SentiSight 3.0 Algorithm Demo

User's guide

User's guide version: 3.0.0.0

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Table of Contents

1 Introduction

SentiSight algorithm demo shows main features (learning and recognition) of SentiSight library.

SentiSight Library is intended for visual appearance based object recognition. Thus, its main features are object learning and recognition. The first part, object learning, is dedicated to extraction of object model from a sequence of images containing the object. The second part, recognition, stands for object recognition in a test image.

Demo application enables learning and recognition from image file, directory, video file and camera. Image file allows selecting one or few images in one time. Directory allows selecting directory with images. Video file enables to select video file. Camera option allows save `avi` file for object selection and for recognition enables to live recognition. Camera option is the same in recognition as live recognition.

Video files, image lists and images for testing can be downloaded from website: http://www.neurotechnology.com/.

1.1 Learning

In order to recognize an object in an image, the appearance of the object should be memorized. The process of memorizing an appearance of the object from images with various poses is called object learning. A set of images containing the object should be provided to the algorithm and the algorithm extracts so called model - a symbolic representation of the object. It is highly recommended to provide information about exact location of the object in the image. This can be done by the shapes of the object. Shapes explicitly specifies the object. Thus, only object specific information will be included into model template.

The quality of object recognition highly depends on model created by object learning part. Thus, a set of images of the object should contain all possible poses of the object - the three dimensional rotations (off plane rotations) are highly recommended. Also, it is recommended that images of the object would be taken under different light conditions or using different light sources in order to improve invariance to diverse light conditions. It is recommended to use shapes.

1.2 Recognition

Recognition is a process of identification whether an image contains an object or not. Recognition compares models which were learnt by object learning part, with current test image or test model, and returns a comparative score (score or similarity). A high similarity score suggests that the test image contains one of the learnt objects. On the other hand, a low similarity score implies that the test image contains noise, background or unknown object.

1.3 Constraints

SentiSight Library performs most excellent with constant exterior objects. The algorithm uses texture to localize the object, so highly discriminatively textured objects are recognized better than poorly textured ones. Also, recognition of objects with some moving parts could decrease due to local changes of textures. This is also the case of rugged objects, since the appearance of them is sensitive to light changes and 3D rotation. Transparent objects change their appearance as pose and background changes, so a recognition rate of them decreases. Also, an appearance of objects with shiny parts usually is sensitive to a direction of light, light sources and even to simple affine transformations of the object. As a result of the conditions, it appears some light peaks and shadows on the surface of such objects and outside changes rapidly. As a consequence, recognition decreases rapidly, unless the same light peaks and shadows were present in the model template of the object.

The model should contain various poses of the object taken in diverse light conditions. Various poses stands for front side and backside of the object and all possible 3D rotations (off plane rotations) of it. On the other hand, translation, planar rotation (in plane, orthogonal to a camera) and small scaling (till the object does not change its appearance due to resolution change) are fully reconstructed by the library. Various light directions and sources change an appearance of the object, so the model should include images taken under a range of light conditions. Noisy and blurred images could decrease quality of the model, and should be removed from it.

The algorithm can recognize only rigid objects. At least significant part of the object should be rigid.

1.4 System Requirements

- PC with 1.4 GHz processor supporting SSE2 technology
- 256 MB of RAM
- Microsoft Windows 2000/2003/XP/Vista/7 or Linux (based on glibc 2.3.4 or compatible) operating system
- Microsoft DirectX 9.0 or later
- Optionally, video capture device (web camera)

