Luxand, Inc.
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Luxand FaceSDK 5.0.1

Face Detection and Recognition Library

Developer's Guide

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Overview

Luxand FaceSDK is a cross-platform face detection and recognition library that can be easily integrated into the customer's application. FaceSDK offers the API (Application Programming Interface) to detect and track faces and facial features, to recognize gender, and to recognize faces on still images and videos.

FaceSDK is provided with Tracker API which allows tracking and recognizing faces in live video. Tracker API simplifies working with video streams, offering the functions to tag subjects with names and recognize them further.

The SDK provides the coordinates of 66 facial feature points (including eyes, eyebrows, mouth, nose and face contours). Luxand FaceSDK uses multiple processor cores to speed up recognition. The library supports DirectShow-compatible web cameras and IP cameras with an MJPEG interface

Luxand FaceSDK is a dynamic link library available for 32-bit and 64-bit versions of Windows and Linux, 64-bit MacOS X, iOS, Android. The SDK contains interface header files and sample applications for C++, Microsoft Visual C++ 6.0/2005/2008, Visual Basic .NET 2005/2008, Microsoft C# .NET 2005/2008, Borland Delphi 6.0/7.0, Netbeans (Java), Xcode 4.2+ (iOS), Eclipse ADT (Android), Visual Basic 6.0 and C++Builder 6.0.Requirements

The FaceSDK library supports the following platforms:

- Windows 2000/XP/2003/Vista/2008, Windows 7, Windows 8
- Linux (RHEL 5+, CentOS 5+ and other)
- Mac OS X 10.5+ x86_64
- iOS 5.0+, armv7/x86 (iPhone 3GS+, iPad 1+, simulator)
- iOS 7.0+, arm64/x86_64 (iPhone 5S+, iPad Air+, iPad mini retina+, simulator)
- Android 4.0+ (platform version 14+), armv7 (armeabi-v7a)/x86

An Intel processor is recommended for better performance.

Minimum system requirements:

- 1 GHz processor
- 256 MB RAM

Recommended system requirements:

- Intel Core i7 or Xeon processor
- 2 GB RAM
- DirectShow-compatible webcam
- IP camera with MJPEG interface (like AXIS IP cameras)

Note that the web camera functions are available only for the Windows platform. IP cameras are accessible only within Windows, Linux and Mac platforms.

Technical Specifications

The FaceSDK library has the following technical specifications:

Face Detection

- Robust frontal face detection
- Detection of multiple faces in a photo

- Head rotation support: –30..30 degrees of in-plane rotation and –30..30 degrees out-of-plane rotation
- Determines in-plane face rotation angle
- Detection speed: as fast as 241 frames per second*, depending on resolution
    - Real time detection: 0.0041 sec (241 FPS)*, webcam resolution, –15..15 degrees of in-plane head rotation
    - Reliable detection: 0.267 sec*, digital camera resolution, –30..30 degrees of in-plane head rotation
- Returned information for each detected face: (x,y) coordinates of face center, face width and rotation angle
- Easy configuration of face detection parameters

Face Matching

- Matching of two faces at given FAR (False Acceptance Rate) and FRR (False Rejection Rate)
- Enrollment time: 0.02 seconds (50 FPS)* at webcam resolution, fast mode (with FSDK_DetectEyes/FSDK_GetFaceTemplateUsingEyes); 0.042 seconds (23.5 FPS) at webcam resolution, higher quality mode (with FSDK_GetFaceTemplateInRegion)
- Template Size: 13 kb
- Matching speed: 60350 faces per second*
- Returned information: facial similarity level

Live Video Recognition with Tracker API

- Assigns a unique ID to each subject detected in video
- Allows tagging any subject in video with a name, and recognizing it further
- No requirement for a subject to pose to be enrolled
- Constant learning of subjects' appearance
- Provides with estimates of false acceptance rate and recognition rate
- Tracks multiple faces and their facial features
- Recognizes male and female genders

Facial Feature Detection

- Detection of 66 facial feature points (eyes, eyebrows, mouth, nose, face contour)
- Detection time: 0.104 seconds* (not including face detection stage)
- Allowed head rotation: –30..30 degrees of in-plane rotation, –10..10 degrees out-of-plane rotation
- Returned information: array of 66 (x,y) coordinates of each facial feature point

Eye Centers Detection

- Detection of eye centers only, detection time: 0.0064 seconds* (not including face detection stage)
- Returned information: two (x,y) coordinates of left eye center and right eye center

Gender Recognition

- Recognition different genders

- Returned information: confidence level in each gender

Multi-Core Support

- The library uses all available processor cores when executing face detection or recognition functions, to maximize performance.

Library Size

- The size of the redistributables does not exceed 25.5MB for each platform.

* Measured on Intel Core i7 930 processor with 8 threads

Installation

Windows

To install Luxand FaceSDK, run the installation file:

```
Luxand_FaceSDK_Setup.exe
```

and follow the instructions.

FaceSDK is installed to the `C:\Program Files\Luxand\FaceSDK` directory by default. FaceSDK is a copy-protected library, and your application must activate the library on startup (see the Library Activation chapter).

Linux/Mac OS X

Unpack the `Luxand_FaceSDK.tar.bz2` archive into the desired directory.

Directory Structure

The FaceSDK directory contains the following directories and files:

bin	FaceSDK binary files
bin\android	FaceSDK Android binaries
bin\iOS	FaceSDK iOS binaries
bin\linux_x86	FaceSDK Linux 32-bit binaries
bin\linux_x86_64	FaceSDK Linux 64-bit binaries
bin\osx_x86_64	FaceSDK Mac OS X 64-bit binaries
bin\win32	FaceSDK Widows 32-bit binaries and stub library files
bin\win64	FaceSDK Windows 64-bit binaries and stub library files
demo	Demo applications (win32)

include	Header files
samples	Sample applications

Sample Applications

FaceSDK is distributed with the following sample applications (they can be found in the FaceSDK `samples\` directory):

1. **LiveRecognition**

   This application receives video from a camera, allows tagging any subject with a name, and then display the name (recognizing the subject). The application utilizes Tracker API. Source code is available on Microsoft C# 2005/2008, iOS, Android, Borland Delphi 6.0 and higher, Microsoft Visual C++ 2005/2008, Microsoft Visual Basic .NET 2005/2008, Java and Visual Basic 6.0. The iOS/Android versions are published in the Apple AppStore and in Google Play ("Luxand Face Recognition" application).

2. **FaceTracking**

   This application receives video from a webcam and highlights all detected faces with rectangles. The application utilizes Tracker API. Source code is available on Microsoft C# 2005/2008, Borland Delphi 6.0 and higher, Microsoft Visual C++ 2005/2008, Microsoft Visual Basic .NET 2005/2008, Java and Visual Basic 6.0.

3. **Lookalikes**

   This application allows the user to create a database of faces and run a search for the best matches (the most similar face from the database is shown). Source code is available on Microsoft Visual C++ 2005/2008, Microsoft C# 2005/2008 and Borland Delphi 6.0 and higher. There is an example of working with Microsoft SQL database on Microsoft C# 2005/2008, and with and SQLite on Microsoft Visual C++ 2005/2008. To run the Microsoft SQL example, you need to attach the database (located in the DB folder of the sample) to the Microsoft SQL Server.

4. **LiveFacialFeatures**

   This application tracks users' facial features in real time using a web camera. The coordinates of facial features are smoothed by Tracker API to prevent jitter. Source code is available on Microsoft C# 2005/2008, Borland Delphi 6.0 and higher, Java, Microsoft Visual C++ 2005/2008, iOS, Android and Microsoft Visual Basic .NET 2005/2008.

5. **GenderRecognition**

   Using Tracker API, this application recognizes the gender of a subject looking into a webcam. Source code is available on Microsoft C# 2005/2008, Borland Delphi 6.0 and higher, Java, Microsoft Visual C++ 2005/2008 and Microsoft Visual Basic .NET 2005/2008.

6. **FacialFeatures**

   This application opens a photograph, detects a face in a photo (only one face, the one that can be detected best), detects facial features and draws a frame around the detected face and detected features. Source code is available on Microsoft C#

2005/2008, Borland C++ Builder 6.0, Borland Delphi 6.0 and higher, Java, Microsoft Visual C++ 2005/2008, Microsoft Visual Basic .NET 2005/2008 and Visual Basic 6.0.

7. **IPCamera**

   This application opens an IP camera (allowing the user to specify its address, user name and password), displays the image from the camera and tracks faces. The application utilizes Tracker API. Source code is available on Microsoft C# 2005/2008, Borland Delphi 6.0 and higher, Java, Microsoft Visual C++ 2005/2008 and Microsoft Visual Basic .NET 2005/2008.

8. **Portrait**

   This application is for the command line. The application receives a picture, detects a face and, if the face is found, crops it and saves it to a file. Source code is available on C++.

9. **Advanced**

   This sample provides source code for .NET wrapper that links facesdk.dll dynamically. Refer to Using with .NET (C# and VB) for details. The sample also provides source code for Java wrapper

Using FaceSDK with Programming Languages

To access the FaceSDK library functions, you need to use its binary file in your applications. The specific file depends on the platform:

- Windows applications use `facesdk.dll`
- Windows .NET applications use `facesdk.NET.dll`
- Linux applications use `libfsdk.so`
- Mac OS X applications use `libfsdk.dylib`
- Java applications use `facesdk.jar` , `jna.jar` and the appropriate binary file (`facesdk.dll`,`libfsdk.dylib` or`libfsdk.so`)

It is usually recommended to store this file in the directory where the executable file of your application is located. Alternatively, you may keep the file in:

- the working directory of your application
- the directory specified in the path environment variable of your system: `PATH` (Windows), `LD_LIBRARY_PATH` (Linux), `DYLD_LIBRARY_PATH` (Mac OS X).

You need to include interface header files into your application project in order to use FaceSDK.

Note that iOS and Android builds do not support IP camera functions.

Using with .NET (C# and VB)

First, you need install .NET Framework 2.0 on your system. In Windows Vista/2008/7/8/2012 it can be done by enabling Microsoft .NET Framework 3.0 or 3.5 in Control Panel (Programs and Features – Turn Windows features on or off).

For Microsoft .NET applications, you need to add the .NET component into your project.

Follow these steps to add the component in Visual Studio 2005/2008/2010/2012:

- Select Project – Add Reference – Browse
- For 32-bit applications, choose the file `bin\win32\FaceSDK.NET.dll`
- For 64-bit native applications, choose the file `bin\win64\FaceSDK.NET.dll`
- Add the following statement to the beginning of your application:

```
using Luxand
```

After that you may use the methods of the `Luxand.FSDK` namespace for general FaceSDK functions, and `Luxand.FSDKCam` namespace for webcam-related functions. You may refer just to `FSDK` and `FSDKCam` namespaces if `using Luxand` is specified.

Once `FaceSDK.NET.dll` is added to the references, it will be redistributed automatically with your application, so no specific deployment actions are required. You do not need to redistribute `facesdk.dll` with your application. However, you need to redistribute Microsoft Visual C++ 2008 SP1 Runtime.

By default, the documentation refers to C/C++ declarations of FaceSDK functions. For example, the function to detect a face is referred to as `FSDK_DetectFace` function. To refer to this function in .NET, replace the `FSDK_` prefix with `FSDK.` namespace. Thus, the reference to this function becomes `FSDK.DetectFace` (note that webcam-specific functions are located in the `FSDKCam.` namespace; refer to Working with Web Cameras for details).

Note: This .NET component is available in a binary form, compatible with .NET 2.0, 3.0, 3.5, 4.0 and 4.5. To use the component with .NET 4.0 and 4.5 (in Visual Studio 2010 and 2012), just add the `useLegacyV2RuntimeActivationPolicy="true"` attribute to the `<startup>` section of the app.config file of your project. If there is no such file in your project, just create the file with the following content:

```
<?xml version="1.0"?>
<configuration>
<startup useLegacyV2RuntimeActivationPolicy="true">
<supportedRuntime version="v4.0"
sku=".NETFramework,Version=v4.0"/>
</startup>
</configuration>
```

If you need a component for a specific .NET version, you may use the source code available in the `samples\advanced\.NET wrapper` directory. Note that this component is actually a wrapper for facesdk.dll that is linked dynamically, so facesdk.dll must be redistributed with the application that uses this wrapper.

Using CImage class in .NET

CImage is a class for Microsoft .NET for easy manipulation of images. CImage encapsulates an HImage handle and provides convenient methods for applying FaceSDK functions to that image.

To start working with CImage, just create an instance of it. You can pass a file path, HImage handle, HBITMAP handle or System.Drawing.Image object to the constructor to load the corresponding object into the image. Alternatively, call the constructor without parameters to create an empty image. Refer to the functions FSDK_LoadImageFromFile, FSDK_LoadImageFromHBitmap, FSDK.LoadImageFromCLRImage and FSDK_CreateEmptyImage for further details.

A CImage instance has three properties: ImageHandle, Width and Height. ImageHandle is a handle of the internal representation of the image encapsulated by the class. Width and Height properties are the width and height of an image in pixels (see FSDK_GetImageWidth and FSDK_GetImageHeight). If you alter the ImageHandle handle directly (for example, executing an FSDK. method applied to that image handle), you must update the CImage object by calling the CImage.ReloadFromHandle() method. CImage throws an exception if any FaceSDK function, called within the CImage method, has returned an error.

Most CImage methods operating with an image (for example, the Resize() method) return the processed image as the result.

The CImage destructor releases ImageHandle, so there is no need to call FSDK.FreeImage explicitly after the instance has been destroyed.

Note that when you pass an existing image handle to the constructor, it will be freed after the destruction of the CImage class instance, and become invalid. If you need the original image handle to be valid after the CImage class instance is destroyed, consider creating a copy of the image handle and passing the copy to the CImage constructor.

CImage();

Creates an empty CImage instance.

Syntax:

```
FSDK.CImage();
```

CImage(Int);

Creates a CImage instance from image already loaded to FaceSDK.

Syntax:

```
FSDK.CImage(int ImageHandle);
```

Parameters:
ImageHandle – the internal handle of an image already loaded to FaceSDK. The destructor will free the ImageHandle handle.

CImage.ReloadFromHandle();

Updates the internal properties of a CImage instance in accordance with the ImageHandle.

Syntax:

```
FSDK.CImage.ReloadFromHandle();
```

Using with C/C++

For Microsoft Visual C++ applications, you need to include the header file `include\C\LuxandFaceSDK.h`, and the stub library file `facesdk.lib` into your project.

Follow these steps to add the library to your project:

- Copy `include\C\LuxandFaceSDK.h` into the directory of your project
- For 32-bit applications, copy `bin\win32\facesdk.dll` and `bin\win32\facesdk.lib` into the output directory of your project

- For 64-bit applications, copy `bin\win64\facesdk.dll` and `bin\win64\facesdk.lib` into the output directory of your project
- Choose Project Properties – Linker – Input – Additional Dependencies, and add `facesdk.lib` string
- Choose Project Properties – Linker – General – Additional Library Directories Dependencies, and add `$(OutDir)` string (a reference to the output directory)
- Add the following statement to the beginning of your application:

```
include "LuxandFaceSDK.h"
```

The output directory `$(OutDir)` typically refers to `Debug\` or `Release\` in the directory of your solution. You may change it in the Configuration Properties – General of your project. You may also choose another directory to store the .lib file, but it is recommended to keep `facesdk.dll` in the directory where the executable file of your application is located.

You need to redistribute the file `facesdk.dll` with your application.

Using with Delphi

For Delphi applications, put `facesdk.dll` into the working directory of your application and use the `include\Delphi\LuxandFaceSDK.pas` unit in your project.

You need to redistribute the file `facesdk.dll` with your application.

Using with Java

You need JDK 1.6 (or OpenJDK 1.6) to use FaceSDK with Java. The FaceSDK Java wrapper uses JNA (all information about JNA and the actual version can be found at https://github.com/twall/jna, but jna.jar is included in the distribution for your convenience). The FaceSDK java wrapper works with any IDE, but only Netbeans sample projects are provided with the distribution.

To use FaceSDK in your Netbeans project, follow these steps:

1) Add FaceSDK.jar (`include\Java\FaceSDK.jar`) and jna.jar (`include\Java\jna.jar`) to the Librariessection of the project.
2) Add the following imports to your source code:

```
import Luxand.*;
import Luxand.FSDK.*;
import Luxand.FSDKCam.*;
```

3) Put the appropriate facesdk binaries (`facesdk.dll`, `libfdsk.so` or `libfdsk.dylib`) in the project directory (or to the `/usr/lib`directory if using OpenJDK).

You need to redistribute the FaceSDK binaries (`facesdk.dll`, `libfdsk.so` or `libfdsk.dylib`) as well as `FaceSDK.jar` and `jna.jar` with your application.

Using with Cocoa

If you are using Cocoa to write an application in XCode, make sure that your source code files (which use FaceSDK) have the `.mm` extension, so they are compiled as Objective-C++. If the files have the `.m` extension, they are compiled as Objective-C and cannot use FaceSDK.

Using with VisualBasic 6.0

For Visual Basic 6.0 applications, put the Visual Basic wrapper (`bin\win32\FaceSDK-VB.dll`) into the project directory and add `LuxandFaceSDK.bas` (`include\VB6\LuxandFaceSDK.bas`) module to your project (Select Project – Add module – Existing and choose a module location). Also you need to put `facesdk.dll` into the application working directory.

Note that Tracker API functions employ the Currency data type to store 64-bit integer values. You need to redistribute both `FaceSDK-VB.dll` and `facesdk.dll` with your application.

Using with iOS

Refer to the "Using with Cocoa" section. You should use the C++ syntax within your program.

To enable FaceSDK support in your Xcode iOS project, add `bin/iOS/libfsdk-static.a`, `bin/iOS/libfsdk-static_64.a` and `include/iOS/LuxandFaceSDK.h` to your project.

Using with Android

You will need to copy the subdirectories contained in `bin/android/` to the `libs/` directory of your project. Also you need to add the `include/android/FSDK.java` file to `src/com/luxand/`.

The syntax of some functions on Android is different from the corresponding Java syntax due to the usage of JNI instead of JNA.

Note: Only armv7 (armeabi-v7a) and x86 architectures are supported by FaceSDK on the Android platform.

Unicode support

The library supports Unicode filenames on the Windows platform. If you work with file names in the Unicode character set, use functions FSDK_LoadImageFromFileW and FSDK_SaveImageToFileW to open and save files.

Redistributables

The following files may be redistributed with your application:

Windows	`bin\win32\facesdk.dll` (for 32-bit systems) `bin\win64\facesdk.dll` (for 64-bit systems) `bin\win32\facesdk.NET.dll` (for 32-bit .NET applications) `bin\win64\facesdk.NET.dll` (for 64-bit .NET applications) `bin\win32\FaceSDK-VB.dll` (for Visual Basic 6.0 applications)
Linux	`bin\linux_x86\libfsdk.so` (for 32-bit systems) `bin\linux_x86_64\libfsdk.so` (for 64-bit systems)
Mac OS X	`bin\osx_x86_64\libfsdk.dylib` (for 64-bit systems)

Android	bin\android\armeabi-v7a\libfsdk.so bin\android\x86\libfsdk.so bin\android\armeabi-v7a\libstlport_shared.so bin\android\x86\libstlport_shared.so
iOS	NONE (static libraries)
All platforms	include\Java\FaceSDK.jar (for Java applications) include\Java\jna.jar (for Java applications)

Usage Scenarios

The library usage level depends on the functionality required from Luxand FaceSDK.

If you work with video, consider using Tracker API, as the API provides high-level functions to recognize subjects and tag them with names, to track their faces and facial features, and to recognize gender. The usage scenario for Tracker API can be found in the Usage Scenario section of the Tracker API chapter.

Otherwise, the typical scenario is as follows:

1. Activate FaceSDK by calling up the FSDK_ActivateLibrary function with the key sent by Luxand, Inc.
2. Initialize FaceSDK by calling up the FSDK_Initialize function.
3. Load images either from a file, a buffer or the HBITMAP handle (FSDK_LoadImageFromFile, FSDK_LoadImageFromBuffer, FSDK_LoadImageFromHBitmap functions).
4. Set face detection parameters if needed (FSDK_SetFaceDetectionParameters, FSDK_SetFaceDetectionThreshold).
5. Use FaceSDK functions:
    - Detect a face (FSDK_DetectFace) or multiple faces (FSDK_DetectMultipleFaces) in an image
    - Detect facial features if needed (FSDK_DetectFacialFeatures, FSDK_DetectFacialFeaturesInRegion)
    - Extract a face template from the image (FSDK_GetFaceTemplate, FSDK_GetFaceTemplateInRegion, FSDK_GetFaceTemplateUsingEyes, FSDK_GetFaceTemplateUsingFeatures)
    - Match the face templates (FSDK_MatchFaces) and acquire the facial similarity level
    - To find out if a face belongs to the same person, calculate the matching threshold at a given FAR or FRR rate (FSDK_GetMatchingThresholdAtFAR and FSDK_GetMatchingThresholdAtFRR functions).
6. Finalize the FaceSDK library (FSDK_Finalize function).

To work with a camera, follow these steps*:

1. Initialize camera capturing (FSDK_InitializeCapturing).
2. Get a list of web cameras available in the system (FSDK_GetCameraList)
3. Get list of video formats supported by the web camera (FSDK_GetVideoFormatList).
4. Set the desired video format for the chosen web camera (FSDK_SetVideoFormat).

5. Open a web camera (FSDK_OpenVideoCamera) or an IP camera (FSDK_OpenIPVideoCamera).
6. Grab frames (FSDK_GrabFrame) in a loop, displaying them and detecting/recognizing faces.
7. Close video camera (FSDK_CloseVideoCamera).
8. Delete the list of video formats (FSDK_FreeVideoFormatList).
9. Delete the list of web cameras (FSDK_FreeCameraList).
10. Finalize capturing (FSDK_FinalizeCapturing).

*If you work with an IP camera, you should not follow steps 2, 3, 4, 8 and 9.

Library Activation

FaceSDK is a copy-protected library, and must be activated with a license key before its use. You need to pass the license key received from Luxand, Inc. to the FSDK_ActivateLibrary function before initializing Luxand FaceSDK. Almost all FaceSDK functions will return the FSDKE_NOT_ACTIVATED error code in case the library is not activated. To retrieve your license information, call FSDK_GetLicenseInfo. This function returns the name the library is licensed to. You may need to use the FSDK_GetHardware_ID function to obtain your hardware ID if your license is restricted to one machine only. Additionally, you can find out hardware ID by running the `hardwareid` program (`ShowHardwareID.exe` for Windows), which is located in the `bin` directory.

To get a temporary evaluation key from Luxand, Inc., run License Key Wizard from the Start – Luxand – FaceSDK menu. You may also request this key at

http://luxand.com/facesdk/requestkey/.

FSDK_GetHardware_ID Function

Generates a Hardware ID code.

C++ Syntax:

```
int FSDK_GetHardware_ID(char* HardwareID);
```

Delphi Syntax:

```
function FSDK_GetHardware_ID(HardwareID: PChar): integer;
```

C# Syntax:

```
int FSDK.GetHardwareID(out string HardwareID);
```

VB Syntax:

```
Function FSDKVB_GetHardwareID(ByRef HardwareID As Byte) As
Long
```

Java Syntax:

```
int GetHardware_ID(String HardwareID[]);
```

iOS and Android: not implemented.

