 2.1 SDK

SentiSight 2.1 SDK	€ 339.00
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SentiSight 2.1 installation licenses (prices per single computer license)

Quantity	Price
1-9	€ 45.00
10-19	€ 33.00
20-49	€ 29.00
50-99	€ 25.00
100-199	€ 21.00
200-499	€ 17.00
500-999	€ 13.00
1000-1999	€ 10.00
2000-3999	€ 7.00
4000-7999	€ 5.00
8000 and more	Please contact us for more information

License management

Volume license manager	€ 16.00
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SentiSight 2.1 enterprise license

SentiSight 2.1 enterprise license	Please contact us for more information
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SentiSight 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