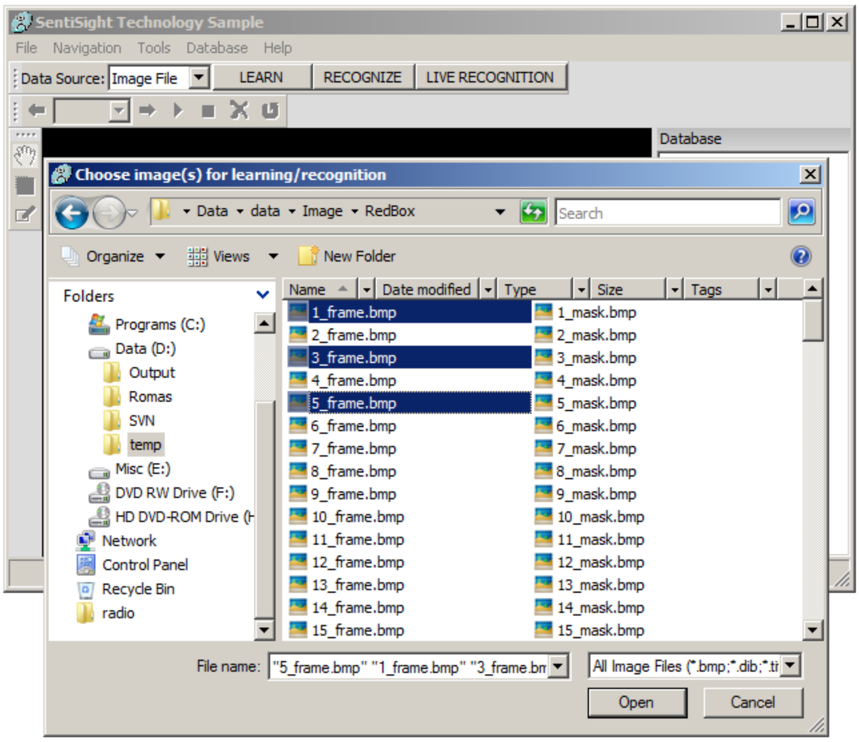
2 Application

2.1 Learning and Recognition

2.1.1 From Image

Learning

Before starting learning task it is highly recommended to read Learning (⧉ see page 1) and Constraints (⧉ see page 1) sections. At the beginning you must learn one or more object models. By pressing “LEARN” button opens image dialog window.