Parameters:

HardwareID – address of the null-terminated string for receiving the Hardware ID code.

Return Value:

Returns FSDKE_OK if successful.

FSDK_ActivateLibrary Function

Activates the FaceSDK library.

C++ Syntax:

```
int FSDK_ActivateLibrary(char* LicenseKey);
```

Delphi Syntax:

```
function FSDK_ActivateLibrary(LicenseKey: PChar): integer;
```

C# Syntax:

```
int FSDK.ActivateLibrary(out string LicenseKey);
```

VB Syntax:

```
Function FSDKVB_ActivateLibrary(ByVal LicenseKey As String) As
Long
```

Java and Android Syntax:

```
int FSDK.ActivateLibrary(String LicenseKey);
```

Parameters:

LicenseKey– License key you received from Luxand, Inc.

Return Value:

Returns FSDKE_OK if the registration key is valid and not expired.

FSDK_GetLicenseInfo Function

Retrieves license information.

C++ Syntax:

```
int FSDK_GetLicenseInfo(char* LicenseInfo);
```

Delphi Syntax:

```
function FSDK_GetLicenseInfo(LicenseInfo: PAnsiChar): integer;
```

C# Syntax:

```
int FSDK.GetLicenseInfo(out string LicenseInfo);
```

VB Syntax:

```
Function FSDKVB_GetLicenseInfo(ByRef LicenseInfo As Byte) As
Long
```

Java and Android Syntax:

```
int FSDK.GetLicenseInfo(String LicenseInfo[]);
```

Parameters:

LicenseInfo – address of the null-terminated string for receiving the license information. This variable should be allocated no less than 256 bytes of memory.

Return Value:

Returns FSDKE_OK if successful.

Initialization

FSDK_Initialize Function

Initializes the FaceSDK library. Should be called before using of any face detection functions.

C++ Syntax:

```
int FSDK_Initialize(char* DataFilesPath);
```

Delphi Syntax:

```
function FSDK_Initialize(DataFilesPath: PChar): integer;
```

C# Syntax:

```
int FSDK.InitializeLibrary();
```

VB Syntax:

```
Function FSDKVB_Initialize(ByRef DataFilesPath As Byte) As
Long
```

Java and Android Syntax:

```
int FSDK.Initialize();
```

Parameters:

DataFilesPath – pointer to the null-terminated string specifying the path where facesdk.dll is stored. An empty string means the current directory. (Note: the parameter is not used since version 1.8; an empty string might be passed as this parameter.)

Return Value:

Returns FSDKE_OK if successful or FSDK_IO_ERROR if an I/O error occurs.

FSDK_Finalize Function

Finalizes the FaceSDK library. Should be called when the application is exited.

C++ Syntax:

```
int FSDK_Finalize();
```

Delphi Syntax:

```
function FSDK_Finalize: integer;
```

C# Syntax:

```
int FSDK.FinalizeLibrary();
```

VB Syntax:

```
Function FSDKVB_Finalize() As Long
```

Java and Android Syntax:

```
int FSDK.Finalize();
```

Return Value:

Returns FSDKE_OK if successful.

Working with Images

Images are represented as the HImage data type.

C++ Declaration:

```
typedef int HImage;
```

C# Declaration:

```
int Image
```

Delphi Declaration:

```
HImage = integer;
PHImage = ^HImage;
```

Java and Android Declaration:

```
class HImage {
    protected int himage;
};
```

FaceSDK provides a number of functions to load images to the internal representation from files, buffers or HBITMAP handles and to save images from the internal representation to files, buffers and HBITMAP handles. Each FSDK_LoadImageFromXXXX function creates a new HImage handle, which can be deleted using the FSDK_FreeImage function.

Note that when you perform multiple stages of recognition on large images (for example, when you first detect a face, and then create its template using FSDK_GetFaceTemplateInRegion), consider first resizing the image to a smaller size to speed up operations. Note that you must resize the image to dimensions no smaller than the InternalResizeWidth parameter of the FSDK_SetFaceDetectionParameters function if you perform face detection, in order to keep the same accuracy of face detection.

FSDK_CreateEmptyImage Function

Creates a handle of an empty image. You don't need to call this function before calling FSDK_LoadImageFromXXXX since these functions already create the HImage handle. Should be called before using the FSDK_CopyImage, FSDK_ResizeImage, FSDK_RotateImage, FSDK_RotateImageCenter, FSDK_RotateImage90, FSDK_MirrorImage, FSDK_CopyRect, FSDK_CopyRectReplicateBorder functions to create the handle of the destination image.

C++ Syntax:

```
int FSDK_CreateEmptyImage(HImage* Image);
```

Delphi Syntax:

```
function FSDK_CreateEmptyImage (Image: PHImage): integer;
```

C# Syntax:

```
int FSDK.CreateEmptyImage(refint Image);
```

VB Syntax:

```
Function FSDKVB_CreateEmptyImage(ByRef Image As Long) As Long
```

Java and Android Syntax:

```
int FSDK.CreateEmptyImage(HImage Image);
```

Parameters:

Image – pointer to HImage for creating the image handle.

Return Value:

Returns FSDKE_OK if successful.

FSDK_LoadImageFromFile Function

Loads the image from a file and provides the internal handle of this image.

C++ Syntax:

```
int FSDK_LoadImageFromFile(HImage* Image, char* FileName);
```

Delphi Syntax:

```
function FSDK_LoadImageFromFile(Image: PHImage; FileName:
PAnsiChar): integer;
```

C# Syntax:

```
int FSDK.LoadImageFromFile(ref int Image, string FileName)
```

VB Syntax:

```
Function FSDKVB_LoadImageFromFile(ByRef Image As Long, ByVal
FileName As String) As Long
```

Java and Android Syntax:

```
int FSDK.LoadImageFromFile(HImage Image, String FileName);
```

CImage Syntax:

```
int FSDK.CImage(String FileName);
```

Parameters:

Image – pointer to HImage for receiving the loaded image handle.
FileName – filename of the image to be loaded. FaceSDK supports the JPG, PNG and BMP file formats.

Return Value:

Returns FSDKE_OK if successful.

FSDK_LoadImageFromFileW Function

Loads the image from a file path in the Unicode character set and provides the internal handle of this image. The function is available only on Windows platforms.

C++ Syntax:

```
int FSDK_LoadImageFromFileW(HImage* Image, wchar_t* FileName);
```

Delphi Syntax:

```
function FSDK_LoadImageFromFileW(Image: PHImage; FileName:
PWideChar): integer;
```

C# Syntax:

```
int FSDK.LoadImageFromFileW(ref int Image, string FileName)
```

Java Syntax:

```
int FSDK.LoadImageFromFileW(HImage Image, String FileName);
```

Parameters:

Image – pointer to HImage for receiving the loaded image handle.
FileName – filename of the image to be loaded. FaceSDK supports the JPG, PNG and BMP file formats.

Return Value:

Returns FSDKE_OK if successful.

This function is not available in Visual Basic 6.0.

FSDK_SaveImageToFile Function

Saves an image to a file. When saving to .jpg files, you can set the quality of JPEG compression using the FSDK_SetJpegCompressionQuality function.

C++ Syntax:

```
int FSDK_SaveImageToFile(HImage Image, char* FileName);
```

Delphi Syntax:

```
function FSDK_SaveImageToFile(Image: HImage; FileName:
PAnsiChar): integer;
```

C# Syntax:

```
int FSDK.SaveImageToFile(int Image, string FileName);
```

VB Syntax:

```
Function FSDKVB_SaveImageToFile(ByVal Image As Long, ByVal
FileName As String) As Long
```

Java and Android Syntax:

```
int FSDK.SaveImageToFile(HImage Image, String FileName);
```

CImage Syntax:

```
void FSDK.CImage.Save(string FileName);
```

Parameters:

Image – internal handle of an image to be saved.
FileName – name of file the image will be saved to. FaceSDK saves images in the BMP, PNG or JPG file format. The format to use is recognized by the extension specified in the `FileName` parameter.

Return Value:

Returns FSDKE_OK if successful.

Example

```
int img1;

FSDK_Initialize("");
FSDK_LoadImageFromFile(&img1, "test.bmp"); // load .bmp file
FSDK_SaveImageToFile(img1, "test.jpg"); // save as .jpg
```

FSDK_SaveImageToFileW Function

Saves an image to a file path in the Unicode character set. The function is available only on Windows platforms. When saving to .jpg files, you can set the quality of the JPEG compression using the FSDK_SetJpegCompressionQuality function.

C++ Syntax:

```
int FSDK_SaveImageToFileW(HImage Image, wchar_t* FileName);
```

Delphi Syntax:

```
function FSDK_SaveImageToFileW(Image: HImage; FileName:
PWideChar): integer;
```

C# Syntax:

```
int FSDK.SaveImageToFileW(int Image, string FileName);
```

Java Syntax:

```
int FSDK.SaveImageToFileW(HImage Image, String FileName);
```

Parameters:

Image – internal handle of an image to be saved.
FileName – name of file the image will be saved to. FaceSDK saves images in the BMP, PNG or JPG file format. The format to use is recognized by the extension specified in the `FileName` parameter.

Return Value:

Returns FSDKE_OK if successful.

The function is not available in Visual Basic 6.0

FSDK_LoadImageFromBuffer Function

Loads an image from a buffer and provides the internal handle of this image. The function suggests that the image data is organized in a top-to-bottom order, and the distance between adjacent rows is ScanLine bytes (for example, in the 24-bit image, the ScanLine value might be 3*Width bytes if there is no spacing between adjacent rows). The following image modes are supported:

Mode name	Meaning
FSDK_IMAGE_GRAYSCALE_8BIT	8-bit grayscale image
FSDK_IMAGE_COLOR_24BIT	24-bit color image (R, G, B order)
FSDK_IMAGE_COLOR_32BIT	32-bit color image with alpha channel (R, G, B, A order)

The function is not available in .NET and Java. It is suggested to use FSDK.LoadImageFromCRLImage in .NET, and FSDK.LoadImageFromAWTImage in Java instead.

C++ Syntax:

```
int FSDK_LoadImageFromBuffer(HImage* Image, unsigned char*
Buffer, int Width, int Height, int ScanLine, FSDK_IMAGEMODE
ImageMode);
```

Delphi Syntax:

```
function FSDK_LoadImageFromBuffer(Image: PHImage; var Buffer;
Width, Height: integer; ScanLine: integer; ImageMode:
FSDK_IMAGEMODE): integer;
```

VB Syntax:

```
Function FSDKVB_LoadImageFromBuffer(ByRef Image As Long, ByRef
Buffer As Byte, ByVal Width As Long, ByVal Height As Long,
ByVal ScanLine As Long, ByVal ImageMode As FSDK_IMAGEMODE) As
Long
```

Android Syntax:

```
int LoadImageFromBuffer(HImage Image, byte Buffer[], int
Width, int Height, int ScanLine, FSDK_IMAGEMODE ImageMode);
```

Parameters:

Image – pointer to HImage for receiving the loaded image handle.
Buffer – pointer to buffer containing image data.
Width – width of an image in pixels.
Height – height of an image in pixels.
ScanLine – distance between adjacent rows in bytes.
ImageMode – mode of an image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_LoadImageFromJpegBuffer Function

Loads an image from a buffer containing JPEG data, and provides the handle of this image.

C++ Syntax:

```
int FSDK_LoadImageFromJpegBuffer (HImage* Image, unsigned
char* Buffer, unsigned int BufferLength);
```

Delphi Syntax:

```
function FSDK_LoadImageFromJpegBuffer (Image: PHImage; var
Buffer; BufferLength: integer): integer;
```

VB Syntax:

```
Function FSDKVB_LoadImageFromJpegBuffer (ByRef Image As Long,
ByRef Buffer As Byte, ByVal BufferLength As Long) As Long
```

Android Syntax:

```
int LoadImageFromJpegBuffer(HImage Image, byte Buffer[], int
BufferLength);
```

Parameters:

Image – pointer to HImage for receiving the loaded image handle.
Buffer – pointer to the buffer containing the image data in JPEG format (usually loaded from a JPEG file).
BufferLength – size of buffer in bytes.

Return Value:

Returns FSDKE_OK if successful.

This function is not available in .NET and Java.

FSDK_LoadImageFromPngBuffer Function

Loads an image from a buffer containing PNG data and provides the handle of this image.

C++ Syntax:

```
int FSDK_LoadImageFromPngBuffer (HImage* Image, unsigned char*
Buffer, unsigned int BufferLength);
```

Delphi Syntax:

```
function FSDK_LoadImageFromPngBuffer (Image: PHImage; var
Buffer; BufferLength: integer): integer;
```

VB Syntax:

```
Function FSDKVB_LoadImageFromPngBuffer (ByRef Image As Long,
ByRef Buffer As Byte, ByVal BufferLength As Long) As Long
```

Android Syntax:

```
int LoadImageFromPngBuffer(HImage Image, byte Buffer[], int
BufferLength);
```

Parameters:

Image – pointer to HImage for receiving the loaded image handle.
Buffer – pointer to the buffer containing the image data in PNG format (usually loaded from a PNG file).
BufferLength – size of buffer in bytes.

Return Value:

Returns FSDKE_OK if successful.

The function is not available in .NET and Java.

FSDK_GetImageBufferSize Function

Returns the size of the buffer required to store an image.

C++ Syntax:

```
int FSDK_GetImageBufferSize(HImage Image, int * BufSize,
FSDK_IMAGEMODE ImageMode);
```

Delphi Syntax:

```
function FSDK_GetImageBufferSize(Image: HImage; BufSize:
PInteger; ImageMode: FSDK_IMAGEMODE): integer;
```

VB Syntax:

```
Function FSDKVB_GetImageBufferSize(ByVal Image As Long, ByRef
BufSize As Long, ByVal ImageMode As FSDK_IMAGEMODE) As Long
```

Android Syntax:

```
int GetImageBufferSize(HImage Image, int BufSize[],
FSDK_IMAGEMODE ImageMode);
```

The function is not available in .NET.

Parameters:

Image – internal handle of an image.
BufSize – pointer to an integer variable to store the calculated buffer size.
ImageMode – desired image mode of a buffer.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SaveImageToBuffer Function

Saves an image to a buffer in the desired image mode. Refer to the FSDK_LoadImageFromBuffer function description to read more about image modes.

C++ Syntax:

```
int FSDK_SaveImageToBuffer(HImage Image, unsigned char*
Buffer, FSDK_IMAGEMODE ImageMode);
```

Delphi Syntax:

```
function FSDK_SaveImageToBuffer(Image: HImage; var Buffer;
ImageMode: FSDK_IMAGEMODE): integer;
```

VB Syntax:

```
Function FSDKVB_SaveImageToBuffer(ByVal Image As Long, ByRef
Buffer As Byte, ByVal ImageMode As FSDK_IMAGEMODE) As Long
```

Android Syntax:

```
int SaveImageToBuffer(HImage Image, byte Buffer[],
FSDK_IMAGEMODE ImageMode);
```

The function is not available in .NET and Java. It is suggested to use FSDK_SaveImageToCLRImage in .NET, and FSDK_SaveImageToAWTImage in Java instead.

Parameters:

Image – internal handle of an image to be saved.
Buffer – pointer to the buffer containing the image data.
ImageMode – desired mode an image will be saved in.

Return Value:

Returns FSDKE_OK if successful.

FSDK_LoadImageFromHBitmap Function

Loads the image from an HBITMAP handle and provides the internal handle of this image.

C++ Syntax:

```
int FSDK_LoadImageFromHBitmap(HImage* Image, HBITMAP*
BitmapHandle);
```

Delphi Syntax:

```
function FSDK_LoadImageFromHBitmap(Image: PHImage;
BitmapHandle: HBitmap): integer;
```

C# Syntax:

```
int FSDK.LoadImageFromHBitmap(ref int Image, IntPtr
BitmapHandle);
```

VB Syntax:

```
Function FSDKVB_LoadImageFromHBitmap(ByRef Image As Long,
ByVal BitmapHandle As Integer) As Long
```

CImage Syntax:

```
FSDK.CImage(IntPtr BitmapHandle);
```

Parameters:

Image – pointer to HImage for receiving the loaded image handle.
BitmapHandle – handle of the image to be loaded.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SaveImageToHBitmap Function

Creates an HBITMAP handle containing the image.

C++ Syntax:

```
int FSDK_SaveImageToHBitmap(HImage Image, HBITMAP*
BitmapHandle);
```

Delphi Syntax:

```
function FSDK_SaveImageToHBitmap(Image: HImage; BitmapHandle:
PHBitmap): integer;
```

C# Syntax:

```
int FSDK.SaveImageToHBitmap(int Image, ref IntPtr
BitmapHandle);
```

VB Syntax:

```
Function FSDKVB_SaveImageToHBitmap(ByVal Image As Long, ByRef
BitmapHandle As Integer) As Long
```

CImage Syntax:

```
IntPtr FSDK.CImage.GetHbitmap();
```

Parameters:

Image – internal handle of the image to be saved to HBITMAP.
BitmapHandle – pointer to HBITMAP the created HBITMAP handle will be saved to.

Return Value:

Returns FSDKE_OK if successful.

FSDK.LoadImageFromCLRImage Function

Loads the image from the System.Drawing.Image object and provides the internal handle of this image.

C# Syntax:

```
int FSDK.LoadImageFromCLRImage(ref int Image,
System.Drawing.Image ImageObject);
```

CImage Syntax:

```
FSDK.CImage(System.Drawing.Image ImageObject);
```

Parameters:

Image – reference to HImage for receiving the loaded image handle.
ImageObject – object of the image to be loaded.

Return Value:

Returns FSDKE_OK if successful.

FSDK.SaveImageToCLRImage Function

Creates a System.Drawing.Image object containing the image.

C# Syntax:

```
int FSDK.SaveImageToCLRImage(int Image, ref
System.Drawing.Image ImageObject);
```

CImage Syntax:

```
System.Drawing.Image FSDK.CImage.ToCLRImage();
```

Parameters:

Image – internal handle of the image to be saved to System.Drawing.Image.
ImageObject– reference to System.Drawing.Image object the image will be saved to.

Return Value:

Returns FSDKE_OK if successful.

FSDK.LoadImageFromAWTImage Function

Loads the image from the java.awt.Image object and provides the internal handle of this image.

Java Syntax:

```
int FSDK.LoadImageFromAWTImage(HImage Image, java.awt.Image
SourceImage, int ImageMode);
```

Parameters:

Image – HImage for receiving the loaded image.
SourceImage – java.awt.Image object of the image to be loaded.
ImageMode – mode of an image. (See FSDK_LoadImageFromBuffer for more information about image modes.)

Return Value:

Returns FSDKE_OK if successful.

FSDK.SaveImageToAWTImage Function

Creates a java.awt.Image object containing the image.

Java Syntax:

```
int FSDK.SaveImageToAWTImage(HImage Image, java.awt.Image
DestImage[], int ImageMode);
```

Parameters:

Image – internal handle of the image to be saved to System.Drawing.Image.
DestImage[] – java.awt.Image object the image will be saved to.
ImageMode – desired mode an image will be saved in.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetJpegCompressionQuality

Sets the quality of the JPEG compression to use in the FSDK_SaveImageToFile function.

C++ Syntax:

```
int FSDK_SetJpegCompressionQuality(int Quality);
```

Delphi Syntax:

```
function FSDK_SetJpegCompressionQuality(Quality: integer):
integer;
```

C# Syntax:

```
int FSDK.SetJpegCompressionQuality(int Quality);
```

VB Syntax:

```
Function FSDKVB_SetJpegCompressionQuality(ByVal Quality As
Long) As Long
```

Java and Android Syntax:

```
int FSDK.SetJpegCompressionQuality(int Quality);
```

Parameters:

Quality – quality of JPEG compression. Varies from 0 to 100.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetImageWidth Function

Returns the width of an image.

C++ Syntax:

```
int FSDK_GetImageWidth(HImage SourceImage, int* Width);
```

Delphi Syntax:

```
function FSDK_GetImageWidth(SourceImage: HImage; Width:
PInteger): integer;
```

C# Syntax:

```
int FSDK.GetImageWidth(int SourceImage, ref int Width);
```

VB Syntax:

```
Function FSDKVB_GetImageWidth(ByVal SourceImage As Long, ByRef
Width As Long) As Long
```

Java and Android Syntax:

```
int FSDK.GetImageWidth(HImage SourceImage, int Width[]);
```

CImage Syntax:

```
int FSDK.CImage.Width;
```

Parameters:

SourceImage – internal handle of an image.
Width – pointer to an integer variable to store the width of an image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetImageHeight Function

Returns the height of an image.

C++ Syntax:

```
int FSDK_GetImageHeight(HImage SourceImage, int* Height);
```

Delphi Syntax:

```
function FSDK_GetImageHeight(SourceImage: HImage; Height:
PInteger): integer;
```

C# Syntax:

```
int FSDK.GetImageHeight(int SourceImage, ref int Height);
```

VB Syntax:

```
Function FSDKVB_GetImageHeight(ByVal SourceImage As Long,
ByRef Height As Long) As Long
```

Java and Android Syntax:

```
int FSDK.GetImageHeight(HImage SourceImage, int Height[]);
```

CImage Syntax:

```
int FSDK.CImage.Height;
```

Parameters:

SourceImage – internal handle of an image.
Height – pointer to an integer variable to store the height of an image.

Return Value:

Returns FSDKE_OK if successful.FSDK_CopyImage Function

Creates a copy of an image. The handle of the destination image should be created with the FSDK_CreateEmptyImage function.

C++ Syntax:

```
int FSDK_CopyImage(HImage SourceImage, HImage DestImage);
```

Delphi Syntax:

```
function FSDK_CopyImage(SourceImage: HImage; DestImage:
HImage): integer;
```

C# Syntax:

```
int FSDK.CopyImage(int SourceImage, int DestImage);
```

VB Syntax:

```
Function FSDKVB_CopyImage(ByVal SourceImage As Long, ByVal
DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.CopyImage(HImage SourceImage, HImage DestImage);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.Copy();
```

Parameters:

SourceImage – handle of an image to be copied.
DestImage – handle of the destination image.
Return Value:
Returns FSDKE_OK if successful.

FSDK_ResizeImage Function

Changes the size of an image. The handle of the destination image should be created with the FSDK_CreateEmptyImage function.

C++ Syntax:

```
int FSDK_ResizeImage(HImage SourceImage, double ratio, HImage
DestImage);
```

Delphi Syntax:

```
function FSDK_ResizeImage (SourceImage: HImage; ratio: double;
DestImage: HImage): integer;
```

C# Syntax:

```
int FSDK.ResizeImage(int SourceImage, double ratio, int
DestImage);
```

VB Syntax:

```
Function FSDKVB_ResizeImage (ByVal SourceImage As Long, ByVal
ratio As Double, ByVal DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.ResizeImage(HImage SourceImage, double ratio, HImage
DestImage);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.Resize(double ratio);
```

Parameters:

SourceImage – handle of an image to be resized.
Ratio – factor by which the x and y dimensions of the source image are changed. A factor value greater than 1 corresponds to increasing the image size.
DestImage – handle of the destination image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_RotateImage Function

Rotates an image around its center. The handle of the destination image should be created with the FSDK_CreateEmptyImage function.