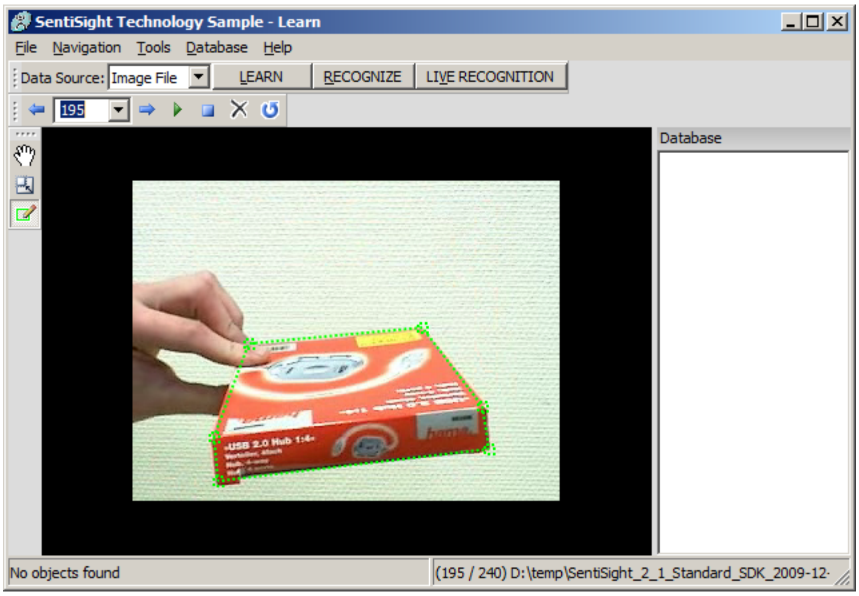
Data Source: Image File

File name: "5_frame.bmp" "1_frame.bmp" "3_frame.bm

All Image Files (*.bmp;*.dib;*.ti

Selecting object bounds

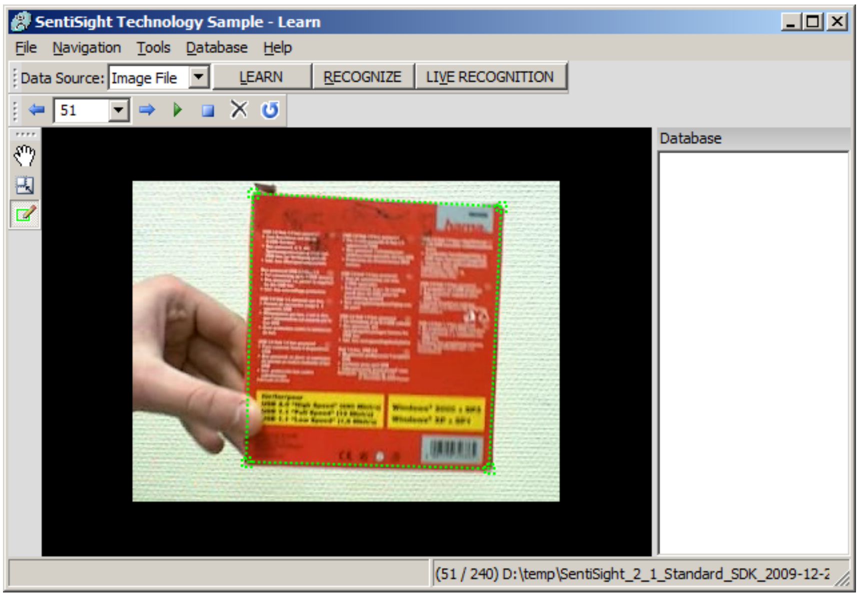
If recognition algorithm suggests several shapes on the same object you must choose the best one (only one should be left).



No objects found

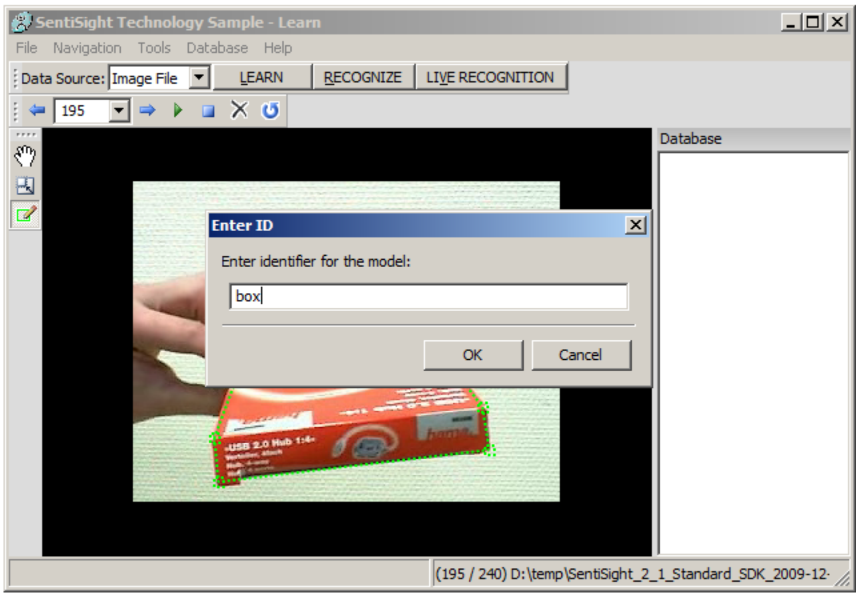
(195 / 240) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-

Selecting object bounds from other side.



(51 / 240) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-2

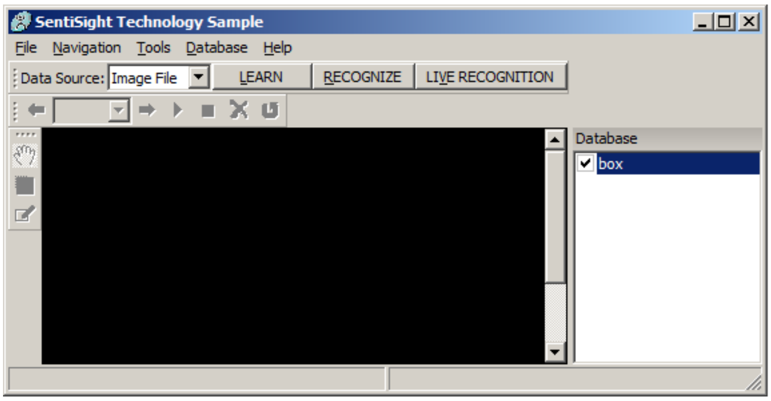
Saving model to database.