C++ Syntax:

```
int FSDK_RotateImage(HImage SourceImage, double angle, HImage
DestImage);
```

Delphi Syntax:

```
function FSDK_RotateImage (SourceImage: HImage; angle: double;
DestImage: HImage): integer;
```

C# Syntax:

```
int FSDK.RotateImage (int SourceImage, double angle, int
DestImage);
```

VB Syntax:

```
Function FSDKVB_RotateImage (ByVal SourceImage As Long, ByVal
angle As Double, ByVal DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.RotateImage(HImage SourceImage, double angle, HImage
DestImage);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.Rotate(double angle);
```

Parameters:

SourceImage – handle of an image to be rotated.
Angle – rotation angle in degrees.
DestImage – handle of the destination image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_RotateImageCenter Function

Rotates an image around an arbitrary center. The handle of the destination image should be created with the FSDK_CreateEmptyImage function.

C++ Syntax:

```
int FSDK_RotateImageCenter(HImage SourceImage, double angle,
double xCenter, double yCenter, HImage DestImage);
```

Delphi Syntax:

```
function FSDK_RotateImageCenter (SourceImage: HImage; angle:
double;  xCenter: double; yCenter: double; DestImage:
HImage;): integer;
```

C# Syntax:

```
int FSDK.RotateImageCenter (int SourceImage, double angle,
double xCenter, double yCenter, int DestImage);
```

VB Syntax:

```
Function FSDKVB_RotateImageCenter (ByVal SourceImage As Long,
ByVal angle As Double, ByVal xCenter As Double, ByVal yCenter
As Double, ByVal DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.RotateImageCenter(HImage SourceImage, double angle,
double xCenter, double yCenter, HImage DestImage);
```

Parameters:

SourceImage – handle of an image to be rotated.
Angle – rotation angle in degrees.
xCenter – the X coordinate of the rotation center.
yCenter – the Y coordinate of the rotation center.
DestImage – handle of the destination image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_RotateImage90 Function

Rotates the image by 90 or 180 degrees clockwise or counter-clockwise. The handle of the destination image should be created with the FSDK_CreateEmptyImage function.

C++ Syntax:

```
int FSDK_RotateImage90(HImage SourceImage, int Multiplier,
HImage DestImage);
```

Delphi Syntax:

```
function FSDK_RotateImage90(SourceImage: HImage; Multiplier:
integer;DestImage: HImage): integer;
```

C# Syntax:

```
int FSDK.RotateImage90(int SourceImage, int Multiplier, int
DestImage);
```

VB Syntax:

```
Function FSDKVB_RotateImage90(ByVal SourceImage As Long, ByVal
Multiplier As Long, ByVal DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.RotateImage90(HImage SourceImage, int Multiplier,
HImage DestImage);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.Rotate90(int Multiplier);
```

Parameters:

SourceImage – handle of an image to be rotated.
Multiplier – an integer multiplier of 90 degrees defining the rotation angle. Specify 1 for 90 degrees clockwise, 2 for 180 degrees clockwise; specify -1 for 90 degrees counter-clockwise.
DestImage – handle of the destination image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_CopyRect Function

Creates a copy of a rectangular area of an image. The handle of the destination image should be created with the FSDK_CreateEmptyImage function. If some apex of a rectangle is located outside the source image, rectangular areas that do not contain the source image will be black.

C++ Syntax:

```
int FSDK_CopyRect(HImage SourceImage, int x1, int y1, int x2,
int y2, HImage DestImage);
```

Delphi Syntax:

```
function FSDK_CopyRect (SourceImage: HImage; x1, y1, x2, y2:
integer;  DestImage: HImage): integer;
```

C# Syntax:

```
int FSDK.CopyRect (int SourceImage, int x1, int y1, int x2,
int y2, int DestImage);
```

VB Syntax:

```
Function FSDKVB_CopyRect (ByVal SourceImage As Long, ByVal x1
As Long, ByVal y1 As Long, ByVal x2 As Long, ByVal y2 As Long,
ByVal DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.CopyRect(HImage SourceImage, int x1, int y1, int x2,
int y2, HImage DestImage);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.CopyRect(int x1, int y1, int x2, int
y2);
```

Parameters:

SourceImage – handle of an image to copy the rectangle from.
x1 – the X coordinate of the bottom left corner of the copied rectangle.
y1 – the Y coordinate of the bottom left corner of the copied rectangle.
x2 – the X coordinate of the top right corner of the copied rectangle.
y2 – the Y coordinate of the top right corner of the copied rectangle.
DestImage – handle of the destination image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_CopyRectReplicateBorder Function

Creates a copy of a rectangular area of an image and adds replicated border pixels. The handle of the destination image should be created with the FSDK_CreateEmptyImage function.
This function copies the source image to the destination image and fills pixels ("border") outside the copied area in the destination image with the values of the nearest source image pixels.

C++ Syntax:

```
int FSDK_CopyRectReplicateBorder(HImage SourceImage, int x1,
int y1, int x2, int y2, HImage DestImage);
```

Delphi Syntax:

```
function FSDK_CopyRectReplicateBorder(SourceImage: HImage; x1,
y1, x2, y2: integer; DestImage: HImage): integer;
```

C# Syntax:

```
int FSDK.CopyRectReplicateBorder(int SourceImage, int x1, int
y1, int x2, int y2, int DestImage);
```

VB Syntax:

```
Function FSDKVB_CopyRectReplicateBorder(ByVal SourceImage As
Long, ByVal x1 As Long, ByVal y1 As Long, ByVal x2 As Long,
ByVal y2 As Long, ByVal DestImage As Long) As Long
```

Java and Android Syntax:

```
int FSDK.CopyRectReplicateBorder(HImage SourceImage, int x1,
int y1, int x2, int y2, HImage DestImage);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.CopyRectReplicateBorder(int x1, int
y1, int x2, int y2);
```

Parameters:

SourceImage – handle of an image to copy the rectangle from.
x1 – the X coordinate of the left bottom corner of the copied rectangle.
y1 – the Y coordinate of the left bottom corner of the copied rectangle.
x2 – the X coordinate of the right top corner of the copied rectangle.
y2 – the Y coordinate of the right top corner of the copied rectangle.
DestImage –handle of the destination image.

Return Value:

Returns FSDKE_OK if successful.

FSDK_MirrorImage Function

Mirrors an image. The function can mirror images horizontally or vertically.

C++ Syntax:

```
int FSDK_MirrorImage(HImage Image, bool
UseVerticalMirroringInsteadOfHorizontal);
```

Delphi Syntax:

```
function FSDK_MirrorImage(Image: HImage;
UseVerticalMirroringInsteadOfHorizontal: boolean): integer;
```

C# Syntax:

```
int FSDK.MirrorImage(int Image, bool
UseVerticalMirroringInsteadOfHorizontal);
```

VB Syntax:

```
Function FSDKVB_MirrorImage(ByVal Image As Long, ByVal
UseVerticalMirroringInsteadOfHorizontal As Boolean) As Long
```

Java and Android Syntax:

```
int FSDK.MirrorImage(HImage Image, boolean
UseVerticalMirroringInsteadOfHorizontal);
```

CImage Syntax:

```
FSDK.CImage FSDK.CImage.MirrorVertical();
FSDK.CImage FSDK.CImage.MirrorHorizontal();
```

Parameters:

Image – handle of the image to be mirrored.
UseVerticalMirroringInsteadOfHorizontal– sets the mirror direction.

TRUE: left-to-right swap;

FALSE: top-to-bottom swap;

Return Value:

Returns FSDKE_OK if successful.

FSDK_FreeImage Function

Frees the internal representation of an image.

C++ Syntax:

```
int FSDK_FreeImage(HImage Image);
```

Delphi Syntax:

```
function FSDK_FreeImage(Image: HImage): integer;
```

C# Syntax:

```
int FSDK.FreeImage(int Image);
```

VB Syntax:

```
Function FSDKVB_FreeImage(ByVal Image As Long) As Long
```

Java and Android Syntax:

```
int FSDK.FreeImage(HImage Image);
```

Parameters:

Image – handle of the image to be freed.

Return Value:

Returns FSDKE_OK if successful.

Face Detection

You can use the FSDK_DetectFace function to detect a frontal face in an image. The function returns the position of the face in the image. The performance and reliability of face detection is controlled by the FSDK_SetFaceDetectionParameters and FSDK_SetFaceDetectionThreshold functions.

Typical parameters for face detection are:

- To detect faces from a webcam in real time, call:

```
FSDK_SetFaceDetectionParameters(false, false, 100);
```

- To reliably detect faces in digital camera photos, call

```
FSDK_SetFaceDetectionParameters(true, false, 500);
```

Data types

Luxand FaceSDK introduces the TFacePosition data type that stores the information about the position of the face. The `xc` and `yc` fields specifies the X and Y coordinates of the center of the face, `w` specifies the width of the face, and `angle` specifies the in-plane rotation angle of the face in degrees.

C++ Declaration:

```
typedef struct {
     int xc, yc, w;
     int padding;
     double angle;
} TFacePosition;
```

C# Declaration:

```
public struct TFacePosition {
     public int xc, yc, w;
     public double angle;
}
```

Delphi Declaration:

```
TFacePosition = record
    xc, yc, w: integer;
    padding: integer;
    angle: double;
end;
PFacePosition = ^TFacePosition;
```

VB Declaration:

```
Type TFacePosition
    xc As Long
    yc As Long
    w As Long
    padding as Long
    angle As Double
End Type
```

Java Declaration:

The class TFacePosition contains the following fields:

```
     public int xc, yc, w;
     public double angle;
```

The class TFaces encapsulates an array of TFacePosition classses. It has the following properties:

```
public TFacePosition faces[];
int maxFaces;
```

FSDK_DetectFace Function

Detects a frontal face in an image and stores information about the face position into the TFacePosition structure.

C++ Syntax:

```
int FSDK_DetectFace(HImage Image, TFacePosition*
FacePosition);
```

Delphi Syntax:

```
function FSDK_DetectFace(Image: HImage; FacePosition:
PFacePosition): integer;
```

C# Syntax:

```
int FSDK.DetectFace(int Image, ref FSDK.TFacePosition
FacePosition);
```

VB Syntax:

```
Function FSDKVB_DetectFace(ByVal Image As Long, ByRef
FacePosition As TFacePosition) As Long
```

Java Syntax:

```
int FSDK.DetectFace(HImage Image, TFacePosition.ByReference
FacePosition);
```

Android Syntax:

```
int FSDK.DetectFace(HImage Image, TFacePosition FacePosition);
```

CImage Syntax:

```
FSDK.TFacePosition FSDK.CImage.DetectFace();
```

Parameters:

Image – handle of the image to detect the face in.
FacePosition – pointer to the TFacePosition structure to store information about the face position.

Return Value:

Returns FSDKE_OK if successful. If a face is not found, the function returns the FSDKE_FACE_NOT_FOUND code. If the input image is too small (less than 20x20 pixels), the functions returns FSDKE_IMAGE_TOO_SMALL.

Example

```
int img1;
TFacePosition FacePosition;
```

```
FSDK_Initialize("");
FSDK_LoadImageFromFile(&img1, "test.jpg");
FSDK_DetectFace(img1, &FacePosition);

printf("face position: %d %d %d", FacePosition.xc,
FacePosition.yc, FacePosition.angle);
```

FSDK_DetectMultipleFaces Function

Detects multiple faces in an image.

C++ Syntax:

```
int FSDK_DetectMultipleFaces(HImage Image, int* DetectedCount,
TFacePosition* FaceArray, int MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_DetectMultipleFaces(Image: HImage;
DetectedCount: PInteger; FaceArray: PFacePositionArray;
MaxSizeInBytes: integer): integer;
```

C# Syntax:

```
int FSDK.DetectMultipleFaces(int Image, ref int DetectedCount,
out FSDK.TFacePosition[] FaceArray, int MaxSizeInBytes);
```

VB Syntax:

```
Function FSDKVB_DetectMultipleFaces(ByVal Image As Long, ByRef
DetectedCount As Long, ByRef FaceArray As TFacePosition, ByVal
MaxSizeInBytes As Long) As Long
```

Java and Android Syntax:

```
int FSDK.DetectMultipleFaces(HImage Image, TFaces FaceArray);
```

CImage Syntax:

```
FSDK.TFacePosition[] FSDK.CImage.DetectMultipleFaces();
```

Parameters:

Image – handle of the image to detect faces in.
DetectedCount – count of the faces found in the image.
FaceArray – pointer to the array of TFacePosition structure to store the information about the detected faces.
MaxSizeInBytes – size of the FaceArray buffer in bytes. The function will not store more than MaxSize bytes in the buffer.

Return Value:

Returns FSDKE_OK if successful. If no faces are found, the function returns the FSDKE_FACE_NOT_FOUND code. If the input image is too small (less than 20x20 pixels), the functions returns FSDKE_IMAGE_TOO_SMALL.

Example

```
int img1;
int DetectedCount;
TFacePosition FaceArray[50];

FSDK_Initialize("");
FSDK_LoadImageFromFile(&img1, "test.jpg");
FSDK_DetectMultipleFaces(img1, &DetectedCount , FaceArray,
sizeof(FaceArray));

for (i = 0; i < DetectedCount; i++) {
     printf("face position: %d %d %d\n", FaceArray[i].xc,
FaceArray[i].yc, FaceArray[i].angle);
}
```

FSDK_SetFaceDetectionParameters Function

Allows setting a number of face detection parameters to control the performance and reliability of face detector.

The function allows configuring the following parameters: HandleArbitraryRotations, DetermineFaceRotationAngle and InternalResizeWidth.

HandleArbitraryRotations, DetermineFaceRotationAngle can be TRUE or FALSE, while InternalResizeWidth is an integer.

C++ Syntax:

```
int FSDK_SetFaceDetectionParameters(bool
HandleArbitraryRotations, bool DetermineFaceRotationAngle, int
InternalResizeWidth);
```

Delphi Syntax:

```
function
FSDK_SetFaceDetectionParameters(HandleArbitraryRotations:
boolean; DetermineFaceRotationAngle: boolean;
InternalResizeWidth: integer): integer;
```

C# Syntax:

```
int FSDK.SetFaceDetectionParameters(bool
HandleArbitraryRotations, bool DetermineFaceRotationAngle, int
InternalResizeWidth);
```

VB Syntax:

```
Function FSDKVB_SetFaceDetectionParameters(ByVal
HandleArbitraryRotations As Boolean, ByVal
DetermineFaceRotationAngle As Boolean, ByVal
InternalResizeWidth As Long) As Long
```

Java and Android Syntax:

```
int FSDK.SetFaceDetectionParameters(boolean
HandleArbitraryRotations, boolean DetermineFaceRotationAngle,
int InternalResizeWidth);
```

Parameters:

HandleArbitraryRotations– extends default in-plane face rotation angle from -15..15 degrees to -30..30 degrees.

TRUE: extended in-plane rotation support is enabled at the cost of detection speed (3 times performance hit).

FALSE: default fast detection -15..15 degrees.

DetermineFaceRotationAngle– enables or disables the detection of in-plane face rotation angle.

TRUE: detects in-plane rotation angle when detecting faces. The angle is recorded into the Angle field of the TFacePosition structure (TFacePosition is a structure returned by FSDK_DetectFace and FSDK_DetectMultipleFaces).

FALSE: disables the detection of rotation angle.

Note: Enabling face rotation angle detection slows down the detection process slightly. Set this parameter to TRUE if you are planning to call FSDK_DetectFacialFeatures or FSDK_DetectFacialFeaturesInRegion.

InternalResizeWidth – controls the detection speed by setting the size of the image the detection functions will work with. Choose higher value to increase detection quality, or lower value to improve the performance.

Note: By default, all images are internally resized to the width of 384 pixels. 384 pixels are a reasonable compromise between performance and detection quality. While large images are down-sized, the smaller ones are up-sized to the specified Resize Width in order to maintain constant detection speed.

Choosing the right value for InternalResizeWidth

Choosing the correct value for the InternalResizeWidth parameter is essential for the correct operation of face detection functions of the SDK. The face detection functions can only detect faces as small as 20x20 pixels. Even if the source image is a large 1000x1000 dots one, the face on that image can be as small as 100x100 pixels. If you set InternalResizeWidth to 200, then the source image will be resized to 200x200 pixels, thus the face will only occupy 20x20 pixels. This is still enough for the SDK functions to work. If, however, you set InternalResizeWidth to 100, then the original image will become 100x100 pixels, and the face on it will only occupy 10x10 dots, which is NOT enough for the SDK functions to work with.
Be extra careful when changing the default value of InternalResizeWidth. For example, webcam images can be usually detected with InternalResizeWidth set to 100, while images from multi-megapixel digital cameras require values of at least 384 or 512 pixels to work with.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetFaceDetectionThreshold Function

Sets a threshold value for face detection. The default value is 5. The lowest possible value is 1.

The function allows adjusting the sensitivity of the detection. If the threshold value is set to a higher value, the detector will only recognize faces with sharp, clearly defined details, thus reducing the number of false positive detections. Setting the threshold lower allows detecting more faces with less clearly defined features at the expense of increased number of false positives.

C++ Syntax:

```
int FSDK_SetFaceDetectionThreshold(int Threshold);
```

Delphi Syntax:

```
function FSDK_SetFaceDetectionThreshold(Threshold: integer):
integer;
```

C# Syntax:

```
int FSDK.SetFaceDetectionThreshold(int Threshold);
```

VB Syntax:

```
Function FSDKVB_SetFaceDetectionThreshold(ByVal Threshold As
Long) As Long
```

Java and Android Syntax:

```
int FSDK.SetFaceDetectionThreshold(int Threshold);
```

Parameters:

Threshold – Threshold value.

Return Value:

Returns FSDKE_OK if successful.

Facial Feature Detection

FaceSDK provides the FSDK_DetectFacialFeatures function to detect facial features in an image and the FSDK_DetectEyes function to detect just eye centers in an image. First, these functions detect a frontal face in an image, and then detect its facial features or only eye centers. The FSDK_DetectFacialFeaturesInRegion and FSDK_DetectEyesInRegion functions do not perform the face detection step and detect facial features or eye centers in a region returned by FSDK_DetectFace or FSDK_DetectMultipleFaces.

The FSDK_DetectEyes function works much faster than FSDK_DetectFacialFeatures and is recommended for real-time applications.

The facial features are stored in the FSDK_Features data structure. FSDK_Features is an array data type containing FSDK_FACIAL_FEATURE_COUNT points. The list of facial features recognized by FaceSDK is available in the Detected Facial Features chapter.

Eye centers are saved to FSDK_Features[0] and FSDK_Features[1]. The FSDK_DetectEyes and FSDK_DetectEyesInRegion functions do not change other elements of the FSDK_Features array.

C++ Declaration:

```
typedef struct { int x,y; } TPoint;
typedef TPoint FSDK_Features [FSDK_FACIAL_FEATURE_COUNT];
```

C# Declaration:

```
public struct TPoint {
     public int x, y;
}
```

Delphi Declaration:

```
TPoint = record
    x, y: integer;
end;
FSDK_Features = array[0..FSDK_FACIAL_FEATURE_COUNT - 1] of
TPoint;
PFSDK_Features = ^FSDK_Features;
```

VB Declaration:

```
Type TPoint
    x As Long
    y As Long
End Type
```

Java and Android Declaration:

The class TPoint has the following properties:

```
        public int x, y;
```

The class FSDK_Features has the following property:

```
        public TPoint features[];
```

FSDK_DetectFacialFeatures Function

Detects a frontal face in an image and detects its facial features.

C++ Syntax:

```
int FSDK_DetectFacialFeatures(HImage Image, FSDK_Features*
FacialFeatures);
```

Delphi Syntax:

```
function FSDK_DetectFacialFeatures(Image: HImage;
FacialFeatures: PFSDK_Features): integer;
```

C# Syntax:

```
int FSDK.DetectFacialFeatures(int Image, out FSDK.TPoint[]
FacialFeatures);
```

VB Syntax:

```
Function FSDKVB_DetectFacialFeatures(ByVal Image As Long,
ByRef FacialFeatures As TPoint) As Long
```

Java Syntax:

```
int FSDK.DetectFacialFeatures(HImage Image,
FSDK_Features.ByReference FacialFeatures);
```

Android Syntax:

```
int FSDK.DetectFacialFeatures(HImage Image, FSDK_Features
FacialFeatures);
```

CImage Syntax:

```
FSDK.TPoint[] FSDK.CImage.DetectFacialFeatures();
```

Parameters:

Image– handle of the image facial features should be detected in.
FacialFeatures– pointer to the FSDK_Features array for receiving the detected facial features.

Return Value:

Returns FSDKE_OK if successful.

Example

```
int img1;
FSDK_Features Features;

FSDK_Initialize("");
FSDK_LoadImageFromFile(&img1, "test.jpg");
FSDK_DetectFacialFeatures(img1, Features);

printf("Left eye location: (%d, %d)\n",
Features[FSDKP_LEFT_EYE].x, Features[FSDKP_LEFT_EYE].y);
printf("Right eye location: (%d, %d)\n",
Features[FSDKP_RIGHT_EYE].y, Features[FSDKP_RIGHT_EYE].y);
```

FSDK_DetectFacialFeaturesInRegion Function

Detects facial features in an image region returned by FSDK_DetectFace or FSDK_DetectMultipleFaces. This function can be useful if an approximate face size is known, or to detect facial features of a specific face returned by FSDK_DetectMultipleFaces.

C++ Syntax:

```
int FSDK_DetectFacialFeaturesInRegion(HImage Image,
TFacePosition* FacePosition, FSDK_Features* FacialFeatures);
```

Delphi Syntax:

```
function FSDK_DetectFacialFeaturesInRegion(Image: HImage;
FacePosition: PFacePosition; FacialFeatures: PFSDK_Features):
integer;
```

C# Syntax:

```
int FSDK.DetectFacialFeaturesInRegion(int Image, ref
FSDK.TFacePosition FacePosition, out FSDK.TPoint[]
FacialFeatures);
```

VB Syntax:

```
Function FSDKVB_DetectFacialFeaturesInRegion(ByVal Image As
Long, ByRef FacePosition As TFacePosition, ByRef
FacialFeatures As TPoint) As Long
```

Java Syntax:

```
int FSDK.DetectFacialFeaturesInRegion(HImage Image,
TFacePosition FacePosition, FSDK_Features.ByReference
FacialFeatures);
```

Android Syntax:

```
int FSDK.DetectFacialFeaturesInRegion(HImage Image,
TFacePosition FacePosition, FSDK_Features FacialFeatures);
```

C# Syntax:

```
FSDK.TPoint[] FSDK.CImage.DetectFacialFeaturesInRegion(ref
FSDK.TFacePosition FacePosition);
```

Parameters:

Image – handle of the image facial features should be detected in.
FacePosition – pointer to the face position structure.
FacialFeatures – pointer to the FSDK_Features array for receiving the detected facial features.

Return Value:

Returns FSDKE_OK if successful.

Example

```
int i, DetectedCount, img1;
FSDK_Features Features;
TFacePosition FaceArray[50];

FSDK_Initialize("");
FSDK_LoadImageFromFile(&img1, "test.jpg");

FSDK_DetectMultipleFaces(img1, &DetectedCount , FaceArray,
sizeof(FaceArray));

for (i = 0; i < DetectedCount; i++) {
```

```
    FSDK_DetectFacialFeaturesInRegion(img1, FaceArray[i],
Features);
    printf("Left eye location: (%d, %d)\n",
Features[FSDKP_LEFT_EYE].x, Features[FSDKP_LEFT_EYE].y);
    printf("Right eye location: (%d, %d)\n",
Features[FSDKP_RIGHT_EYE].x, Features[FSDKP_RIGHT_EYE].y);
}
```

FSDK_DetectEyes Function

Detects a frontal face in an image and detects its eye centers.

C++ Syntax:

```
int FSDK_DetectEyes(HImage Image, FSDK_Features*
FacialFeatures);
```

Delphi Syntax:

```
function FSDK_DetectEyes(Image: HImage; FacialFeatures:
PFSDK_Features): integer;
```

C# Syntax:

```
int FSDK.DetectEyes(int Image, out FSDK.TPoint[]
FacialFeatures);
```

VB Syntax:

```
Function FSDKVB_DetectEyes(ByVal Image As Long, ByRef
FacialFeatures As TPoint) As Long
```

Java Syntax:

```
int FSDK.DetectEyes(HImage Image, FSDK_Features.ByReference
FacialFeatures);
```

Android Syntax:

```
int FSDK.DetectEyes(HImage Image, FSDK_Features
FacialFeatures);
```

CImage Syntax:

```
FSDK.TPoint[] FSDK.CImage.DetectEyes();
```

Parameters:

Image – handle of the image eye centers should be detected in.
FacialFeatures – pointer to the FSDK_Features array for receiving the detected eye centers.

Return Value:

Returns FSDKE_OK if successful.

FSDK_DetectEyesInRegion Function

Detects eye centers in an image region returned by FSDK_DetectFace or FSDK_DetectMultipleFaces.

C++ Syntax:

```
int FSDK_DetectEyesInRegion(HImage Image, TFacePosition*
FacePosition, FSDK_Features* FacialFeatures);
```

Delphi Syntax:

```
function FSDK_DetectEyesInRegion(Image: HImage; FacePosition:
PFacePosition; FacialFeatures: PFSDK_Features): integer;
```

C# Syntax:

```
int FSDK.DetectEyesInRegion(int Image, ref FSDK.TFacePosition
FacePosition, out FSDK.TPoint[] FacialFeatures);
```

VB Syntax:

```
Function FSDKVB_DetectEyesInRegion(ByVal Image As Long, ByRef
FacePosition As TFacePosition, ByRef FacialFeatures As TPoint)
As Long
```

Java Syntax:

```
int FSDK.DetectEyesInRegion(HImage Image, TFacePosition
FacePosition, FSDK_Features.ByReference FacialFeatures);
```

Android Syntax:

```
int FSDK.DetectEyesInRegion(HImage Image, TFacePosition
FacePosition, FSDK_Features FacialFeatures);
```

CImage Syntax:

```
FSDK.TPoint[] FSDK.CImage.DetectEyesInRegion(ref
FSDK.TFacePosition FacePosition);
```

Parameters:

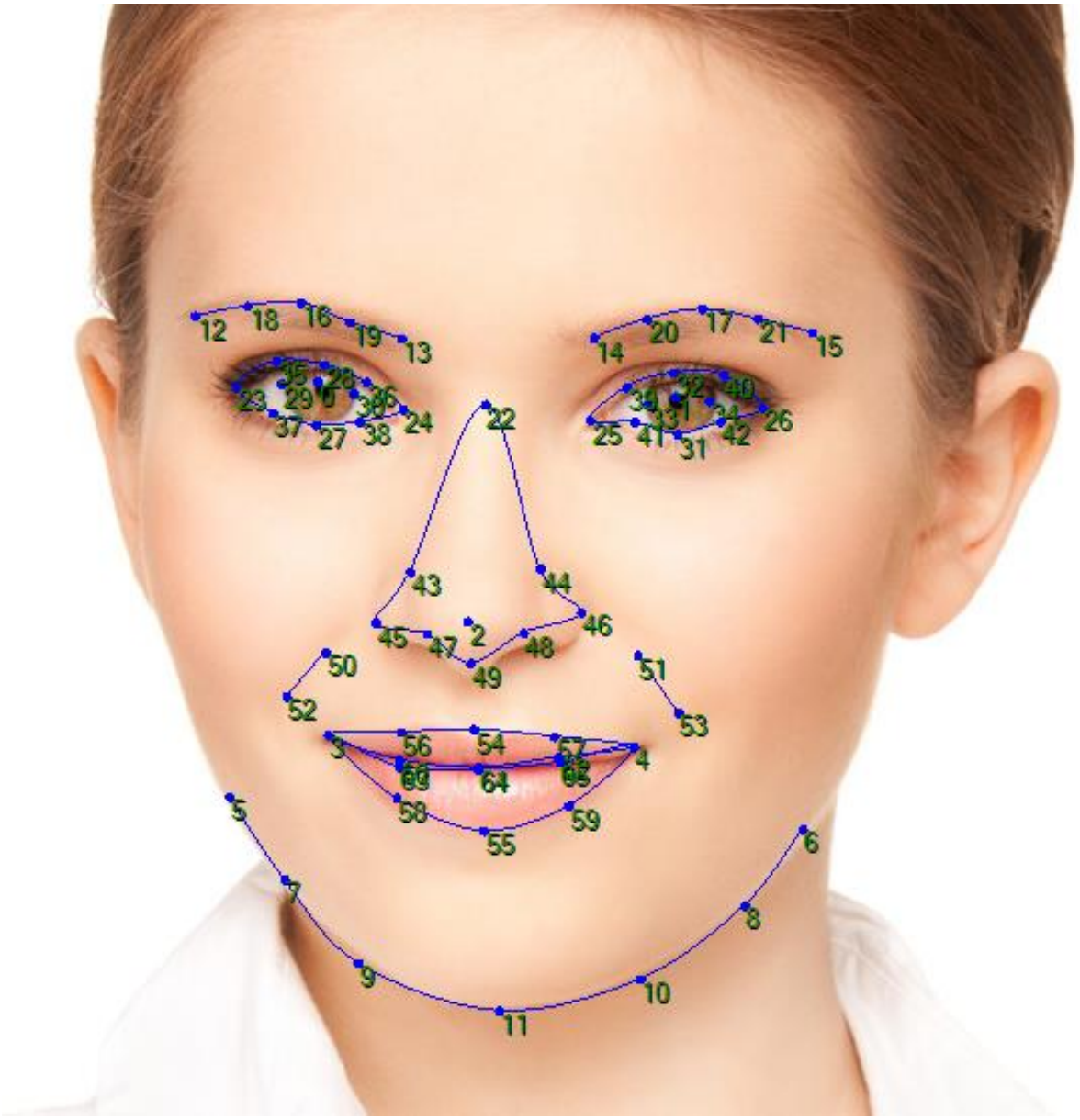
Image – handle of the image eye centers should be detected in.
FacePosition – pointer to the face position structure.
FacialFeatures – pointer to the FSDK_Features array for receiving the detected eye centers.

Return Value:

Returns FSDKE_OK if successful.

Detected Facial Features

Luxand FaceSDK detects 66 facial feature points. These facial feature points can be accessed by their names in the FSDK_Features array.



Facial Feature Name	Value
FSDKP_LEFT_EYE	0
FSDKP_RIGHT_EYE	1
FSDKP_LEFT_EYE_INNER_CORNER	24
FSDKP_LEFT_EYE_OUTER_CORNER	23
FSDKP_LEFT_EYE_LOWER_LINE1	38
FSDKP_LEFT_EYE_LOWER_LINE2	27

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FSDKP_LEFT_EYE_LOWER_LINE3	37
FSDKP_LEFT_EYE_UPPER_LINE1	35
FSDKP_LEFT_EYE_UPPER_LINE2	28
FSDKP_LEFT_EYE_UPPER_LINE3	36
FSDKP_LEFT_EYE_LEFT_IRIS_CORNER	29
FSDKP_LEFT_EYE_RIGHT_IRIS_CORNER	30
FSDKP_RIGHT_EYE_INNER_CORNER	25
FSDKP_RIGHT_EYE_OUTER_CORNER	26
FSDKP_RIGHT_EYE_LOWER_LINE1	41
FSDKP_RIGHT_EYE_LOWER_LINE2	31
FSDKP_RIGHT_EYE_LOWER_LINE3	42
FSDKP_RIGHT_EYE_UPPER_LINE1	40
FSDKP_RIGHT_EYE_UPPER_LINE2	32
FSDKP_RIGHT_EYE_UPPER_LINE3	39
FSDKP_RIGHT_EYE_LEFT_IRIS_CORNER	33
FSDKP_RIGHT_EYE_RIGHT_IRIS_CORNER	34
FSDKP_LEFT_EYEBROW_INNER_CORNER	13
FSDKP_LEFT_EYEBROW_MIDDLE	16
FSDKP_LEFT_EYEBROW_MIDDLE_LEFT	18
FSDKP_LEFT_EYEBROW_MIDDLE_RIGHT	19
FSDKP_LEFT_EYEBROW_OUTER_CORNER	12
FSDKP_RIGHT_EYEBROW_INNER_CORNER	14
FSDKP_RIGHT_EYEBROW_MIDDLE	17
FSDKP_ RIGHT_EYEBROW_MIDDLE_LEFT	20
FSDKP_ RIGHT_EYEBROW_MIDDLE_RIGHT	21
FSDKP_RIGHT_EYEBROW_OUTER_CORNER	15
FSDKP_NOSE_TIP	2
FSDKP_NOSE_BOTTOM	49
FSDKP_NOSE_BRIDGE	22
FSDKP_NOSE_LEFT_WING	43

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FSDKP_NOSE_LEFT_WING_OUTER	45
FSDKP_NOSE_LEFT_WING_LOWER	47
FSDKP_NOSE_RIGHT_WING	44
FSDKP_NOSE_RIGHT_WING_OUTER	46
FSDKP_NOSE_RIGHT_WING_LOWER	48
FSDKP_MOUTH_RIGHT_CORNER	3
FSDKP_MOUTH_LEFT_CORNER	4
FSDKP_MOUTH_TOP	54
FSDKP_MOUTH_TOP_INNER	61
FSDKP_MOUTH_BOTTOM	55
FSDKP_MOUTH_BOTTOM_INNER	64
FSDKP_MOUTH_LEFT_TOP	56
FSDKP_MOUTH_LEFT_TOP_INNER	60
FSDKP_MOUTH_RIGHT_TOP	57
FSDKP_MOUTH_RIGHT_TOP_INNER	62
FSDKP_MOUTH_LEFT_BOTTOM	58
FSDKP_MOUTH_LEFT_BOTTOM_INNER	63
FSDKP_MOUTH_RIGHT_BOTTOM	59
FSDKP_MOUTH_RIGHT_BOTTOM_INNER	65
FSDKP_NASOLABIAL_FOLD_LEFT_UPPER	50
FSDKP_NASOLABIAL_FOLD_LEFT_LOWER	52
FSDKP_NASOLABIAL_FOLD_RIGHT_UPPER	51
FSDKP_NASOLABIAL_FOLD_RIGHT_LOWER	53
FSDKP_CHIN_BOTTOM	11
FSDKP_CHIN_LEFT	9
FSDKP_CHIN_RIGHT	10
FSDKP_FACE_CONTOUR1	7
FSDKP_FACE_CONTOUR2	5
FSDKP_FACE_CONTOUR12	6
FSDKP_FACE_CONTOUR13	8

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Face Matching

Luxand FaceSDK provides the API to extract face templates and match them. A template extracted from a face can be stored in a database and can then be used to match faces using the FSDK_MatchFaces function.

Using the FSDK_GetFaceTemplate or FSDK_GetFaceTemplateInRegion function, the created template will have higher accuracy, thus allowing for better overall recognition rates (lower false rejection level at the same false acceptance level). If your priority is higher speed, first you need to detect eyes with FSDK_DetectEyes or FSDK_DetectEyesInRegion, and then pass the detected coordinates to FSDK_GetFaceTemplateUsingEyes. However, the accuracy of the template will be lower in this case. The FSDK_MatchFaces function returns the facial similarity level. You may consider similarity to be equal to the probability that templates belong to one and same person.

More precisely: if the access control system provides access to a person when similarity is higher of threshold x, the possibility of providing erroneous access to another person is 1-x. For example, if the decision to provide access to a person is based on the code

```
if (similarity > 0.99)
    AllowAccess();
```

*the possibility of erroneous access to another person is 0.01, or 1%.*A facial template is non-reversible, i.e. there is no way to create the original face image using a template. To determine if the matched templates belong to the same person (with a specified error possibility), you can compare the facial similarity value with a threshold calculated by the FSDK_GetMatchingThresholdAtFAR or FSDK_GetMatchingThresholdAtFRR functions.

Please note: it is also recommended to retain both the original face images and their templates in the database. This is because future versions of Luxand FaceSDK may offer an improved template extraction algorithm, together with changes to the template format.

Note that it is not recommended to extract facial templates if the face is only partially visible in the image (that is, if some facial features are outside the image), as this may increase the false acceptance rate. Check to make sure that the region containing the face is completely included inside the image boundaries. Note that Tracker API always performs this check, and is recommended to use when recognizing subjects on video.

A face template is stored in the FSDK_FaceTemplate data structure.

In .NET, there is no specific data type for a template. Instead, it is stored in an array of bytes of FSDK.TemplateSize length. Below is an example of retrieving facial template in C#.

C# Example:

```
templateData = new byte[FSDK.TemplateSize];
FSDK.GetFaceTemplate(imageHandle, out templateData);
```

C++ Declaration:

```
typedef struct {
     char ftemplate [13324];
} FSDK_FaceTemplate;
```

Delphi Declaration:

```
FSDK_FaceTemplate = record
   Template: array[0.. 13324-1] of byte;
```

```
end;
PFSDK_FaceTemplate = ^FSDK_FaceTemplate;
```

Java and Android Declaration:

The class `FSDK_FaceTemplate` has the following property:

```
public byte template[];
```

FSDK_GetFaceTemplate Function

This function is used to extract a template from a facial image. The function first detects a face, then detects its facial features and extracts the template. Note that facial features are detected with less accuracy, but higher speed, than when FSDK_DetectFacialFeatures is called.
If there is more than one face in the image, the template is extracted for the face with the most clearly visible details. If there is no clearly visible face, the function returns an error code. To set the threshold determining the accepted quality for faces, use the FSDK_SetFaceDetectionThreshold function.

If the face position or its features or eye centers are known, it is more efficient to use the FSDK_GetFaceTemplateInRegion or FSDK_GetFaceTemplateUsingEyes functions. To extract the template for a specific face, use the FSDK_GetFaceTemplateInRegion function.

C++ Syntax:

```
int FSDK_GetFaceTemplate(HImage Image, FSDK_FaceTemplate*
FaceTemplate);
```

Delphi Syntax:

```
function FSDK_GetFaceTemplate(Image: HImage; FaceTemplate:
PFSDK_FaceTemplate): integer;
```

C# Syntax:

```
int FSDK.GetFaceTemplate(int Image, out byte[] FaceTemplate);
```

VB Syntax:

```
Function FSDKVB_GetFaceTemplate(ByVal Image As Long, ByRef
FaceTemplate As Byte) As Long
```

Java Syntax:

```
int FSDK.GetFaceTemplate(HImage Image,
FSDK_FaceTemplate.ByReference FaceTemplate);
```

Android Syntax:

```
int FSDK.GetFaceTemplate(HImage Image, FSDK_FaceTemplate
FaceTemplate);
```

CImage Syntax:

```
byte[] FSDK.CImage.GetFaceTemplate();
```

Parameters:

Image– handle of the image from which to extract the face template.

FaceTemplate – pointer to the FSDK_FaceTemplate structure, used to receive the face template.

Return Value:

Returns FSDKE_OK if successful. If no faces are found, or the quality of the image is not sufficient, the function returns the FSDKE_FACE_NOT_FOUND code.

FSDK_GetFaceTemplateInRegion Function

Extracts a template for a face located in a specific region returned by FSDK_DetectFace or FSDK_DetectMultipleFaces.
The function detects facial features in a specific region and extracts a template. Note that facial features are detected with less accuracy, but higher speed, than when FSDK_DetectFacialFeaturesInRegion is called. The face detection stage is not performed. This function can be useful if an approximate face size and position is known, or to process a specific face returned by FSDK_DetectMultipleFaces. The function produces no error if the face is not clearly visible. This is because it assumes that if face detection functions return a detected face position, the face is of sufficient quality.

If facial features or eye centers are known, it is more efficient to use the FSDK_GetFaceTemplateUsingFeatures or FSDK_GetFaceTemplateUsingEyes function.

C++ Syntax:

```
int FSDK_GetFaceTemplateInRegion(HImage Image, TFacePosition*
FacePosition, FSDK_FaceTemplate* FaceTemplate);
```

Delphi Syntax:

```
function FSDK_ GetFaceTemplateInRegion (Image: HImage;
FacePosition: PFacePosition; FaceTemplate:
PFSDK_FaceTemplate): integer;
```

C# Syntax:

```
int FSDK.GetFaceTemplateInRegion(int Image, ref
FSDK.TFacePosition FacePosition, out byte[] FaceTemplate);
```

VB Syntax:

```
Function FSDKVB_GetFaceTemplateInRegion(ByVal Image As Long,
ByRef FacePosition As TFacePosition, ByRef FaceTemplate As
Byte) As Long
```

Java Syntax:

```
int FSDK.GetFaceTemplateInRegion(HImage Image, TFacePosition
FacePosition, FSDK_FaceTemplate.ByReference FaceTemplate);
```

Android Syntax:

```
int FSDK.GetFaceTemplateInRegion(HImage Image, TFacePosition
FacePosition, FSDK_FaceTemplate FaceTemplate);
```

CImage Syntax:

```
byte[] FSDK.CImage.GetFaceTemplateInRegion(ref
FSDK.TFacePosition FacePosition);
```

Parameters:

Image – handle of the image from which to extract the face template.
FacePosition – pointer to the face position structure.
FaceTemplate – pointer to the FSDK_FaceTemplate structure, used to receive the face template.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetFaceTemplateUsingEyes Function

Extracts a face template using the detected eye centers.

The function receives eye centers coordinates detected by the FSDK_DetectFacialFeatures, FSDK_DetectFacialFeaturesInRegion, FSDK_DetectEyes or FSDK_DetectEyesInRegion functions and extracts a face template. Face detection, facial feature detection, and eye centers detection are not performed. This function can be useful when facial features or eye centers for a specific face are already detected. The function produces no error if the face is not clearly visible, since it assumes that if the face and its facial features or eye centers are already detected, the face is of sufficient quality.

C++ Syntax:

```
int FSDK_GetFaceTemplateUsingEyes(HImage Image, FSDK_Features*
eyeCoords, FSDK_FaceTemplate* FaceTemplate);
```

Delphi Syntax:

```
function FSDK_ GetFaceTemplateUsingEyes(Image: HImage;
eyeCoords: PFSDK_Features; FaceTemplate: PFSDK_FaceTemplate):
integer;
```

C# Syntax:

```
int FSDK.GetFaceTemplateUsingEyes(int Image, ref FSDK.TPoint[]
eyeCoords, out byte[] FaceTemplate);
```

VB Syntax:

```
Function FSDKVB_GetFaceTemplateUsingEyes(ByVal Image As Long,
ByRef eyeCoords As TPoint, ByRef FaceTemplate As Byte) As Long
```

Java Syntax:

```
int FSDK.GetFaceTemplateUsingEyes(HImage Image, FSDK_Features
eyeCoords, FSDK_FaceTemplate.ByReference FaceTemplate);
```

Android Syntax:

```
int FSDK.GetFaceTemplateUsingEyes(HImage Image, FSDK_Features
eyeCoords, FSDK_FaceTemplate FaceTemplate);
```

CImage Syntax:

```
byte[] FSDK.CImage.GetFaceTemplateUsingEyes(ref FSDK.TPoint[]
eyeCoords);
```

Parameters:

Image – handle of the image to extract the face template from.
eyeCoords – pointer to the FSDK_Features array containing eye centers coordinates.
FaceTemplate – pointer to the FSDK_FaceTemplate structure for receiving the face template.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetFaceTemplateUsingFeatures Function

Extracts a face template using the detected facial feature coordinates.

The function receives facial feature coordinates detected by the FSDK_DetectFacialFeatures or FSDK_DetectFacialFeaturesInRegion functions and extracts a face template. Face detection, facial feature detection, and eye centers detection are not performed. This function can be useful when facial features for a specific face are already detected. The function produces no error if the face is not clearly visible, since it assumes that if the face and its facial features are already detected, the face is of sufficient quality.

The function determines if facial features, starting with the 2nd, are equal to zero or uninitialized. In this case, the functions calls FSDK_GetFaceTemplateUsingEyes instead.

C++ Syntax:

```
int FSDK_GetFaceTemplateUsingFeatures(HImage Image,
FSDK_Features* FacialFeatures, FSDK_FaceTemplate*
FaceTemplate);
```

Delphi Syntax:

```
function FSDK_ GetFaceTemplateUsingFeatures(Image: HImage;
FacialFeatures: PFSDK_Features; FaceTemplate:
PFSDK_FaceTemplate): integer;
```

C# Syntax:

```
int FSDK.GetFaceTemplateUsingFeatures(int Image, ref
FSDK.TPoint[]FacialFeatures, out byte[] FaceTemplate);
```

VB Syntax:

```
Function FSDKVB_GetFaceTemplateUsingFeatures(ByVal Image As
Long, ByRef FacialFeaturesAs TPoint, ByRef FaceTemplate As
Byte) As Long
```

Java Syntax:

```
int FSDK.GetFaceTemplateUsingFeatures(HImage Image,
FSDK_Features FacialFeatures, FSDK_FaceTemplate.ByReference
FaceTemplate);
```

Android Syntax:

```
int FSDK.GetFaceTemplateUsingFeatures(HImage Image,
FSDK_Features FacialFeatures, FSDK_FaceTemplate FaceTemplate);
```

CImage Syntax:

```
byte[] FSDK.CImage.GetFaceTemplateUsingFeatures(ref
FSDK.TPoint[]FacialFeatures);
```

Parameters:

Image – handle of the image to extract the face template from.
FacialFeatures – pointer to the FSDK_Features array containing facial feature coordinates.
FaceTemplate – pointer to the FSDK_FaceTemplate structure for receiving the face template.

Return Value:

Returns FSDKE_OK if successful.

FSDK_MatchFaces Function

Match two face templates. The returned value determines the similarity of the faces.