Enter identifier for the model: box

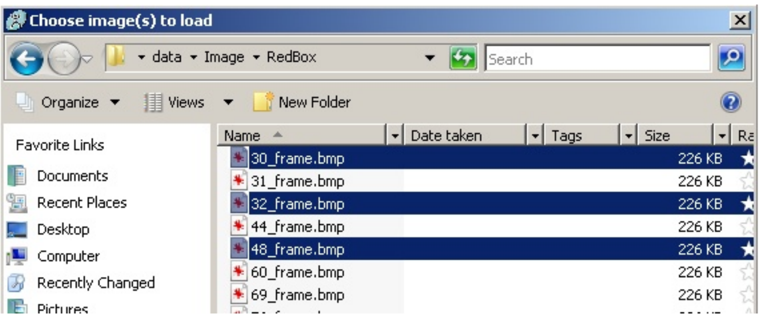
(195 / 240) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-

Saved model.



Recognition

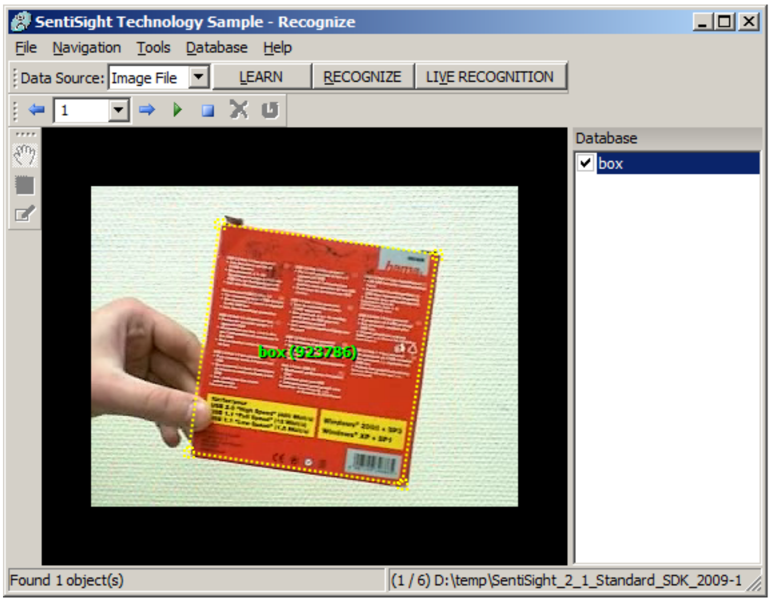
Before starting recognition task it is highly recommended to read Recognition (see page 1) section. Next, when one or more object models are learnt you may proceed to object recognition. You should click Recognize button in the main window to start object recognition. Select one or few images for object recognition.



Name	Date taken	Tags	Size
30_frame.bmp			226 KB
31_frame.bmp			226 KB
32_frame.bmp			226 KB
44_frame.bmp			226 KB
48_frame.bmp			226 KB
60_frame.bmp			226 KB
69_frame.bmp			226 KB

When you have at least one object learnt you may use them in object recognition process - to check whether a test image contains the learnt object. If you have opened few images you can use Play button to go through files automatically.

During recognition process algorithm is able to locate objects in the image and display recognition score.

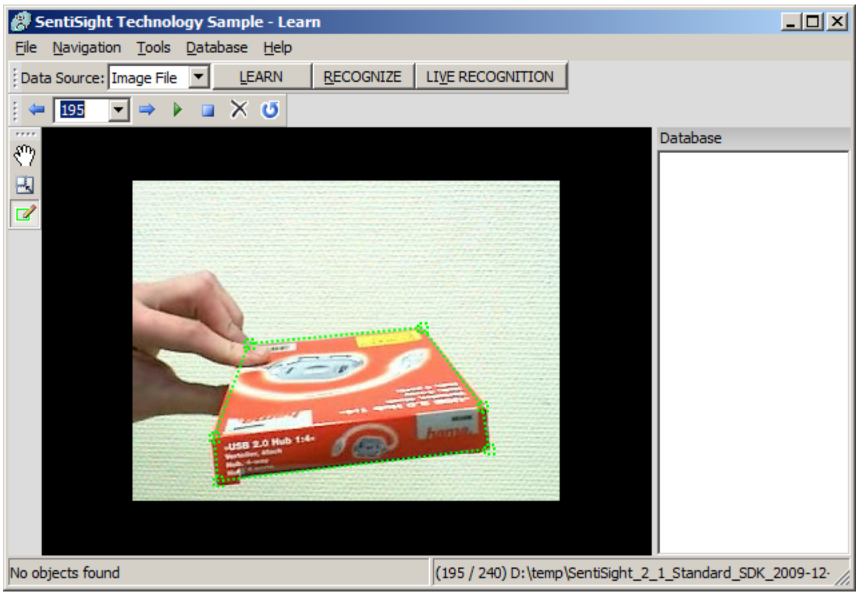


Database: ☑ box

Found 1 object(s)