C++ Syntax:

```
int FSDK_MatchFaces(FSDK_FaceTemplate* FaceTemplate1,
FSDK_FaceTemplate* FaceTemplate2, float* Similarity);
```

Delphi Syntax:

```
function FSDK_MatchFaces(FaceTemplate1, FaceTemplate2:
PFSDK_FaceTemplate; Similarity: PSingle): integer;
```

C# Syntax:

```
int FSDK.MatchFaces(ref byte[] FaceTemplate1, ref byte[]
FaceTemplate2, ref float Similarity);
```

VB Syntax:

```
Function FSDKVB_MatchFaces(ByRef FaceTemplate1 As Byte, ByRef
FaceTemplate2 As Byte, ByRef Similarity As Single) As Long
```

Java Syntax:

```
int FSDK.MatchFaces(FSDK_FaceTemplate.ByReference
FaceTemplate1, FSDK_FaceTemplate.ByReference FaceTemplate2,
float Similarity[]);
```

Android Syntax:

```
int FSDK.MatchFaces(FSDK_FaceTemplate FaceTemplate1,
FSDK_FaceTemplate FaceTemplate2, float Similarity[]);
```

Parameters:

FaceTemplate1 – pointer to the FSDK_FaceTemplate structure, using the first template for comparison.
FaceTemplate2 – pointer to the FSDK_FaceTemplate structure, using the second template for comparison.

Similarity – pointer to an integer value, used to receive the similarity of the face templates.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_INVALID_TEMPLATE if any of the face templates is in an invalid format.
Returns FSDKE_UNSUPPORTED_TEMPLATE_VERSION if any of the templates is created with an unsupported version of FaceSDK.

FSDK_GetMatchingThresholdAtFAR Function

This function returns the threshold value for similarity to determine if two matched templates belong to the same person at a given FAR (False Acceptance Rate) value. The FAR determines the acceptable error rate when two different people's templates are mistakenly recognized as the same person. Decreasing FAR leads to an increase in FRR – i.e. with low FAR it becomes more probable that two templates from the same person will be determined as belonging to different people.**C++ Syntax:**

```
int FSDK_GetMatchingThresholdAtFAR(float FARValue, float*
Threshold);
```

Delphi Syntax:

```
function FSDK_GetMatchingThresholdAtFAR(FARValue: single; var
Threshold: single): integer;
```

C# Syntax:

```
int FSDK.GetMatchingThresholdAtFAR(float FARValue, ref float
Threshold);
```

VB Syntax:

```
Function FSDKVB_GetMatchingThresholdAtFAR(ByVal FARValue As
Single, ByRef Threshold As Single) As Long
```

Java and Android Syntax:

```
int FSDK.GetMatchingThresholdAtFAR(float FARValue, float
Threshold[]);
```

Parameters:

FARValue – the desired FAR value. Varies from 0.0 (means 0%) to 1.0 (means 100%).
Threshold – pointer to a float variable to store the calculated Threshold value.

Return Value:

Returns FSDKE_OK if successful.

Example

```
FSDK_FaceTemplate template1, template2;

float MatchingThreshold, Smilarity;
FSDK_GetMatchingThresholdAtFAR(0.02, &MatchingThreshold);
```

```
FSDK_GetFaceTemplate(img1, &template1);
FSDK_GetFaceTemplate(img2, &template2);
FSDK_MatchFaces(&template1, &template2, &Similarity);
if (Similarity > MatchingThreshold)
    printf("Same Person\n");
else
    printf("Different Person\n");
```

FSDK_GetMatchingThresholdAtFRR Function

This function returns the threshold value for similarity to determine if two matched templates belong to the same person at a given FRR (False Rejection Rate) value. The FRR determines the acceptable error rate when two templates of the same person are identified as belonging to different people. Decreasing FRR leads to an increase in FAR – i.e. with low FRR it becomes more probable that two different people's templates will be recognized as the same person.

C++ Syntax:

```
int FSDK_GetMatchingThresholdAtFRR(float FRRValue, float*
Threshold);
```

Delphi Syntax:

```
function FSDK_GetMatchingThresholdAtFRR(FRRValue: single; var
Threshold: single): integer;
```

C# Syntax:

```
int FSDK.GetMatchingThresholdAtFRR(float FRRValue, ref float
Threshold);
```

VB Syntax:

```
Function FSDKVB_GetMatchingThresholdAtFRR(ByVal FRRValue As
Single, ByRef Threshold As Single) As Long
```

Java and Android Syntax:

```
int FSDK.GetMatchingThresholdAtFRR(float FRRValue, float
Threshold[]);
```

Parameters:

FRRValue – the desired FRR value. Varies from 0.0 (means 0%) to 1.0 (means 100%).
Threshold – pointer to a float variable, used to store the calculated Threshold value.

Return Value:

Returns FSDKE_OK if successful.

Gender Recognition

The SDK permits gender recognition of faces. To accomplish this, first you must to detect facial features in an image, and then pass these features to the FSDK_DetectFacialAttributeUsingFeatures function, specifying the *"Gender"* attribute.

FSDK_DetectFacialAttributeUsingFeatures

Detects an attribute of a face, and returns the Values of a particular attribute, and Confidences in these Values.

Each facial attribute has a number of Values, and each Value has an associated Confidence. A Value is a string, and a Confidence is a float from 0 to 1, which represents confidence level of this particular value of the attribute.

The following attribute names are supported:

"Gender" – to detect the gender of a face. The attribute has *"Male"* and *"Female"* values.

The Values and their Confidences are returned in a string of the following format:

"Value1=Confidence1[;Value2=Confidence2[;…]]"

For example, when calling the function with the *"Gender"* attribute, the following string may be returned:

"Male=0.95721;Female=0.04279"

It means that the subject has male gender with a confidence of 95.7%, and female gender with a confidence of 4.3%.

You may use the FSDK_GetValueConfidence to parse the returned string and retrieve the Confidences for individual Values.

C++ Syntax:

```
int FSDK_DetectFacialAttributeUsingFeatures(HImage Image,
const FSDK_Features * FacialFeatures, const char *
AttributeName, char * AttributeValues, long long
MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_DetectFacialAttributeUsingFeatures(Image:
HImage; FacialFeatures: PFSDK_Features; AttributeName,
AttributeValues: PAnsiChar; MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int DetectFacialAttributeUsingFeatures(int Image, ref TPoint
[] FacialFeatures, string AttributeName, out string
AttributeValues, long MaxSizeInBytes);
```

VB Syntax:

```
Function FSDKVB_DetectFacialAttributeUsingFeatures(ByVal Image
As Long, ByRef FacialFeatures As TPoint, ByVal AttributeName
As String, ByRef AttributeValues As String, ByVal
MaxSizeInBytes As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.DetectFacialAttributeUsingFeatures(int Image,
FSDK_Features FacialFeatures, String AttributeName, String
AttributeValues[], long MaxSizeInBytes);
```

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Parameters:

Image – HImage handle in which to detect the attribute.
FacialFeatures – pointer to the FSDK_Features array containing facial feature coordinates.
AttributeName – name of the attribute.
AttributeValues – pointer to the null-terminated string that will receive the attribute Values and their Confidences.
MaxSizeInBytes – amount of memory allocated for the output string.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output string; however, the output string still fills up all the space available.

FSDK_GetValueConfidence

Parses the string returned by FSDK_DetectFacialAttributeUsingFeatures or FSDK_GetTrackerFacialAttribute, and returns the Confidence in an individual Value.

C++ Syntax:

```
intFSDK_GetValueConfidence(const char * AttributeValues, const char * Value, float * Confidence);
```

Delphi Syntax:

```
function FSDK_GetValueConfidence(AttributeValues, Value: PAnsiChar; Confidence: PSingle): integer;
```

C# Syntax:

```
int GetValueConfidence(string AttributeValues, string Value, ref float Confidence);
```

VB Syntax:

```
Function FSDKVB_GetValueConfidence(ByVal AttributeValues As String, ByVal Value As String, ByRef Confidence As Single) As Long
```

Java and Android Syntax:

```
int FSDK_GetValueConfidence(String AttributeValues, String Value, float Confidence[]);
```

Parameters:

AttributeValues – pointer to the null-terminated string containing the attribute Values and their Confidences.
Value – pointer to the null-terminated string containing the desired Value.
Confidence – pointer to the float variable to store the Confidence in a Value.

Return Value:

Returns FSDKE_OK if successful.

Example:

```
char AttributeValues[1024];
FSDK_DetectFacialAttributeUsingFeatures(image, features,
"Gender", AttributeValues, sizeof(AttributeValues));

float ConfidenceMale = 0.0f;
float ConfidenceFemale = 0.0f;
FSDK_GetValueConfidence(AttributeValues, "Male",
&ConfidenceMale);
FSDK_GetValueConfidence(AttributeValues, "Female",
&ConfidenceFemale);
```

Working with Cameras

The library offers a set of functions to work with DirectShow-compatible web cameras and IP cameras with an MJPEG interface. The functions allow single frames to be retrieved from a camera one-by-one; they are stored in HImage descriptors. The application usually grabs frames in a loop, displaying each frame in its window and performing manipulations with images (such as face detection).

Web camera functions are available only for Windows platforms. IP camera functions are available for Windows, Linux and Mac.

Data Types

There are data types to store the information about video formats. Note that the names of video cameras are stored in wide char format (each char occupies two bytes).

C++ Declaration:

```
typedef struct {
     int Width;
     int Height;
     int BPP;
} FSDK_VideoFormatInfo;

typedef enum {
     FSDK_MJPEG
} FSDK_VIDEOCOMPRESSIONTYPE;
```

Delphi Declaration:

```
FSDK_VideoFormatInfo = record
    Width: integer;
    Height: integer;
    BPP: integer;
end;

PFSDK_VideoFormatInfo = ^FSDK_VideoFormatInfo;
FSDK_VideoFormatInfoArray =
                    array[0..255] of FSDK_VideoFormatInfo;
PFSDK_VideoFormatInfoArray = ^FSDK_VideoFormatInfoArray;
```

```
FSDK_CameraList = array[0..255] of PWideChar;
PFSDK_CameraList = ^FSDK_CameraList;

FSDK_VIDEOCOMPRESSIONTYPE = (
     FSDK_MJPEG
);
```

VB Declaration:

```
Type FSDK_VideoFormatInfo
    Width As Long
    Height As Long
    BPP As Long
End Type

Enum FSDK_VIDEOCOMPRESSIONTYPE
    FSDK_MJPEG
End Enum
```

Java Declaration:

```
class HCamera {
     protected int hcamera;
}
```

The class `FSDK_VideoFormatInfo` has the following properties:

```
     public int Width, Height, BPP;

class FSDK_VideoFormats {
     public FSDK_VideoFormatInfo.ByValue formats[];
}

class TCameras {
     public String cameras[];
}
class FSDK_VIDEOCOMPRESSIONTYPE {
       public static final int FSDK_MJPEG = 0;
   }
```

FSDK_InitializeCapturing Function

This function initializes the capturing process (but does not open a camera). This function should be called in a certain thread that works with cameras. Note that on Windows platforms this function initializes COM in the thread; if you already initialized COM, you must not call this function, and you must not call FSDK_FinalizeCapturing.

C++ Syntax:

```
int FSDK_InitializeCapturing(void);
```

Delphi Syntax:

```
function FSDK_InitializeCapturing: integer;
```

C# Syntax:

```
int FSDKcam.InitializeCapturing();
```

VB Syntax:

```
Function FSDKVB_InitializeCapturing() As Long
```

Java Syntax:

```
int FSDKCam.InitializeCapturing();
```

Return Value:

Returns FSDKE_OK if successful.

FSDK_FinalizeCapturing Function

This function finalizes the capturing process, initialized by the FSDK_InitializeCapturing function (and finalizes COM on Windows platforms). If you already finalized COM, you must not call this function.

C++ Syntax:

```
int FSDK_FinalizeCapturing(void);
```

Delphi Syntax:

```
function FSDK_FinalizeCapturing: integer;
```

C# Syntax:

```
int FSDKcam.FinalizeCapturing();
```

VB Syntax:

```
Function FSDKVB_FinalizeCapturing() As Long
```

Java Syntax:

```
int FSDKCam.FinalizeCapturing();
```

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetCameraNaming Function

Sets the retrieval format for the FSDK_GetCameraList function. Depending on the value of the argument, either web camera names (by default) or their unique IDs (Device Path) are returned. Device Path may be necessary if the system has several web cameras from the same manufacturer that have the same name. This function does not support IP cameras.

C++ Syntax:

```
int FSDK_SetCameraNaming(bool UseDevicePathAsName);
```

Delphi Syntax:

```
function FSDK_SetCameraNaming(UseDevicePathAsName: boolean):
integer;
```

C# Syntax:

```
int FSDKcam.SetCameraNaming(bool UseDevicePathAsName)
```

VB Syntax:

```
Function FSDKVB_SetCameraNaming(ByVal UseDevicePathAsName As
Boolean) As Long
```

Java Syntax:

```
int FSDKCam.SetCameraNaming (boolean UseDevicePathAsName);
```

Parameters:

UseDevicePathAsName – sets a retrieval format for the FSDK_GetCameraList function.

FALSE: FSDK_GetCameraListreturns the list of names for cameras installed in the system;

TRUE: FSDK_GetCameraListreturns the list of unique device paths of these cameras.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetCameraList Function

This function retrieves the list of web cameras available in the system. The name of each camera is stored in wide char format (each character occupies two bytes). The function does not support IP cameras. The camera list must be destroyed by calling the FSDK_FreeCameraList function after the list is no longer needed.

C++ Syntax:

```
int FSDK_GetCameraList(wchar_t*** CameraList, int*
CameraCount);
```

Delphi Syntax:

```
function FSDK_GetCameraList(CameraList: PWideChar;CameraCount:
Pinteger): integer;
```

C# Syntax:

```
int FSDKcam.GetCameraList(out string[] CameraList, out int
CameraCount)
```

VB Syntax:

```
Function FSDKVB_GetCameraList(ByRef CameraList As Variant,
ByRef CameraCount As Long) As Long
```

Java Syntax:

```
int FSDKCam.GetCameraList(TCameras CameraList, int
CameraCount[]);
```

Parameters:

CameraList – pointer to wchar_t** variable to store the camera list.
CameraCount – pointer to integer variable to store the count of cameras in the system.

Return Value:

Returns FSDKE_OK if successful.

Example

```
wchar_t** CameraList;
int CameraCount;

FSDK_InitializeCapturing();
if (FSDK_GetCameraList(&CameraList, &CameraCount)!=FSDKE_OK)
     for (int i=0; i<CameraCount; i++)
          wprintf(L"camera: %s\n", CameraList[i]);
printf("%d camera(s) found.\n", CameraCount);
FSDK_FinalizeCapturing();
```

FSDK_GetCameraListEx Function

This function retrieves the list of names and the device paths of the web cameras available in the system. The name and the device path of each camera are stored in wide char format (each character occupies two bytes) at the same indices at the corresponding arrays. The function does not support IP cameras. Both lists must be destroyed by calling the FSDK_FreeCameraList function after they are no longer needed.

C++ Syntax:

```
int FSDK_GetCameraListEx(wchar_t*** CameraNameList, wchar_t***
CameraDevicePathList, int* CameraCount);
```

Delphi Syntax:

```
function FSDK_GetCameraListEx(CameraNameList: PWideChar;
CameraDevicePathList: PWideChar; CameraCount: PInteger):
integer;
```

C# Syntax:

```
int FSDKcam.GetCameraListEx(out string[] CameraNameList, out
string[] CameraDevicePathList, out int CameraCount)
```

VB Syntax:

```
Function FSDKVB_GetCameraListEx(ByRef VCameraNameList As
Variant, ByRef VCameraDevicePathList As Variant, ByRef
CameraCount As Long) As Long
```

Java Syntax:

```
int FSDKCam.GetCameraListEx(TCameras CameraNameList, TCameras
CameraDevicePathList, int CameraCount[]);
```

Parameters:

CameraNameList – pointer to wchar_t** variable to store the camera name list.
CameraDevicePathList – pointer to wchar_t** variable to store the camera device path list.
CameraCount – pointer to integer variable to store the number of cameras in the system.

Return Value:

Returns FSDKE_OK if successful.

FSDK_FreeCameraList Function

This function frees the list of web cameras obtained from the FSDK_GetCameraList or FSDK_GetCameraListEx function. The call of the function is not required in .NET, VB and Java.

C++ Syntax:

```
int FSDK_FreeCameraList(wchar_t*** CameraList, int
CameraCount);
```

Delphi Syntax:

```
function FSDK_FreeCameraList(CameraList: Pointer; CameraCount:
integer): integer;
```

Parameters:

CameraList – pointer to wchar_t** variable where the camera list is stored.
CameraCount – the count of cameras in the system, obtained from the FSDK_GetCameraList or FSDK_GetCameraListEx function.
Note:
You must call FSDK_FreeCameraList for CameraNameList and CameraDevicePathList, if you were using FSDK_GetCameraListEx.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetVideoFormatList Function

This function returns the list of video formats supported by a given camera. This function does not support IP cameras.

C++ Syntax:

```
int FSDK_GetVideoFormatList(wchar_t* CameraName,
FSDK_VideoFormatInfo** VideoFormatList, int*
VideoFormatCount);
```

Delphi Syntax:

```
function FSDK_GetVideoFormatList(CameraName: PWideChar;
VideoFormatList: PFSDK_VideoFormatInfo; VideoFormatCount:
Pinteger): integer;
```

C# Syntax:

```
int FSDKcam.GetVideoFormatList(string CameraName, out
FSDKcam.VideoFormatInfo[] VideoFormatList, out int
VideoFormatCount)
```

VB Syntax:

```
Function FSDKVB_GetVideoFormatList(ByVal CameraName As String,
ByRef VideoFormatList As Variant, ByRef VideoFormatCount As
Long) As Long
```

Java Syntax:

```
int FSDKCam.GetVideoFormatList(String CameraName,
FSDK_VideoFormats VideoFormatList, int VideoFormatCount[]);
```

Parameters:

CameraName – pointer to name of desired video camera.
VideoFormatList – pointer to FSDK_VideoFormatInfo* variable to store the list of video formats.
VideoFormatCount – pointer to integer variable to store the count of video formats.

Return Value:

Returns FSDKE_OK if successful.

FSDK_FreeVideoFormatList Function

This function frees the list of video formats obtained from FSDK_GetVideoFormatList. Calling this function is not required in .NET, VB and Java.

C++ Syntax:

```
int FSDK_FreeVideoFormatList(FSDK_VideoFormatInfo *
VideoFormatList);
```

Delphi Syntax:

```
function FSDK_FreeVideoFormatList(VideoFormatList: Pointer):
integer;
```

Parameters:

VideoFormatList – pointer to FSDK_VideoFormatInfo* variable where the list of video formats is stored.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetVideoFormat Function

The function sets the format of camera output. The function does not support IP cameras.

C++ Syntax:

```
int FSDK_SetVideoFormat(wchar_t* CameraName,
FSDK_VideoFormatInfo VideoFormat);
```

Delphi Syntax:

```
function FSDK_SetVideoFormat(CameraName: PWideChar;
VideoFormat: FSDK_VideoFormatInfo): integer;
```

C# Syntax:

```
int FSDKcam.SetVideoFormat(ref string CameraName,
FSDKcam.VideoFormatInfo VideoFormat);
```

VB Syntax:

```
Function FSDKVB_SetVideoFormat(ByVal CameraName As String,
ByRef VideoFormat As FSDK_VideoFormatInfo) As Long
```

Java Syntax:

```
int FSDKCam.SetVideoFormat(String CameraName,
FSDK_VideoFormatInfo.ByValue VideoFormat);
```

Parameters:

CameraName – pointer to name of desired video camera.
VideoFormat – desired video format.

Return Value:

Returns FSDKE_OK if successful.

Example

```
wchar_t** CameraList;
int CameraCount;
FSDK_VideoFormatInfo* VideoFormatList;
int VideoFormatCount;

FSDK_GetCameraList(&CameraList, &CameraCount);

FSDK_GetVideoFormatList(CameraList[0], &VideoFormatList,
&VideoFormatCount);
FSDK_SetVideoFormat(CameraList[0], VideoFormatList[0]);
```

FSDK_OpenVideoCamera Function

The function opens the web camera of a given name and returns its handle.

C++ Syntax:

```
int FSDK_OpenVideoCamera(wchar_t* CameraName, int*
CameraHandle);
```

Delphi Syntax:

```
function FSDK_OpenVideoCamera(CameraName: PWideChar;
CameraHandle: Pinteger): integer;
```

C# Syntax:

```
int FSDKcam.OpenVideoCamera(ref string CameraName, ref int
CameraHandle);
```

VB Syntax:

```
Function FSDKVB_OpenVideoCamera(ByVal CameraName As String,
ByRef CameraHandle As Long) As Long
```

Java Syntax:

```
int FSDKCam.OpenVideoCamera (String CameraName, HCamera
CameraHandle);
```

Parameters:

CameraName – pointer to name of web camera to open.
CameraHandle – pointer to integer variable to store the opened camera handle.

Return Value:

Returns FSDKE_OK if successful.

FSDK_OpenIPVideoCamera Function

This function opens the IP camera at a given URL and returns its handle. You may call the FSDK_SetHTTPProxy function to set an HTTP proxy for accessing the camera.

Note that the function is not supported on iOS and Android platforms.

C++ Syntax:

```
int FSDK_OpenIPVideoCamera(FSDK_VIDEOCOMPRESSIONTYPE
CompressionType, char * URL, char * Username, char * Password,
int TimeoutSeconds, int * CameraHandle);
```

Delphi Syntax:

```
function FSDK_OpenIPVideoCamera(CompressionType:
FSDK_VIDEOCOMPRESSIONTYPE; URL: PAnsiChar; Username:
PAnsiChar; Password: PAnsiChar; TimeoutSeconds: integer;
CameraHandle: PInteger): integer;
```

C# Syntax:

```
int FSDKcam.OpenIPVideoCamera(FSDK_VIDEOCOMPRESSIONTYPE
CompressionType, string URL, string Username, string Password,
int TimeoutSeconds, ref int CameraHandle);
```

VB Syntax:

```
Function FSDKVB_OpenIPVideoCamera(ByVal CompressionType As
FSDK_VIDEOCOMPRESSIONTYPE, ByVal URL As String, ByVal Username
As String, ByVal Password As String, ByVal TimeoutSeconds As
Long, ByRef CameraHandle As Long) As Long
```

Java Syntax:

```
int OpenIPVideoCamera(int CompressionType, String URL, String
Username, String Password, int TimeoutSeconds, HCamera
CameraHandle);
```

Parameters:

CompressionType– the type of video stream (MJPEG by default).
URL – URL of the IP camera to be opened.
Username – IP camera access username.
Password – IP camera access password.
TimeoutSeconds – connection timeout in seconds.
CameraHandle – pointer to integer variable to store the opened camera handle.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetHTTPProxy Function

This function sets an HTTP proxy to be used with an IP camera. If a proxy is required, the function should be called before the FSDK_OpenIPVideoCamera function.

Note that the function is not supported on iOS and Android platforms.

C++ Syntax:

```
int FSDK_SetHTTPProxy(char* ServerNameOrIPAddress, unsigned
short Port, char* UserName, char* Password);
```

Delphi Syntax:

```
function FSDK_SetHTTPProxy(ServerNameOrIPAddress: PAnsiChar;
Port: Word; Username: PAnsiChar; Password: PAnsiChar):
integer;
```

C# Syntax:

```
int FSDK.SetHTTPProxy(string ServerNameOrIPAddress, UInt16
Port, string UserName, string Password);
```

VB Syntax:

```
Function FSDKVB_ SetHTTPProxy(ByVal ServerNameOrIPAddress As
String, ByVal Port As Long, ByVal Username As String, ByVal
Password As String) As Long
```

Java Syntax:

```
int FSDKCam.SetHTTPProxy(String ServerNameOrIPAddress, int
Port, String UserName, String Password);
```

Parameters:

ServerNameOrIPAddress – proxy address.
Port – proxy port.
UserName – proxy username.
Password – proxy password.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GrabFrame Function

Retrieves the current frame from a web camera or an IP camera and stores the frame in the created HImage handle. If a camera returns an image, mirrored horizontally (it depends on the camera settings), then you can mirror it by using FSDK_MirrorImage.