(1 / 6) D:\temp\SentiSight_2_1_Standard_SDK_2009-1

If recognition fails or no object models selected the object in the image is not selected. A Similarity Threshold allows you to manipulate the recognition results. The similarity score is a comparative score which shows how likely the test image contains the object. A high similarity score suggests that test image contains the object. On the other hand, a low similarity score implies that test image displays noise. See Options->Matching Threshold.



No objects found

(195 / 240) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-

2.1.2 From Directory

Is the same procedure of learning and recognition as “Learning and recognition from file” only "Directory" source enables to load images from directory and subdirectories.

2.1.3 From Video File

Source “Video File” enables object learning and recognition from avi files. Is the same procedure of learning and recognition as “Learning and recognition from file”.

2.1.4 From Camera

Learning from camera captures video stream in avi file and allows saving them. Then learning from camera is the same procedure of learning and recognition as “Learning and recognition from file”.

2.2 Options

General

1. Matching threshold

A Matching threshold allows you to manipulate the recognition results. The similarity score is a comparative score which shows how likely the test image contains the object. A high similarity score suggests that test image contains the object. On the other hand, a low similarity score implies that test image displays noise. The matching threshold is selected experiment way because objects are very different. Default is 40000 and for concrete case it should be determined. Matching threshold can be in range 0 to 500 000.

2. Enable mask enhancement

Enables mask enhancement. The given mask can be extended in order to eliminate noise and small halls inside the object.

3. Recognition speed

- "High Speed", - as fast as SentiSight 1.1, cannot find all instances of an object (finds only one instance).
- "Low speed", - slower, but returns all detected instances of an object, better recognition quality.

4. Use tracking

This option used during object recognition with test images If the option is marked the tracking of the object in a sequence of test images is enabled. Otherwise, if the option is unmarked the tracking is disabled and object recognition uses the other algorithm for comparison. This options should be marked only with a sequence of test images where the neighbouring images differ only slightly. Also, constant light conditions and constant background usually improve tracking results. Also, high speed should be selected and one object is selected in database.

5. Transform type

If auto, selects best possible transform, if particular transform is selected but current condition do not allow to perform it simple transform is selected. Transform complexity: Similarity->Affine->Perspective.

Learning/Recognition

1. Learning mode

LowProfile

Fastest and has smallest template size, suitable in most situations.

HighProfile

Additional not rotation invariant information added, improves recognition quality for not rotated objects (has no impact on rotated object recognition). About 5%-10% slower and has about 20%-60% bigger template size than for low profile learning mode.

HighProfileEx

Additional information is added, improves recognition for all types of objects. About 50%-100% slower and has about

5%-10% bigger template size compared with low profile.

2. Feature type

Recognition or learning features type.

Blob

Local features based recognition/learning type. This feature type is faster compared to Shape type.

Shape

Shape based recognition/learning type. Allows to recognize not so local feature rich (texture rich) objects if they have distinguishable external or internal edges. This mode is intended for rigid object recognition and localization. This recognition mode is scale invariant and in plane rotation invariant. If the scale difference is so big that object changes its appearance, like rugged edge becomes smooth line, several views can be added to the model to still recognize the object.

The speed of this mode is slower than of blob based one however in some conditions near real time performance can be achieved.

Combined

Combined recognition/learning type. Shape based recognition/learning mode can be combined with blob based mode to increase recognition/learning quality even more for object which have both kind features.

3. Shape scaling level

Identifier specifying how many times to reduce image size to capture difference appearance of the shape duo to visual differences on smaller scales. This parameter can be applied only for shape mode. When using this parameter model size will be bigger and recognition speed slower.

Range: 0 - all possible scaling; N (natural number) - how many reduced images to process (no error condition, just does not extract more than possible in case)

4. Image rescale factor

Identifier specifying how to rescale input image before processing. The image can be downsampled or increased. Features are stored in rescaled size.

5. Use all CPU cores

Identifier specifying to use all CPU cores to make parallel recognition.

6. Number of CPU cores to use

Specifies how many CPU cores to use for recognition.

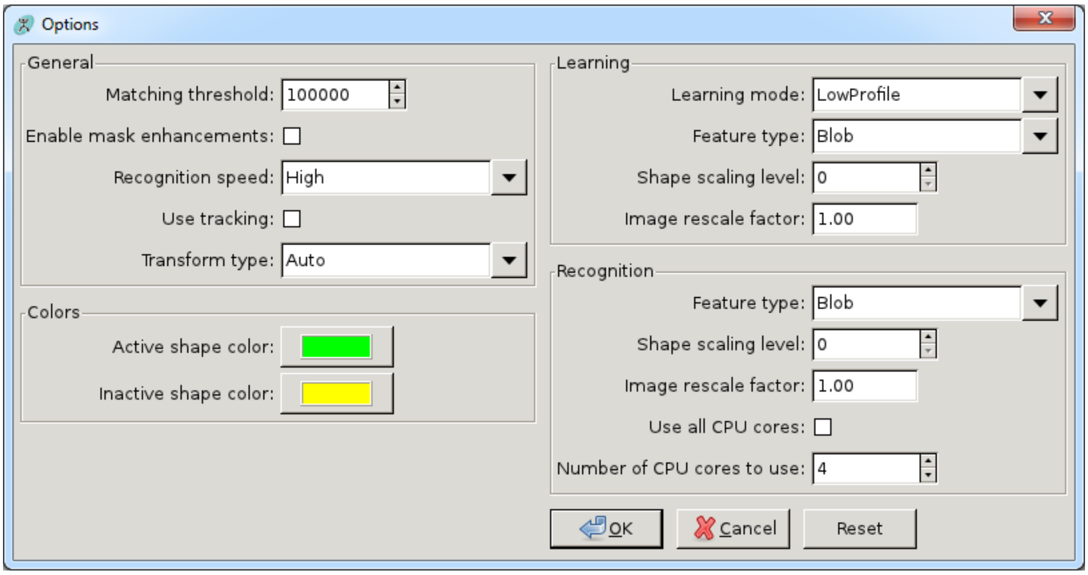
Colors

1. Active shape color

Active shape color and model name, score in recognition mode.

2. Inactive shape color

Inactive shape color and matched object in recognition mode.



Options

General

Matching threshold: 100000

Enable mask enhancements: ☐

Recognition speed: High

Use tracking: ☐

Transform type: Auto

Colors

Active shape color: 🟩

Inactive shape color: 🟨

Learning

Learning mode: LowProfile

Feature type: Blob

Shape scaling level: 0

Image rescale factor: 1.00

Recognition

Feature type: Blob

Shape scaling level: 0

Image rescale factor: 1.00

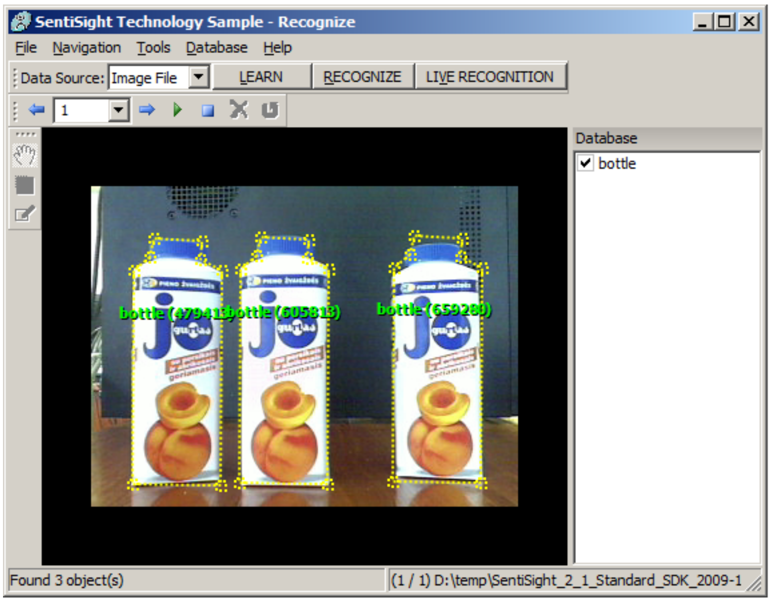
Use all CPU cores: ☐

Number of CPU cores to use: 4

2.3 Usage Examples

2.3.1 Several Objects Recognition

Several objects can be recognized using only low speed setting (Options->Recognition Speed).