C++ Syntax:

```
int FSDK_GrabFrame(int CameraHandle, HImage* Image);
```

Delphi Syntax:

```
function FSDK_GrabFrame(CameraHandle: integer; var Image:
PHImage): integer;
```

C# Syntax:

```
int FSDKcam.GrabFrame(int CameraHandle, ref int Image);
```

VB Syntax:

```
Function FSDKVB_GrabFrame(ByVal CameraHandle As Long, ByRef
Image As Long) As Long
```

Java Syntax:

```
int FSDKCam.GrabFrame(HCamera CameraHandle, HImage Image);
```

Parameters:

CameraHandle – handle of the opened camera to grab frame.
Image – pointer to HImage variable to store the frame. Note that the created HImage handle should be deleted once it is no longer needed using the FSDK_FreeImage function.

Return Value:

Returns FSDKE_OK if successful.

FSDK_CloseVideoCamera Function

This function closes the camera, opened by the FSDK_OpenVideoCamera or FSDK_OpenIPVideoCamera function.

C++ Syntax:

```
int FSDK_CloseVideoCamera(int CameraHandle);
```

Delphi Syntax:

```
function FSDK_CloseVideoCamera(CameraHandle: integer):
integer;
```

C# Syntax:

```
int FSDKcam.CloseVideoCamera(int CameraHandle);
```

VB Syntax:

```
Function FSDKVB_CloseVideoCamera(ByVal CameraHandle As Long)
As Long
```

Java Syntax:

```
int FSDKCam.CloseVideoCamera(HCamera CameraHandle);
```

Parameters:

CameraHandle – handle of opened video camera to close.

Return Value:

Returns FSDKE_OK if successful.

Tracker API: Face Recognition and Tracking in Video Streams

What is Tracker API

Tracker API is a set of functions that allows for recognizing subjects in live video streams. The API receives the video frame by frame, and assigns a unique identifier (ID) to each subject detected in the video. Thus, each subject can be determined by its ID across the video. You can attach a name tag to an identifier, and query any identifier for its name. The API also allows simply tracking faces (without registering subjects), tracking the coordinates of either all facial features or just eye centers, and recognizing the gender of the subjects. The API provides an estimate of both recognition rate and false acceptance rate as the video progresses.

If your task is to track or recognize faces in video streams, consider using Tracker API instead of manually calling functions like FSDK_DetectFace, FSDK_DetectFacialFeatures or FSDK_GetFaceTemplate for each frame ("manual handling"). The difference between Tracker API and manual handling is summarized in the table below.

	Tracker API	**Manual handling**
Development effort	A developer uses a few Tracker API functions to handle an incoming video frame and set and retrieve subjects' names. The API automatically learns the appearance of every detected subject.	A developer must implement different modes in the program: a mode to enroll subjects and a mode to recognize faces. In the enrollment mode, the program must store a certain (usually found experimentally) number of face templates in the database, while the subject is posing in front of the camera. In recognition mode, a template for each detected face is created and is matched against the database.

	Tracker API	**Manual handling**
Performance	The API constantly learns how subjects appear. Thus, its recognition rate is usually higher than of a system that merely stores several templates of a subject.	If environmental conditions (such as lighting) change after the enrollment, the system may not recognize the subject, and a new enrollment will be required.
Recognition rates	Tracker API provides the estimate of recognition rate and false acceptance rate specifically for video streams.	FSDK_MatchFaces provides FAR/FRR values for matching a pair of images. Typically, it is not easy to estimate how the storage of several templates per person affects recognition rate, how often false acceptances occur as the video progresses, and if false acceptance rate increases as more subjects are enrolled.
Enrollment	The subject is generally not required to pose. When the operator assigns a name to the subject, it is likely that Tracker API has already captured enough views of a subject to recognize it I later frames.	The subject is required to pose in front of the camera, for the system to capture the face in different views and environmental conditions, and with different facial expressions.
Recognition without enrollment	Every subject is recognized, regardless of whether it was already tagged with a name. The API assigns a unique ID to track the subject across the video. This allows for surveillance applications, when subjects cannot be required to participate willingly (that is, to pose) to be enrolled for recognition.	Only enrolled subjects can be recognized. The requirement to participate actively in recognition makes surveillance applications difficult.
Tracking of multiple faces	The API tracks, recognizes, and allows assigning names to multiple faces simultaneously present in the video frame.	Usually only a single subject can pose in front of the camera when enrolling. If other subjects are visible, the system may mistakenly store their templates into the subject's database record. A separate tracking mechanism is required to decide whether the detected face belongs to the enrolled subject or not.

	Tracker API	Manual handling
Facial feature detection	Tracker API allows tracking of facial feature coordinates of each subject in the video frame. Jitter is eliminated by smoothing.	The coordinates detected by FSDK_DetectFacialFeatures may jitter because of noise present in the video. If multiple faces are present, a tracking mechanism is required to implement smoothing.
Gender recognition	The API allows for identifying gender for each subject tracked in the video. The analysis of the video usually provides higher recognition rates than still image gender recognition.	When each video frame is treated as a still image, gender recognition rates are usually lower.

Understanding Identifiers

The API analyzes the video stream sequentially, frame by frame. For each frame, the function FSDK_FeedFrame returns the list of identifiers (integer numbers) of faces recognized in this frame. The purpose of an identifier is to assign a unique number to each subject in the video. If a face is similar to one recognized previously, it receives the same identifier. Otherwise, a new identifier (in ascending numeric order) is assigned. Thus, subjects recognized as different should get different identifiers.

It is important to note that the identifier value is meaningful only within a particular video stream. Identifiers of the same subject are not expected to be the same across different video streams.

A subject can have several identifiers

The same subject can get different identifiers in different frames (for example, ID1 in the first frame and ID2 in the second, ID2 > ID1), if the system was not able to match its face to ones previously seen (which might happen if the appearance of the subject on the second frame was notably or unexpectedly different).

Merger of identifiers

However, as the video progresses, the system learns more about the appearance of each person; at some point it may deduce that ID1 and ID2 actually represent the same person. In such a case (and if it is possible) it merges both identifiers into ID1, further returning ID1 for every novel recognized occurrence of this subject. The system retains the information of all merger events, so it is possible to receive the resulting value of an early assigned identifier (for example, receive the ID1 value when providing the ID2 value) by calling the FSDK_GetIDReassignment function. Note that if an identifier was tagged with a name, it can be merged only with other identifiers that are untagged; in such a case the tagged name is retained.

When calling Tracker API functions with identifiers received on earlier frames, it is always recommended to convert the identifier values with the FSDK_GetIDReassignment function first, and only then pass them to Tracker API. The reason is that they may have been merged

on the subsequent frames, so the corresponding subjects are being represented with other identifier values.

When identifiers are not merged

The API supports tagging an identifier with a name, provided by the user. If identifiers are tagged with different names, they will not be merged.

The appearances of each subject are stored in the memory (see the Memory section). If a subject has been tagged with a name, and the memory for this subject is full, it will not be merged with any other identifier (because such a merger requires additional memory for the subject).

Similar identifiers

The identifier returned by the FSDK_FeedFrame function can be similar enough to other identifiers for the API to decide they represent the same person. Still, some reason (such as the one described above) may prevent them from merging. In such case, similar identifiers of an ID can be retrieved using the FSDK_GetSimilarIDList function.

You should always retrieve the list of similar identifiers when deciding if therecognized face belongs to a certain subject or not. Let us assume that you have a particular subject of interest and should respond when it is recognized. You may have stored an identifier of that subject, or assigned a name to it with FSDK_SetName, and wait for such identifier (or name) to appear. (Keep in mind that you need to adjust the stored identifier with FSDK_GetIDReassignment after calling FSDK_FeedFrame.) When the subject appears, however, there is no guarantee that the stored identifier will be returned by the FSDK_FeedFrame function. Instead, it may appear in the list of similar identifiers. Therefore, you should compare your identifier against the list of similar identifiers for each ID returned by FSDK_FeedFrame. Accordingly, you need to retrieve the names of each similar identifier, for each ID returned by FSDK_FeedFrame, to find if any of these names belong to the subject of interest. If you are not considering such lists of similar identifiers, your recognition rate will be lower (that is, you may miss the appearance of the subject of interest).Of course, your false acceptance rate will be lower as well. But the drop in recognition rate will be higher compared to when you set a higher recognition threshold (see the Recognition Performance section), and handle similar identifiers.

The function FSDK_GetAllNames implements the above functionality – it returns the name of an identifier, concatenated with the names (if any) of similar identifiers, separated by a semicolon.

Tracker Memory

The API allows limiting the memory used by a tracker. The memory size is measured in the total number of facial appearances stored (about 14Kbytes per appearance). By default, the limit is 2150 appearances (about 30 Mbytes). You can change the limit by setting the MemoryLimit parameter (see the Tracker Parameters section) to your desired value.

Memory available for each subject

For each subject tagged with a name, the amount of memory available is

max(1, memoryLimit/(subjectCount+1))

where subjectCount is the total number of subjects tagged with a name. The remaining memory is dedicated to untagged identifiers.

If, when setting a name with FSDK_SetName, there is not enough room for a new subject, the API will return the FSDKE_INSUFFICIENT_TRACKER_MEMORY_LIMIT error.

Imposing memory limits

If a memory limit for an identifier, tagged with a name, is approached, then no new appearances of that subject will be stored. That is, the system stops learning novel appearances of the subject. Furthermore, the identifier will not be merged with any other identifiers.

If a memory limit is approached for untagged identifiers, the earliest untagged facial appearance becomes purged when calling FSDK_FeedFrame. Note that only a particular appearance of some untagged identifier becomes purged, not the identifier's entire record of appearances; identifiers that have only one occurrence are purged completely. To prevent purging, you may use the FSDK_LockID function.

Note that if an identifier is tagged, and does not occupy more memory than available per subject, its facial appearances are not purged.

How to set the memory limit

The higher the limit, the more identifiers you can tag, and the more facial appearances can be stored for each identifier (thus improving the recognition rate). However, the Threshold parameter should also be higher (but setting too high a Threshold has its downsides – see the "Recognition Performance" section), for the false acceptance rate to stay at an acceptable level.

When increasing MemoryLimit, the frame rate will decrease. Therefore, it is practical to choose a memory limit that will allow for a sufficient frame rate, will not require too high a threshold, and will consume only a certain amount of memory, while at the same time allowing for the storage of the desired number of subjects.

See the "Recognition performance" section to find which Threshold values should be chosen with different memory limits to achieve the desired recognition rates.

Tracker Parameters

Each HTracker instance allows setting a number of parameters with the FSDK_SetTrackerParameter or FSDK_SetTrackerMultipleParameters function.

Face tracking parameters

Note that the Tracker API does not use the parameters of face detection, set with FSDK_SetFaceDetectionParameters or FSDK_SetFaceDetectionThresholds. Instead, you should use the Tracker API parameters below.

HandleArbitraryRotations, *DetermineFaceRotationAngle*, *InternalResizeWidth* – the parameters analogous to ones in FSDK_SetFaceDetectionParameters. Their default values are (false, false, 256).

FaceDetectionThreshold – a parameter analogous to one in FSDK_SetFaceDetectionThreshold. The default value is 5.

FaceTrackingDistance – specifies the maximum distance between faces of one person on consecutive frames, to consider an uninterrupted tracking sequence. The parameter is measured in width of the detected face. The default value is 0.5. You may decrease it when the frame rate is high to lower the probability of false acceptances, or increase it when the frame rate is low and the recognition rate is low due to interrupted tracking.

Face recognition parameters

RecognizeFaces – whether to recognize subject's identity. If set to true, the system attempts to assign each subject a unique id, while giving equal identifiers to the same subject across the video. If set to false, the system will return a unique ID value for every uninterrupted sequence of a detected face (that is, when a certain face is detected on every frame of the sequence), regardless of the identity of this face. The default value is true.

RecognitionPrecision – whether to use faster (less precise) or slower (more precise) extraction of facial appearances. If set to 0, the faster option is used, and, facial feature coordinates are not employed; only the coordinates of eye centers are detected. If set to 1, facial features are detected, but with less precision compared to when DetectFacialFeatures is set to true. If DetectFacialFeatures or DetectGender is set to true, and RecogntitionPrecision is set to 1, facial appearances will be extracted even more accurately, but at a lower frame rate. Changing this parameter affects only those facial appearances extracted after it is changed. The default value is 1.

DetectGender – whether to recognize the gender of a subject. Gender recognition requires the detection of facial features, so when set to true, facial features are detected regardless of the DetectFacialFeatures parameter. The default value is false.

Learning – whether to learn subjects' appearances. If set to true, the API will learn the appearance of each subject, unless its memory is full, and add new subjects to the memory. If set to false, the system will return only the identifiers already present in the memory; no addition of novel subjects, novel facial appearances, or merger of identifiers will occur. If a subject does not match any appearance stored in the memory, FSDK_FeedFrame will return the -1 identifier for that subject. Set this flag to false if you have a reason not to alter the memory. The default value is true.

MemoryLimit – the amount of memory available for the storage of facial appearances. See the Tracker Memory section below. The default value is 2150.

Threshold – the threshold used when deciding if two facial appearances belong to the same subject. Each threshold value alters both the false acceptance rate and recognition rate. See the Recognition Performance below. The default value is 0.992.

Facial feature tracking parameters

DetectEyes – whether to detect eyes. Eyes will be detected regardless of the value of this parameterwhen RecognitionPrecision is set to 0, and RecognizeFaces is set to 1. When eyes are detected, their coordinates can be retrieved with FSDK_GetTrackerEyes. The default value is false.

DetectFacialFeatures – whether to detect facial features. Facial features are detected when RecognizeFaces is set to 1, and RecognitionPrecision is set to 1, regardless of the value of this parameter; however if this parameter is set to false, the accuracy of the detection will be lower. If DetectGender is set to 1, facial features will be detected with the highest accuracy. The default value is false.

SmoothFacialFeatures – whether to smooth facial features from frame to frame to prevent jitter. If set to false, the coordinates of facial features are detected independently of the previous frame, and may jitter because of the noise present in the video. If the parameter is set to true, the API will smooth the coordinates of facial features. The default value is true.

FacialFeatureSmoothingSpatial – a coefficient employed in facial feature smoothing. Controls spatial smoothing of facial features. The default value is 0.5.

FacialFeatureSmoothingTemporal – a coefficient employed in facial feature smoothing. Affects temporal smoothing of facial features (that is, how the smoothed coordinates relate to their coordinates on the previous frame). The default value is 250.

Tuning for Optimal Performance

The higher the frame rate of FSDK_FeedFrame (i.e., the faster it processes a frame), the better the recognition rate usually is, because more facial appearances of a person get captured per unit of time. Sometimes, such as on Atom or ARM processor, an increased frame rate will yield higher a recognition rate than a higher precision of recognition (when RecognitionPrecision=1). You may try the setting RecognitionPrecision=0.

Experiment with face detection parameters, especially withInternalResizeWidth: higher values allow for faces to be detected at greater distance, but require additional time (and lower the frame rate). If you find a high number of false detections (i.e. when faces are detected where they are not present), try increasing the FaceDetectionThreshold parameter.

Setting DetectFacialFeatures to true will lower the frame rate, but the recognition precision will be somewhat higher. Setting DetectGender to true forces facial features to be detected, and will again lower the frame rate. If you need only to detect gender, you may consider setting the RecognizeFaces parameter to false, in order to increase the frame rate.

Using the API

The API allows for creating several trackers within the program, each having a separate memory for the recognized subjects and their names.

The tracker is represented with the HTracker data type.

C++ Declaration:

```
typedef unsigned int HTracker;
```

Locking identifiers

There are cases when you need to work with (or tag) an identifier across several frames. For example, you may have the user interface running in a different thread than FSDK_FeedFrame. Then, there is a chance that when a user selects an untagged identifier and starts to enter a name for it, the identifier may become purged by FSDK_FeedFrame running in parallel (see the Tracker Memory section). To prevent this, you need to use the FSDK_LockID functions as soon as the user selected an identifier. The function will prevent the untagged identifier from being purged completely.

Multiple camera support

Tracker API is designed to support multiple cameras, though in the current release only a single camera is supported. You should pass 0 as the CameraIdx parameter to every function

that accepts it. You should not alternate frames from multiple cameras while sending them to FSDK_FeedFrame, since it will disrupt the tracking process, and yield a lower recognition rate and a higher false acceptance rate. It is also not recommended to switch from one camera to another while sending the frames using FSDK_FeedFrame. It is acceptable, however, to switch cameras before the memory of the tracker is loaded with FSDK_LoadTrackerMemoryFromFile or FSDK_LoadTrackerMemoryFromBuffer.

Usage Scenario

The following scenario is employed when using Tracker API.

1. Create a tracker (FSDK_CreateTracker) or load it from a file (FSDK_LoadTrackerMemoryFromFile) or from a memory buffer (FSDK_LoadTrackerMemoryFromBuffer).
2. Set tracker parameters (FSDK_SetTrackerParameter, FSDK_SetTrackerMultipleParameters), such as face detection parameters, recognition precision, or the option to recognize gender or detect facial features.
3. Open a video camera (FSDK_OpenVideoCamera, FSDK_OpenIPVideoCamera), or prepare to receive video frames from another source.
4. In a loop:
    1) Receive a frame from a camera (FSDK_GrabFrame) or another source.
    2) Send the image to the FSDK_FeedFrame function.
    3) Display the image on a screen.
    4) For each ID returned by FSDK_FeedFrame:
        i. Retrieve its facial coordinates (FSDK_GetTrackerFacePosition), eye center coordinates (FSDK_GetTrackerEyes), facial feature coordinates (FSDK_GetTrackerFacialFeatures), or gender (FSDK_GetTrackerFacialAttribute).
        ii. Retrieve the list of possible names (FSDK_GetAllNames).
        iii. If, relying on coordinates, you found that that user has clicked on a face, call FSDK_LockID on that identifier, display an input box and ask the user for a name of the subject. You may continue to run FSDK_FeedFrame in parallel.
        iv. If the user entered a name, set it using the FSDK_SetName function. If the user chose to erase the subject, call FSDK_SetName with an empty name. In any case, call FSDK_UnlockID to unlock the identifier.
        v. If manually handling identifiers (for example, storing the identifier of each subject to look up them later, or storing images of each subject), call FSDK_GetSimilarIDCount and FSDK_GetSimilarIDList to retrieve identifiers, similar to ID, and store (or compare against) them as well. In addition, call FSDK_GetIDReassignment for every previously stored identifier before comparing against them.
    5) If necessary, save tracker memory to a file or a buffer (FSDK_SaveTrackerMemoryToFile, FSDK_SaveTrackerMemoryToBuffer).
5. Free the tracker handle using FSDK_FreeTracker.
6. Close the video camera (FSDK_CloseVideoCamera).

User Interaction with the System

In a typical scenario, a user observes the images from a camera, with faces outlined in rectangles and names displayed under the rectangles. There is an option to tag a subject with a name by clicking its face and entering the name, or to remove the subject from the memory.

The software may notify the user when some previously defined subjects appear. The software may additionally store each image of a subject, and allow browsing such subject's images. The software may store images of untagged subjects as well (and store their ID along with the image), but keep in mind that if the memory limit is reached, earlier appearances of untagged subjects will be purged, and should these subjects appear again, they may be given with new ID numbers (unrelated to their old identifiers; see the Tracker Memory section).

The user normally should have control over the MemoryLimit and Theshold parameters to alter the recognition quality and the number of subjects that can be stored in the system.

Enrollment

To enroll a subject, the user is usually only required to click a subject's face and enter the name. If the subject has been already present in front of the camera for some time (for example, while approaching the user's desk), and the frame rate is sufficiently high (at least 10 frames per second), it is likely that the API has stored enough facial appearances of the subject to recognize it again. If this is not the case, the subject maybe asked to tilt or rotate its head, to walk closer to or further away from the camera, and the lighting can be altered. If the frame rate is especially low, or if environmental conditions change unexpectedly, the API may not recognize the subject in some appearances. In such cases, the user may tag a subject with the same name on several occasions, until enough facial appearances are stored, and the subject is consistently recognized.

Typically you cannot enroll a subject with a photograph – for example, when planning to alert the user once the subject displayed on the photo appears. A still photo does not allow the API to extract enough information compared to what is available in the video, but it is such information that allows for the recognition of person across different conditions.

Dealing with false acceptances

The API is designed to return several names with FSDK_GetAllNames for a certain ID. In most cases, the system will return only a single name. If the system returns several names, it means that a false acceptance has occurred. That is, two (or more) subjects became confused.

Although the false acceptance rate is usually low, there is no way to eliminate it completely; instead, the user balances the false acceptance rate against the recognition rate. The software should account for the scenario when a false acceptance has been occurred.

In an access control setting, you may decide to grant access to the subject if any of the names recognized has the appropriate permissions. Alternatively, the software may signal about a false acceptance, and the user may decide to set the Threshold parameter to a higher value – to lower the probability of next false acceptance. In that case it is necessary, first, to erase the persons that were confused (by calling FSDK_SetName with an empty name), and then, when the threshold is set to a higher value, to set their names again.

Keep in mind that not every false acceptance will return several names of a person. It is possible that just a single incorrect name is returned, and the false acceptance may go unnoticed. However, with the appropriate setting of the Threshold parameter, such scenarios are rare.

Note that when there are one or more similar identifiers returned with FSDK_GetSimilarIDList, and these identifiers do not have name tags, this does not always mean a false acceptance. As described in the Understanding Identifiers section, when the memory for an identifier is full, it will not become merged with other identifiers (even if they

represent the same subject), so these identifiers will be returned in the list of similar identifiers.

Saving and Loading Tracker Memory

To save the memory of a tracker to file, use the FSDK_SaveTrackerMemoryToFile function. Alternatively, you may save it to a memory buffer (for example, to for later importing into a database). You need to call FSDK_GetTrackerMemoryBufferSize to determine the size of the buffer, and then call FSDK_SaveTrackerMemoryToBuffer.

Conversely, to load the memory of a tracker from a file or a buffer, use the FSDK_LoadTrackerMemoryFromFile or FSDK_LoadTrackerMemoryFromBuffer functions. Note that you need to set the tracker parameters again after loading, because a new tracker handle has been created, with parameters set to default values.

Note that this operation saves only the memory contents of a tracker: stored facial appearances, identifiers, and names. The parameters of a tracker are *not* saved. Moreover, the internal state of face tracking is not saved as well. It means that if, during the main loop (where you call FSDK_FeedFrame), you save the tracker to a file, and then immediately load it, such an operation will disrupt face tracking. Because of this, the later recognition results you receive will be different (compared to when such an operation was not done), and the parameters will be reset to defaults. Also, you will not be able to receive face position, eye coordinates, facial feature coordinates, or get the list of similar identifiers immediately after loading. However, after the next FSDK_FeedFrame call, face tracking resumes, and the aforementioned functions operate normally.