SentiSight Technology Sample - Recognize

Data Source: Image File

Database

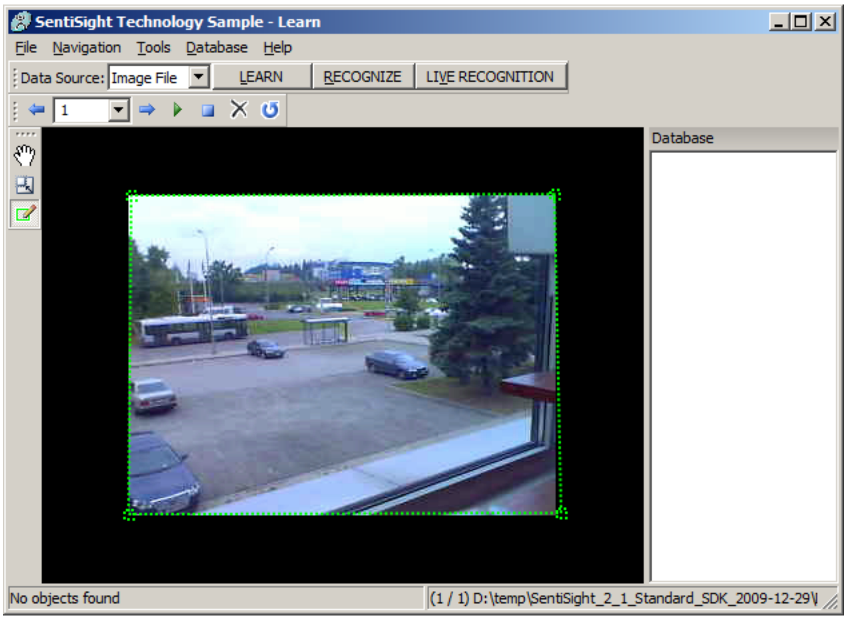
☑ bottle

Found 3 object(s)

(1 / 1) D:\temp\SentiSight_2_1_Standard_SDK_2009-1

2.3.2 Image Comparison

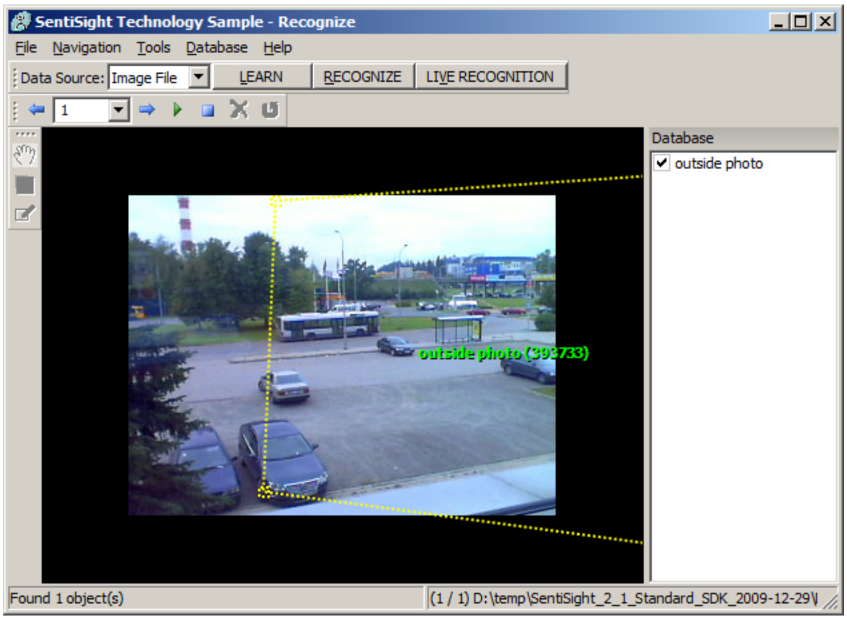
SentiSight demo application also allows to compare images. In order to compare several images, first of all image should be learnt:



No objects found

(1 / 1) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-29\

After that an image or part of it is recognized:

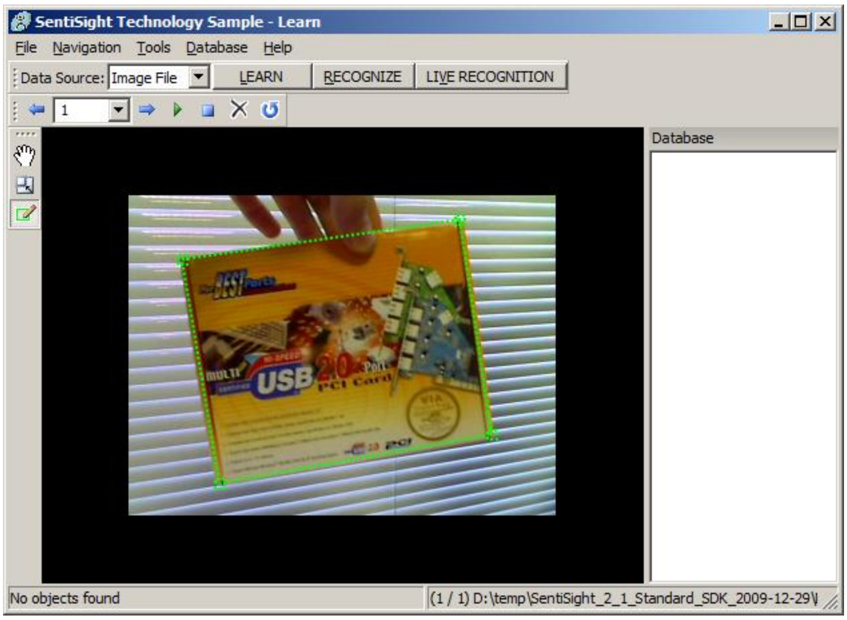


Found 1 object(s)

(1 / 1) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-29\

2.3.3 Occlusions

Learning


SentiSight Technology Sample - Learn
File Navigation Tools Database Help
LEARN
RECOGNIZE
LIVE RECOGNITION
Database

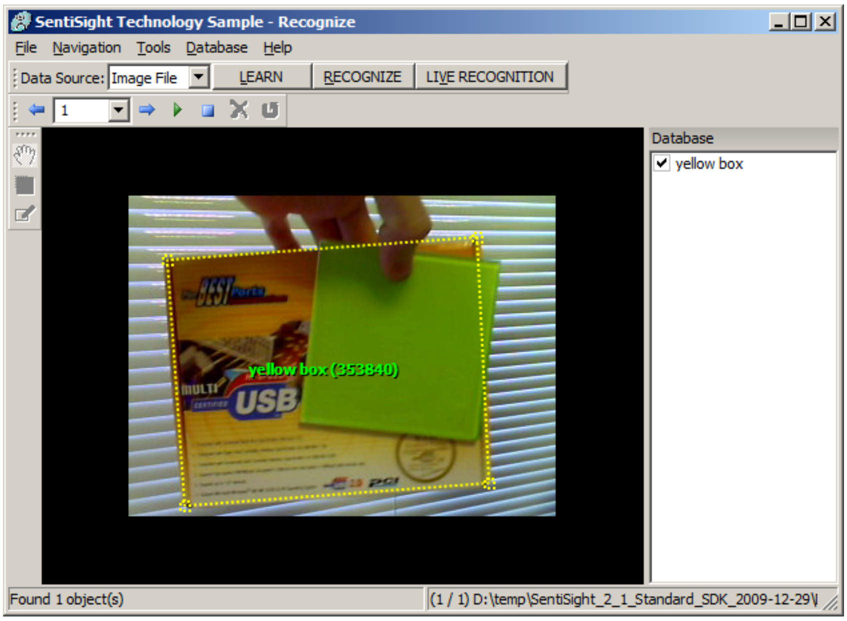
Data Source: Image File

1

No objects found

(1 / 1) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-29\

Recognition


SentiSight Technology Sample - Recognize
File Navigation Tools Database Help
LEARN
RECOGNIZE
LIVE RECOGNITION
Database

Data Source: Image File

1

☑ yellow box

yellow box (353840)

Found 1 object(s)

(1 / 1) D:\temp\SentiSight_2_1_Standard_SDK_2009-12-29\

Index