Recognition Performance

The performance of face recognition (i.e. how often a subject is recognized, and how often different subjects are confused) is controlled with the Threshold and MemoryLimit parameters. The higher the Threshold parameter (and the lower the MemoryLimit parameter), the less often a subject will be recognized, and the less often confusions will occur.

Performance measures

Tracker API employs two performance measures: false acceptance rate (**FAR**) and recognition rate (**R**). **FAR** measures the rate of confusing different subjects (that is, assigning different subjects with equal identifier values) during a certain number of *storage events*, once the memory becomes full. **R** measures the rate of recognizing a person after tagging, once all available memory is full.

Understanding storage events

When calculating **FAR**, one could just count how often false acceptances occur during a certain time interval (for example, an hour). However, such a measure will vary greatly across different kinds of video footage.

For example, in an office setting, when subjects are sitting at their desks, and change their positions or facial expressions rather slowly, almost every frame will be very similar to the previous one. Therefore, the API will store novel facial appearances at a slow pace. If there were no false acceptances on a previous frame, they are very unlikely to occur on the next; therefore we expect false acceptances to occur rather rarely.

On the other hand, in an active setting (when many novel subjects appear in front of the camera, move around, and disappear from view), we expect the system to store novel facial appearances quite often, because many subjects appears at previously unseen views. Therefore, we expect false acceptances to occur more often, because of the faster pace of the video.

To employ a rate that is meaningful in both settings, we instead measure time not in seconds, but in *storage events*. For example, in the office setting, at 12 frames per second, we may get only 400 storage events during an hour, and in the active setting we may get 3600 *storage events* during an hour. We measure **FAR** at an interval of 2000 *storage events*, which could be roughly equal to 5 hours of a hypothetical less active setting, or 32 minutes of an active setting. It is important to note that as facial appearances of a subject accumulate, the rate of *storage events* will slow down, since there will be fewer novel facial appearances.

How to measure your rate of storage events

To measure the rate of storage events in your setting, call FSDK_GetTrackerParameter with the MemorySize parameter during the main loop. Each time a storage event occurs, the MemorySize parameter increases. As your video progresses, you may calculate how much time will be needed to reach 2000 storage events. Note that when the memory is full, storage events themselves still occur, but nothing is stored; this does not mean that **FAR** becomes zero. You should estimate the rate of storage events before the memory is full.

Understanding FAR

FAR is the rate of assigning different subjects with equal identifier values. The rate tells how often a certain subject (say, John) will be falsely accepted as any other subject. For example, if **FAR** is 0.001, John might expect a 0.001 probability of being falsely accepted as some other subject. However, if we have 10 subjects in the system, such a rate applies to every one of them. Therefore, it is practical to know the rate of falsely accepting at least two subjects among any of them. Such a rate can be calculated as

$$1 - (1 - \mathbf{FAR})^{N*(N-1)/2}$$

where N is the number of subjects. For example, at **FAR**=0.001, N=10, we have a 4.4% rate that at least one false acceptance will occur during the 2000 storage events considered. To have a 1% rate with 10 subjects, **FAR** should not exceed 0.0003.

Understanding R

R is the rate of recognizing a subject after it was tagged a single time, and all memory available for a subject becomes full. A subject is successfully recognized, if its name is present among the names returned by FSDK_GetAllNames. R is measured from 0 to 1, which translates to recognition in 0% and 100%, respectively, of frames received by FSDK_FeedFrame.

R depends mainly on the amount of memory available for each subject. For example, if there are 30 subjects in your system, and you allow 20 units of memory for each subject, your memory limit should be (30+1)*20=620.

Choosing Threshold value

To choose the Threshold value, refer to the tables below. You should consider the maximum number of subjects to be tagged within your system, and the maximum memory per subject.

Generally, the higher the MemoryLimit is set, the higher the FAR will be (once all available memory has been used).

Note that higher Threshold values together with a higher memory amount allow higher recognition rate *only* when enough facial appearances of an identifier have been accumulated. If there are sudden changes in facial appearance (due to low frame rate or environmental factors, for example), it may require more time to capture enough facial appearances with a higher Threshold value.

The tables below are applicable when RecognitionPrecision=1, and show the expected false acceptance rate and recognition rate.

False Acceptance Rate at Threshold and MemoryLimit

Threshold	MemoryLimit					
	350	700	1750	3500	5250	7500
0.992000	0.000042	0.000162	0.000782	0.001731	0.002471	0.003181
0.993141	0.000028	0.000145	0.000659	0.001483	0.002136	0.002611
0.994283	0.000031	0.000098	0.000444	0.001190	0.001709	0.002044
0.995424	0.000020	0.000098	0.000399	0.000938	0.001312	0.001625
0.996566	0.000014	0.000064	0.000318	0.000720	0.001067	0.001254
0.997707	0.000017	0.000056	0.000223	0.000475	0.000642	0.000793
0.998849	0.000011	0.000031	0.000223	0.000240	0.000335	0.000430
0.999990	0.000003	0.000006	0.000006	0.000006	0.000006	0.000014

Recognition Rate at Threshold and Memory per subject

Threshold	Memory per subject			
	5	10	15	21
0.992000	0.470029	0.707030	0.812454	0.859773
0.993141	0.457467	0.691039	0.813938	0.867250
0.994283	0.448789	0.688625	0.816311	0.876991
0.995424	0.436635	0.676645	0.809373	0.870615
0.996566	0.417210	0.660652	0.801148	0.872192
0.997707	0.386770	0.631219	0.789319	0.873580
0.998849	0.328183	0.581425	0.748394	0.853809
0.999990	0.057315	0.065404	0.076962	0.097187

For example, let us assume that you have 30 subjects in an office setting, your frame rate is 12 per second, and you decide to allow 21 units of memory per subject. Therefore, your memory limit is (30+1)*21 = 651 (see the formula in the "Memory available for each subject" section). You decide to have a FAR of 0.0001 and calculate that with 30 subjects, there will be 4.3% rate that a subject will be given with an ID of any other subject (see the formula in the Understanding FAR section) during 2000 storage events (approximately 5 hours in an office setting). To have a FAR of 0.0001 with MemoryLimit=700 (the value closest to 651 in the table), you choose Threshold=0.995424. You note that at such a threshold and 21 units of

memory per subject, you have an 0.870615 recognition rate (meaning subjects will be recognized in 87% of frames in the video).

Gender Recognition

The API allows for identifying gender of a face by using the FSDK_GetTrackerFacialAttribute function. To be able to detect gender, you need to set the DetectGender tracking parameter to true. The function returns confidence levels for each gender (male and female) in the output string. You can parse this string using the FSDK_GetValueConfidence function.

The confidence level for each gender, returned by the FSDK_GetTrackerFacialAttribute function, varies from 0 to 1. The recognized gender will be the one with the higher confidence level.

If your system should respond to the particular gender of a novel subject (for example, when advertising separate products for male and female visitors), consider waiting for about a second after the subject has first appear, for the gender to be recognized with higher accuracy. You may also consider responding when the confidence level is not just merely than 0.5, but exceeds a certain threshold (for example, 0.7 or 0.9, which translate to 70% or 90% accuracy).

Note that gender recognition requires the detection of facial features, so facial features will be detected regardless of the DetectFacialFeatures parameter value. This will decrease the frame rate. You might consider setting the RecognizeFaces parameter to false if you only need to detect gender and do not need recognition of the subjects' identities, which will increase the frame rate.

Face, Eye and Facial Feature Tracking

Tracker API supports the tracking of face, eye centers, and facial features in addition to the recognition of a subject's identity. You need to use the FSDK_GetTrackerFacePosition, FSDK_GetTrackerEyes and FSDK_GetTrackerFacialFeatures to retrieve the corresponding coordinates. You also need to set the parameter DetectEyes or DetectFacialFeatures to true when tracking eyes or facial features, respectively. Tracker API perform smoothing of facial features (see the SmoothFacialFeatures parameter).

When you only need to track faces, and do not need to recognize subjects' identities, you can disable face recognition to improve performance. To accomplish that, you need to set the RecognizeFaces parameter to false.

Counting the number of people

You should not estimate the amount of people the system observed based on the values of the identifiers, since some of they may have been merged with others. Instead, you may retain all the ID values returned by Tracker API, and at the point when the number of people should be estimated, you should replace each ID with the value returned by the FSDK_GetIDReassignment function. Then, you can count the amount of different identifiers in the list. Note that if memory limit is approached, some untagged identifiers may be purged, and the amount of people may be overestimated. See the "User Interaction with the System" section for details.

If each subject captured by the camera appears only once, you may consider not determining the subject's identity (set RecognizeFaces to false). Then, the value of the ID returned by the

API will be equal to the total number of continuous facial sequences, or approximately the number of people appeared in front of the camera.

Thread Safety

All tracker functions are thread safe. Note that you should avoid calling FSDK_FeedFrame simultaneously on the same tracker from several threads, since it will disrupt the FSDK_GetTrackerEyes, FSDK_GetTrackerFacialFeatures, FSDK_GetTrackerFacePosition, FSDK_GetTrackerFacialAttribute, FSDK_GetSimilarIDCount, FSDK_GetSimilarIDList and FSDK_GetAllNames functions. The reason is that the ID received from FSDK_FeedFrame must be passed to these functions before the next FSDK_FeedFrame is executed with the following frame; otherwise these functions may not perform correctly.

FSDK_CreateTracker Function

Creates a new tracker handle to be passed to other Tracker API functions.

C++ Syntax:

```
int FSDK_CreateTracker(HTracker * Tracker);
```

Delphi Syntax:

```
function FSDK_CreateTracker(Tracker: PHTracker): integer;
```

C# Syntax:

```
int CreateTracker(ref int Tracker);
```

VB Syntax:

```
Function FSDKVB_CreateTracker(ByRef Tracker As Long) As Long
```

Java and Android Syntax:

```
int FSDK.CreateTracker(HTracker Tracker);
```

Parameters:

Tracker – pointer to the integer variable that will to store the created tracker handle.

Return Value:

Returns FSDKE_OK if successful.

FSDK_FreeTracker Function

Frees a tracker handle. The handle becomes invalid, and all memory associated with it is released. You should not pass the tracker handle to any other Tracker API functions after the handle was freed.

C++ Syntax:

```
int FSDK_FreeTracker(HTracker Tracker);
```

Delphi Syntax:

```
function FSDK_FreeTracker(Tracker: HTracker): integer;
```

C# Syntax:

```
int FreeTracker(int Tracker);
```

VB Syntax:

```
Function FSDKVB_FreeTracker (ByVal Tracker As Long) As Long
```

Java and Android Syntax:

```
int FSDK.FreeTracker(HTracker Tracker);
```

Parameters:

Tracker – handle of the tracker to be freed.

Return Value:

Returns FSDKE_OK if successful.

FSDK_ClearTracker Function

Clears the content of a tracker, releasing all its memory. The tracker handle stays valid.

C++ Syntax:

```
int FSDK_ClearTracker(HTracker Tracker);
```

Delphi Syntax:

```
function FSDK_ClearTracker(Tracker: HTracker): integer;
```

C# Syntax:

```
int ClearTracker(int Tracker);
```

VB Syntax:

```
Function FSDKVB_ClearTracker(ByVal Tracker As Long) As Long
```

Java and Android Syntax:

```
int FSDK.ClearTracker(HTracker Tracker);
```

Parameters:

Tracker – handle of the tracker to be cleared.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetTrackerParameter Function

Sets the parameter of a tracker. See the "Tracker Parameters" section for details.

C++ Syntax:

```
int FSDK_SetTrackerParameter(HTracker Tracker, const char *
ParameterName, const char * ParameterValue);
```

Delphi Syntax:

```
function FSDK_SetTrackerParameter(Tracker: HTracker;
ParameterName, ParameterValue: PAnsiChar): integer;
```

C# Syntax:

```
int SetTrackerParameter(int Tracker, string ParameterName,
string ParameterValue);
```

VB Syntax:

```
Function FSDKVB_SetTrackerParameter(ByVal Tracker As Long,
ByVal ParameterName As String, ByVal ParameterValue As String)
As Long
```

Java and Android Syntax:

```
int FSDK.SetTrackerParameter(HTracker Tracker, String
ParameterName, String ParameterValue);
```

Parameters:

Tracker – handle of the tracker to have parameters set parameters.
ParameterName – name of the parameter to be set.
ParameterValue – value of the parameter.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetTrackerMultipleParameters Function

Sets multiple parameters of a tracker.The parameters and their values are specified in the following format:

"Parameter1=Value1[;Parameter2=Value2[;…]]"

See the "Tracker Parameters" section for details.

C++ Syntax:

```
int FSDK_SetTrackerMultipleParameters(HTracker Tracker, const
char * Parameters, int * ErrorPosition);
```

Delphi Syntax:

```
function FSDK_SetTrackerMultipleParameters(Tracker: HTracker;
Parameters: PAnsiChar; ErrorPosition: PInteger): integer;
```

C# Syntax:

```
int SetTrackerMultipleParameters(int Tracker, string
Parameters, ref int ErrorPosition);
```

VB Syntax:

```
Function FSDKVB_SetTrackerMultipleParameters(ByVal Tracker As
Long, ByVal Parameters As String, ByRef ErrorPosition As Long)
As Long
```

Java and Android Syntax:

```
int FSDK.SetTrackerMultipleParameters(HTracker Tracker, String
Parameters, IntByReference ErrorPosition);
```

Parameters:

Tracker – handle of the tracker to have parameters set.
Parameters – string containing the parameters and corresponding values to be set.
ErrorPosition – pointer to the integer variable that will receive the position of the character that caused syntax error in the string.

Return Value:

Returns FSDKE_OK if successful. In case of syntax error returns FSDKE_SYNTAX_ERROR and sets the value of the ErrorPosition variable.

Example:

```
int err = 0;
FSDK_SetTrackerMultipleParameters(tracker,
"HandleArbitraryRotations=false;
DetermineFaceRotationAngle=false; InternalResizeWidth=100;
FaceDetectionThreshold=5;", &err);
```

FSDK_GetTrackerParameter Function

Retrieves the value of a tracker parameter. See the "Tracker Parameters" section for details.

C++ Syntax:

```
int FSDK_GetTrackerParameter(HTracker Tracker, const char *
ParameterName, char * ParameterValue, long long
MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_GetTrackerParameter(Tracker: HTracker;
ParameterName, ParameterValue: PAnsiChar; MaxSizeInBytes:
int64): integer;
```

C# Syntax:

```
int GetTrackerParameter(int Tracker, string ParameterName, out
string ParameterValue, long MaxSizeInBytes)
```

VB Syntax:

```
Function FSDKVB_GetTrackerParameter(ByVal Tracker As Long,
ByVal ParameterName As String, ByRef ParameterValue As String,
ByVal MaxSizeInBytes As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetTrackerParameter(HTracker Tracker, String
ParameterName, String ParameterValue[], long MaxSizeInBytes);
```

Parameters:

Tracker – handle of the tracker whose parameter value is desired.

ParameterName – name of the parameter to be retrieved.
ParameterValue – pointer to the output null-terminated string that will store the value of the parameter.
MaxSizeInBytes –amount of memory allocated for the output string.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output string; however, the output string still fills up all the space available.

FSDK_FeedFrame Function

Processes a video frame according to tracker's parameters, and returns the identifiers of the tracked faces. See the "Understanding Identifiers", "Tracker Memory" and "Tracker Parameters" sections for details.

C++ Syntax:

```
int FSDK_FeedFrame(HTracker Tracker, long long CameraIdx,
HImage Image, long long * FaceCount, long long * IDs, long
long MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_FeedFrame(Tracker: HTracker; CameraIdx: int64;
Image: HImage; FaceCount: PInt64; IDs: PIDArray;
MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int FeedFrame(int Tracker, long CameraIdx, int Image, ref long
FaceCount, out long[] IDs, long MaxSizeInBytes)
```

VB Syntax:

```
Function FSDKVB_FeedFrame(ByVal Tracker As Long, ByVal
CameraIdx As Currency, ByVal Image As Long, ByRef FaceCount As
Currency, ByRef IDs As Currency, ByVal MaxSizeInBytes As
Currency) As Long
```

Java and Android Syntax:

```
int FSDK.FeedFrame(HTracker Tracker, long CameraIdx, HImage
Image, long FaceCount[], long IDs[], long MaxSizeInBytes);
```

Parameters:

Tracker – handle of the tracker in which to process the frame.
CameraIdx – index of the camera; should be equal to 0 in the current release.
Image – the HImage handle of the video frame to process.
FaceCount – address of the 64-bit integer value that will receive the count of faces tracked in the current frame.
IDs – address of the array of 64-bit integer values that will receive the identifiers of the tracked faces.
MaxSizeInBytes – amount of memory allocated for the IDs array.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetTrackerEyes Function

Retrieves the coordinates of the eye centers of a tracked face. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetTrackerEyes before the next call of FSDK_FeedFrame using the same tracker.

For the function to return the eye center coordinates, at least one of the parameters DetectEyes, DetectFacialFeatures, RecognizeFaces or DetectGender must be set to true.

C++ Syntax:

```
int FSDK_GetTrackerEyes(HTracker Tracker, long long CameraIdx,
long long ID, FSDK_Features * FacialFeatures);
```

Delphi Syntax:

```
function FSDK_GetTrackerEyes(Tracker: HTracker; CameraIdx, ID:
int64; FacialFeatures: PFSDK_Features): integer;
```

C# Syntax:

```
int GetTrackerEyes(int Tracker, long CameraIdx, long ID, out
TPoint[] FacialFeatures)
```

VB Syntax:

```
Function FSDKVB_GetTrackerEyes(ByVal Tracker As Long, ByVal
CameraIdx As Currency, ByVal ID As Currency, ByRef
FacialFeatures As TPoint) As Long
```

Java Syntax:

```
int FSDK.GetTrackerEyes(HTracker Tracker, long CameraIdx, long
ID, FSDK_Features.ByReference FacialFeatures);
```

Android Syntax:

```
int FSDK.GetTrackerEyes(HTracker Tracker, long CameraIdx, long
ID, FSDK_Features FacialFeatures);
```

Parameters:

Tracker – handle of the tracker where the coordinates of the eye centers will be retrieved.
CameraIdx – index of the camera; should be equal to 0 in the current release.
ID – identifier of the subject returned by FSDK_FeedFrame, whose eye center coordinates will be received.
FacialFeatures – pointer to the FSDK_Features variable that will receive the eye center coordinates.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call. Returns FSDKE_ATTRIBUTE_NOT_DETECTED if eye centers were not tracked on the previous FSDK_FeedFrame call.

FSDK_GetTrackerFacialFeatures Function

Retrieves the coordinates of a tracked face's features. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetTrackerFacialFeatures before the next call of FSDK_FeedFrame with the same tracker.

For the function to return the facial feature coordinates, either of the parameters DetectFacialFeatures, or DetectGender should be set to true, or the parameter RecognitionPrecision should be set to 1. See the Tracker Parameters section for details.

C++ Syntax:

```
int FSDK_GetTrackerFacialFeatures(HTracker Tracker, long long
CameraIdx, long long ID, FSDK_Features * FacialFeatures);
```

Delphi Syntax:

```
function FSDK_GetTrackerFacialFeatures(Tracker: HTracker;
CameraIdx, ID: int64; FacialFeatures: PFSDK_Features):
integer;
```

C# Syntax:

```
int GetTrackerFacialFeatures(int Tracker, long CameraIdx, long
ID, out TPoint[] FacialFeatures)
```

VB Syntax:

```
Function FSDKVB_GetTrackerFacialFeatures(ByVal Tracker As
Long, ByVal CameraIdx As Currency, ByVal ID As Currency, ByRef
FacialFeatures As TPoint) As Long
```

Java Syntax:

```
int FSDK.GetTrackerFacialFeatures(HTracker Tracker, long
CameraIdx, long ID, FSDK_Features.ByReference FacialFeatures);
```

Android Syntax:

```
int FSDK.GetTrackerFacialFeatures(HTracker Tracker, long
CameraIdx, long ID, FSDK_Features FacialFeatures);
```

Parameters:

Tracker – handle of the tracker from which to retrieve the facial feature coordinates.
CameraIdx – index of the camera; should be equal to 0 in the current release.
ID – identifier of the subject returned by FSDK_FeedFrame, whose facial feature coordinates will be received.
FacialFeatures – pointer to the FSDK_Features variable to receive facial feature coordinates.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call.
ReturnsFSDKE_ATTRIBUTE_NOT_DETECTED if facial features were not tracked on the previous FSDK_FeedFrame call.

FSDK_GetTrackerFacePosition Function

Retrieves the position of a tracked face. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetTrackerFacePosition before the next call of FSDK_FeedFrame with the same tracker.

C++ Syntax:

```
int FSDK_GetTrackerFacePosition(HTracker Tracker, long long
CameraIdx, long long ID, TFacePosition * FacePosition);
```

Delphi Syntax:

```
function FSDK_GetTrackerFacePosition(Tracker: HTracker;
CameraIdx, ID: int64; FacePosition: PFacePosition): integer;
```

C# Syntax:

```
int GetTrackerFacePosition(int Tracker, long CameraIdx, long
ID, ref TFacePosition FacePosition);
```

VB Syntax:

```
Function FSDKVB_GetTrackerFacePosition(ByVal Tracker As Long,
ByVal CameraIdx As Currency, ByVal ID As Currency, ByRef
facePosition As TFacePosition) As Long
```

Java Syntax:

```
int FSDK.GetTrackerFacePosition(HTracker Tracker, long
CameraIdx, long ID, TFacePosition.ByReference FacePosition);
```

Android Syntax:

```
int FSDK.GetTrackerFacePosition(HTracker Tracker, long
CameraIdx, long ID, TFacePosition FacePosition);
```

Parameters:

Tracker – handle of the tracker from which to retrieve the face position.
CameraIdx – index of the camera; should be equal to 0 in the current release.
ID – identifier of the subject returned by FSDK_FeedFrame whose face position will be received.
FacePosition – pointer to the TFacePosition variable that will receive the face position.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call.

FSDK_GetTrackerFacialAttribute Function

Given an attribute of a tracked face, retrieves its Values and their Confidences. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetTrackerFacialAttribute before the next call of FSDK_FeedFrame with the same tracker.

The function allows for detecting gender when provided with the "Gender" attribute name. Refer to the FSDK_DetectFacialAttributeUsingFeatures function description for details on attributes, their Values and Confidences.

C++ Syntax:

```
int FSDK_GetTrackerFacialAttribute(HTracker Tracker, long long
CameraIdx, long long ID, const char * AttributeName, char *
AttributeValues, long long MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_GetTrackerFacialAttribute(Tracker: HTracker;
CameraIdx, ID: int64; AttributeName, AttributeValues:
PAnsiChar; MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int GetTrackerFacialAttribute(int Tracker, long CameraIdx,
long ID, string AttributeName, out string AttributeValues,
long MaxSizeInBytes);
```

VB Syntax:

```
Function FSDKVB_GetTrackerFacialAttribute(ByVal Tracker As
Long, ByVal CameraIdx As Currency, ByVal ID As Currency, ByVal
AttributeName As String, ByRef AttributeValues As String,
ByVal MaxSizeInBytes As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetTrackerFacialAttribute(HTracker Tracker, long
CameraIdx, long ID, String AttributeName, String
AttributeValues[], long MaxSizeInBytes);
```

Parameters:

Tracker – handle of the tracker whose attribute will be retrieved.
CameraIdx – index of the camera; should be equal to 0 in the current release.
ID – – identifier of a subject returned by FSDK_FeedFrame whose attribute will be retrieved.
AttributeName – name of the attribute.
AttributeValues – pointer to the null-terminated string that will receive the attribute Values and their Confidences.
MaxSizeInBytes – amount of memory allocated for the output string.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call. ReturnsFSDKE_ATTRIBUTE_NOT_DETECTED if the specified attribute was not detected on the previous FSDK_FeedFrame call. Returns FSDKE_UNKNOWN_ATTRIBUTE if the specified attribute name is not supported. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output string; however, the output string still fills up all the space available.

FSDK_LockID Function

Locks an identifier. When an identifier is locked, at least one facial appearance of an identifier will not be deleted during any possible purge. You should call this function before the FSDK_SetName function. The function has no effect on identifiers which were already tagged with a name. The call should be usually paired with FSDK_UnlockID call. When the user does not set a name to a locked identifier, unlocking it allows it to become purged if necessary for memory efficient memory use.

See the Locking Identifiers section for details. You may call this function with any identifier regardless of when it was returned as long as it remains present in the tracker memory.

C++ Syntax:

```
int FSDK_LockID(HTracker Tracker, long long ID);
```

Delphi Syntax:

```
function FSDK_LockID(Tracker: HTracker; ID: int64): integer;
```

C# Syntax:

```
int LockID(int Tracker, long ID);
```

VB Syntax:

```
Function FSDKVB_LockID(ByVal Tracker As Long, ByVal ID As
Currency) As Long
```

Java and Android Syntax:

```
int FSDK.LockID(HTracker Tracker, long ID);
```

Parameters:

Tracker – handle of the tracker in which to lock an identifier.
ID – identifier of the subject to lock.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID is not present in the tracker memory.

FSDK_UnlockID Function

Unlocks the ID so it may be purged. You should call this function after the FSDK_LockID call. The function has no effect on identifiers which were already tagged with a name.

See the "Locking identifiers" section for details. You may call this function with any identifier regardless of when it was returned, as long as it is present in the tracker memory.

C++ Syntax:

```
int FSDK_UnlockID(HTracker Tracker, long long ID);
```

Delphi Syntax:

```
function FSDK_UnlockID(Tracker: HTracker; ID: int64): integer;
```

C# Syntax:

```
int UnlockID(int Tracker, long ID);
```

VB Syntax:

```
Function FSDKVB_UnlockID(ByVal Tracker As Long, ByVal ID As
Currency) As Long
```

Java and Android Syntax:

```
int FSDK.UnlockID(HTracker Tracker, long ID);
```

Parameters:

Tracker – handle of the tracker in which to unlock an identifier.
ID – identifier of the subject to unlock.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID is not present in the tracker memory.

FSDK_GetName Function

Returns the name the identifier has been tagged with. You may call this function with any identifier regardless of when it was returned, as long as it is present in the tracker memory.

C++ Syntax:

```
int FSDK_GetName(HTracker Tracker, long long ID, char * Name,
long long MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_GetName(Tracker: HTracker; ID: int64; Name:
PAnsiChar; MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int GetName(int Tracker, long ID, out string Name, long
MaxSizeInBytes);
```

VB Syntax:

```
Function FSDKVB_GetName(ByVal Tracker As Long, ByVal ID As
Currency, ByRef Name As String, ByVal MaxSizeInBytes As
Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetName(int Tracker, long ID, String Name[], long
MaxSizeInBytes);
```

Parameters:

Tracker – handle of the tracker in which to retrieve the name.
ID – identifier of a subject to retrieve the name of.
Name – identifier of the subject whose name is to be retrieved.
MaxSizeInBytes – amount of memory allocated for the output string.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output string; however, the output string still fills up all the space available. Returns FSDKE_ID_NOT_FOUND if the specified ID is not present in the tracker memory.

FSDK_SetName Function

Sets the name of an identifier. To erase the name tag, specify an empty name string. The function will unlock the identifier if the name is successfully set.

You may call this function with any identifier regardless of when it was returned, as long as it is present in the tracker memory.

C++ Syntax:

```
int FSDK_SetName(HTracker Tracker, long long ID, const char * Name);
```

Delphi Syntax:

```
function FSDK_SetName(Tracker: HTracker; ID: int64; Name: PAnsiChar): integer;
```

C# Syntax:

```
int SetName(int Tracker, long ID, string Name);
```

VB Syntax:

```
Function FSDKVB_SetName(ByVal Tracker As Long, ByVal ID As Currency, ByVal Name As String) As Long
```

Java and Android Syntax:

```
int FSDK.SetName(HTracker Tracker, long ID, String Name);
```

Parameters:

Tracker – handle of the tracker in which to set the name.
ID – identifier of the subject whose name is to be set.
Name – pointer to the null-terminated string containing the name of an identifier.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID is not present in the tracker memory.

Returns FSDKE_INSUFFICIENT_TRACKER_MEMORY_LIMIT if there is not enough room to store the identifier's facial appearances in memory. See the Tracker Memory section for details.

FSDK_GetIDReassignment Function

When provided with a subject's ID received on earlier frames, returns the new subject's ID if there was a merger. See the "Understanding Identifiers" section for details. If an identifier was not merged, the function returns the same ID value in the output variable. Note that the

function does not return an error if an identifier is not present in the tracker memory; instead; the same ID value is returned in the output variable.

C++ Syntax:

```
int FSDK_GetIDReassignment(HTracker Tracker, long long ID,
long long * ReassignedID);
```

Delphi Syntax:

```
function FSDK_GetIDReassignment(Tracker: HTracker; ID: int64;
ReassignedID: PInt64): integer;
```

C# Syntax:

```
int GetIDReassignment(int Tracker, long ID, ref long
ReassignedID);
```

VB Syntax:

```
Function FSDKVB_GetIDReassignment(ByVal Tracker As Long, ByVal
ID As Currency, ByRef ReassignedID As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetIDReassignment(HTracker Tracker, long ID, long
ReassignedID[]);
```

Parameters:

Tracker – handle of the tracker in which to get the reassigned ID value.
ID – identifier of the subject whose reassigned identifier is sought.
ReassignedID – pointer to the 64-bit integer value that will store the reassigned value of an identifier.

Return Value:

Returns FSDKE_OK if successful.

FSDK_GetSimilarIDCount Function

Returns the number of identifiers that are similar to a given identifier. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetSimilarIDCount before the next call of FSDK_FeedFrame with the same tracker. See the "Understanding Identifiers" section for details.

C++ Syntax:

```
int FSDK_GetSimilarIDCount(HTracker Tracker, long long ID,
long long * Count);
```

Delphi Syntax:

```
function FSDK_GetSimilarIDCount(Tracker: HTracker; ID: int64;
Count: PInt64): integer;
```

C# Syntax:

```
int GetSimilarIDCount(int Tracker, long ID, ref long Count);
```

VB Syntax:

```
FSDKVB_GetSimilarIDCount(ByVal Tracker As Long, ByVal ID As
Currency, ByRef Count As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetSimilarIDCount(HTracker Tracker, long ID, long
Count[]);
```

Parameters:

Tracker – handle of the tracker in which to retrieve the number of similar identifiers.
ID – identifier of the subject for which to return the number of similar identifiers.
Count – pointer to the 64-bit integer value that will store the number of similar identifiers.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call.

FSDK_GetSimilarIDList Function

Returns the list of identifiers that are similar to a given identifier. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetSimilarIDList before the next call of FSDK_FeedFrame with the same tracker. See the "Understanding Identifiers" section for details.

C++ Syntax:

```
int FSDK_GetSimilarIDList(HTracker Tracker, long long ID, long
long * SimilarIDList, long long MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_GetSimilarIDList(Tracker: HTracker; ID: int64;
SimilarIDList: PIDArray; MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int GetSimilarIDList(int Tracker, long ID, out long[]
SimilarIDList, long MaxSizeInBytes)
```

VB Syntax:

```
Function FSDKVB_GetSimilarIDList(ByVal Tracker As Long, ByVal
ID As Currency, ByRef SimilarIDList As Currency, ByVal
MaxSizeInBytes As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetSimilarIDList(HTracker Tracker, long ID, long
SimilarIDList[], long MaxSizeInBytes);
```

Parameters:

Tracker – handle of the tracker in which to get the list of similar identifiers.
ID – identifier of the subject for which to return the list of similar identifiers.

SimilarIDList – pointer to the array of 64-bit integer values that will store the list of similar identifiers.
MaxSizeInBytes – amount of memory allocated for the output array.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output string; however, the output string still fills up all the space available.

FSDK_GetAllNames Function

Returns the list of names that an identifier can have. The function accepts the identifier returned by FSDK_FeedFrame. This identifier should be passed to FSDK_GetAllNames before the next call of FSDK_FeedFrame with the same tracker. See the "Understanding Identifiers" and "Dealing with false acceptances" sections for details.

The function returns all names that belong to a given identifier, and similar identifiers, separated by a semicolon. The output format is:

```
"Name1[;Name2[;…]]"
```

You should call this function instead of FSDK_GetName whenever possible, and then parse the returned string for all returned names. Alternatively, you may implement the functionality of FSDK_GetAllNames, calling FSDK_GetName on the given identifier, then FSDK_GetSimilarIDCount and FSDK_GetSimilarIDList to get the list of similar identifiers, then finally call FSDK_GetName on that list.

C++ Syntax:

```
int FSDK_GetAllNames(HTracker Tracker, long long ID, char *
Names, long long MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_GetAllNames(Tracker: HTracker; ID: int64; Names:
PAnsiChar; MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int GetAllNames(int Tracker, long ID, out string Names, long
MaxSizeInBytes);
```

VB Syntax:

```
Function FSDKVB_GetAllNames(ByVal Tracker As Long, ByVal ID As
Currency, ByRef Names As String, ByVal MaxSizeInBytes As
Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetAllNames(HTracker Tracker, long ID, String
Names[], long MaxSizeInBytes);
```

Parameters:

Tracker – handle of the tracker in which to retrieve the names.
ID – identifier of the subject whose possible names are to be retrieved.

Names – pointer to the null-terminated string that will receive the possible names of an identifier.
MaxSizeInBytes – amount of memory allocated for the output string.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_ID_NOT_FOUND if the specified ID was not returned by the previous FSDK_FeedFrame call. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output string; however, the output string still fills up all the space available.

FSDK_SaveTrackerMemoryToFile Function

Saves the memory of a tracker to a file. Note that tracker parameters, along with its face tracking state, are not saved. See the "Saving and Loading Tracker Memory" section for details.

C++ Syntax:

```
int FSDK_SaveTrackerMemoryToFile(HTracker Tracker, const char
* FileName);
```

Delphi Syntax:

```
function FSDK_SaveTrackerMemoryToFile(Tracker: HTracker;
FileName: PAnsiChar): integer;
```

C# Syntax:

```
int SaveTrackerMemoryToFile(int Tracker, string FileName);
```

VB Syntax:

```
Function FSDKVB_SaveTrackerMemoryToFile(ByVal Tracker As Long,
ByVal FileName As String) As Long
```

Java and AndroidSyntax:

```
int FSDK.SaveTrackerMemoryToFile(HTracker Tracker, String
FileName);
```

Parameters:

Tracker – handle of the tracker to save.
FileName – pointer to the null-terminated string containing the name of the file to which the tracker memory will be saved.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_IO_ERROR if an I/O error has occurred.

FSDK_LoadTrackerMemoryFromFile Function

Loads the memory of a tracker from a file. Note that tracker parameters, along with its face tracking state, are not loaded. See the "Saving and Loading Tracker Memory" section for details.

C++ Syntax:

```
int FSDK_LoadTrackerMemoryFromFile(HTracker * Tracker, const
char * FileName);
```

Delphi Syntax:

```
function FSDK_LoadTrackerMemoryFromFile(Tracker: PHTracker;
FileName: PAnsiChar): integer;
```

C# Syntax:

```
int LoadTrackerMemoryFromFile(ref int Tracker, string
FileName);
```

VB Syntax:

```
Function FSDKVB_LoadTrackerMemoryFromFile(ByRef Tracker As
Long, ByVal FileName As String) As Long
```

Java and Android Syntax:

```
int FSDK.LoadTrackerMemoryFromFile(HTracker Tracker, String
FileName);
```

Parameters:

Tracker – pointer that will store the handle of the loaded tracker.
FileName – pointer to the null-terminated string containing the name of a file from which the tracker memory will be to loaded.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_BAD_FILE_FORMAT if the file has unsupported format. Returns FSDKE_UNSUPPORTED_FILE_VERSION if the file was saved with Luxand FaceSDK of an unsupported version. Returns FSDKE_FILE_NOT_FOUND if there was an error opening the file. Returns FSDKE_IO_ERROR if an I/O error has occurred.

FSDK_GetTrackerMemoryBufferSize Function

Returns the size of a buffer (in bytes) needed to save the memory of a tracker.

C++ Syntax:

```
int FSDK_GetTrackerMemoryBufferSize(HTracker Tracker, long
long * BufSize);
```

Delphi Syntax:

```
function FSDK_GetTrackerMemoryBufferSize(Tracker: HTracker;
BufSize: PInt64): integer;
```

C# Syntax:

```
int GetTrackerMemoryBufferSize(int Tracker, ref long BufSize);
```

VB Syntax:

```
Function FSDKVB_GetTrackerMemoryBufferSize(ByVal Tracker As
Long, ByRef BufSize As Currency) As Long
```

Java and Android Syntax:

```
int FSDK.GetTrackerMemoryBufferSize(HTracker Tracker, long
BufSize[]);
```

Parameters:

Tracker – handle of the tracker whose buffer size needs calculation.
BufSize – pointer to the 64-bit integer variable that will store the size of a buffer.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SaveTrackerMemoryToBuffer Function

Saves the memory of a tracker to a buffer. Note that tracker parameters, along with its face tracking state, are not saved. See the "Saving and Loading Tracker Memory" section for details.

C++ Syntax:

```
int FSDK_SaveTrackerMemoryToBuffer(HTracker Tracker, unsigned
char * Buffer, long long MaxSizeInBytes);
```

Delphi Syntax:

```
function FSDK_SaveTrackerMemoryToBuffer(Tracker: HTracker; var
Buffer; MaxSizeInBytes: int64): integer;
```

C# Syntax:

```
int SaveTrackerMemoryToBuffer(int Tracker, out byte[] Buffer,
long MaxSizeInBytes);
```

VB Syntax:

```
Function FSDKVB_SaveTrackerMemoryToBuffer(ByVal Tracker As
Long, ByRef Buffer As Byte, ByVal MaxSizeInBytes As Currency)
As Long
```

Java and Android Syntax:

```
int FSDK.SaveTrackerMemoryToBuffer(HTracker Tracker, byte
Buffer[]);
```

Parameters:

Tracker – handle of the tracker to save.
Buffer – pointer to the buffer to which the tracker memory will be saved.
MaxSizeInBytes – amount of memory allocated for the output buffer, in bytes.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_INSUFFICIENT_BUFFER_SIZE if there is not enough room to store the output buffer.

FSDK_LoadTrackerMemoryFromBuffer Function

Loads the memory of a tracker from a buffer. Note that tracker parameters, along with its face tracking state, are not loaded. See the "Saving and Loading Tracker Memory" section for details.

C++ Syntax:

```
int FSDK_LoadTrackerMemoryFromBuffer(HTracker * Tracker, const unsigned char * Buffer);
```

Delphi Syntax:

```
function FSDK_LoadTrackerMemoryFromBuffer(Tracker: PHTracker; var Buffer): integer;
```

C# Syntax:

```
int LoadTrackerMemoryFromBuffer(ref int Tracker, byte[] Buffer);
```

VB Syntax:

```
Function FSDKVB_LoadTrackerMemoryFromBuffer(ByRef Tracker As Long, ByRef Buffer As Byte) As Long
```

Java and Android Syntax:

```
int FSDK.LoadTrackerMemoryFromBuffer(HTracker Tracker, byte Buffer[]);
```

Parameters:

Tracker – pointer to store the handle of a loaded tracker.
Buffer – pointer to the buffer from which to load the tracker memory.

Return Value:

Returns FSDKE_OK if successful. Returns FSDKE_BAD_FILE_FORMAT if the file has unsupported format. Returns FSDKE_UNSUPPORTED_FILE_VERSION if the file was saved with Luxand FaceSDK of an unsupported version.

Multi-Core Support

The following FaceSDK functions use multiple CPU cores, thus speeding up the calculations:

```
FSDK_DetectEyes,
FSDK_DetectEyesInRegion,
FSDK_DetectFace,
FSDK_DetectMultipleFaces,
FSDK_DetectFacialFeatures,
FSDK_DetectFacialFeaturesInRegion,
FSDK_GetFaceTemplate,
FSDK_GetFaceTemplateInRegion,
FSDK_GetFaceTemplateUsingFeatures,
FSDK_GetFaceTemplateUsingEyes,
FSDK_FeedFrame.
```

By default, these functions use all available processor cores. To get the number of processor cores used, call the FSDK_GetNumThreads function. To limit the number of processor cores used, call the FSDK_SetNumThreads function. Calling FSDK_SetNumThreads(1) will disable multi-core support.

Note that each of these functions forks into a number of threads on each call. It is not recommended to use nested parallelism when calling these functions; if you need nested parallelism, you may limit the number of threads with the FSDK_SetNumThreads functions. For example, if your application runs in several threads, and each thread executes FSDK_DetectFace (which uses all available cores), this is acceptable; however, if each thread forks into several threads, each executing FSDK_DetectFace, this could potentially reach the limit of resources available.

It is safe to use extensions for parallel computation (like OpenMP) with the above FaceSDK functions, if they are executed from a single thread. For example, the following C++ sample code is acceptable:

```
#pragma omp parallel for
     for (int i = 0; i < 100; i++)
          FSDK_DetectFace(...);
```

However, if your application forks into multiple threads, it is not recommended to execute the above FaceSDK functions within OpenMP statements in such threads. If you must, consider limiting the number of cores used by FaceSDK with the FSDK_SetNumThreads function.

FSDK_GetNumThreads Function

Retrieves the number of processor cores used by FaceSDK.

C++ Syntax:

```
int FSDK_GetNumThreads(int * Num);
```

Delphi Syntax:

```
function FSDK_GetNumThreads(Num: PInteger): integer;
```

C# Syntax:

```
int FSDK.GetNumThreads(ref int Num);
```

VB Syntax:

```
Function FSDKVB_GetNumThreads(ByRef Num As Long) As Long
```

Java and Android Syntax:

```
int FSDK.GetNumThreads(int Num[]);
```

Parameters:

Num – pointer to an integer valueto receive the number of threads used by FaceSDK.

Return Value:

Returns FSDKE_OK if successful.

FSDK_SetNumThreads Function

Sets the number of processor cores to be used by FaceSDK. If you set the number of cores to 1, support for multiple cores will be disabled, and the SDK will use only a single processor core.

C++ Syntax:

```
int FSDK_SetNumThreads(int Num);
```

Delphi Syntax:

```
function FSDK_SetNumThreads(Num: integer): integer;
```

C# Syntax:

```
int FSDK.SetNumThreads(int Num);
```

VB Syntax:

```
Function FSDKVB_SetNumThreads(ByVal Num As Long) As Long
```

Java and Android Syntax:

```
int FSDK.SetNumThreads(int Num);
```

Parameters:

Num – the number of cores to be used by FaceSDK.

Return Value:

Returns FSDKE_OK if successful.

Thread Safety

This chapter describes using FaceSDK in applications that execute FaceSDK functions from multiple threads. If your program runs in a single thread (by default, this happens in almost all environments), you can skip this chapter.

Most FaceSDK functions are safe for multithreaded operations. The functions not guaranteed to be thread-safe are

```
FSDK_Initialize,
FSDK_Finalize,
FSDK_ActivateLibrary,
FSDK_GetLicenseInfo,
FSDK_GetHardware_ID,
FSDK_SetNumThreads.
```

When working with cameras in multiple threads on Windows platforms, make sure that each thread calls the FSDK_InitializeCapturing function and the FSDK_FinalizeCapturing function when the thread is done. The following functions are thread safe (on all supported platforms) given that no different threads are simultaneously accessing the same camera handle:

```
FSDK_GetVideoFormatList,
FSDK_FreeVideoFormatList,
FSDK_SetVideoFormat,
FSDK_OpenVideoCamera,
```

```
FSDK_CloseVideoCamera,
FSDK_GrabFrame.
```

The following functions set global parameters that have effect on each thread:

```
FSDK_SetFaceDetectionParameters,
FSDK_SetFaceDetectionThreshold,
FSDK_SetJpegCompressionQuality,
FSDK_SetCameraNaming,
FSDK_SetHTTPProxy,
FSDK_SetNumThreads.
```

Note that HImage is safe only for multiple simultaneous reads or single write. Do not read from (e.g. with FSDK_DetectFace) and write to (e.g. with FSDK_FreeImage) the same HImage handle at one time.

For more information on thread safety of Tracker API, see the Thread Safety section in the Tracker API chapter.

Migration from FaceSDK 4.0

Important changes for users migrating to Luxand FaceSDK 5.0.1 from the 4.0 version:

The function FSDK_GetFaceTemplateUsingFeatures is no longer deprecated. The function expects that the coordinates of all facial features are detected. If you are passing just the coordinates of eye centers (detected with FSDK_DetectEyes, FSDK_DetectEyesInRegion) to the function, call FSDK_GetFaceTemplateUsingEyes instead.

The format of the face template has changed. The size of the template is now 13324 bytes. If you have stored face templates in a database, you must recreate them from the original photos by calling the FSDK_GetFaceTemplate or FSDK_GetFaceTemplateInRegion functions.

The FSDK_MatchFaces function now returns an error when the template has an invalid format or when the formats of the templates are not supported (that is, when face templates was created with an unsupported version of Luxand FaceSDK).

If you were calling FSDK_GetFaceTemplate or FSDK_GetFaceTemplateInRegion, you may find that they consume more time. This is because these functions extract face templates with higher accuracy. If you need higher performance, replace these calls with FSDK_DetectEyes or FSDK_DetectEyesInRegion, and call FSDK_GetFaceTemplateUsingEyes. See the Face Matching section for details.

On the other hand, if you were detecting eyes and then passing their coordinates to FSDK_GetFaceTemplateUsingEyes, you need to replace this call together with the detection of eye centers to the FSDK_GetFaceTemplate or FSDK_GetFaceTemplateInRegion function to achieve the higher accuracy available in the 5.0.1 version.

Error Codes

The FaceSDK library defines the following error codes:

Error Name	Value

FSDKE_OK	0
FSDKE_FAILED	–1
FSDKE_NOT_ACTIVATED	–2
FSDKE_OUT_OF_MEMORY	–3
FSDKE_INVALID_ARGUMENT	–4
FSDKE_IO_ERROR	–5
FSDKE_IMAGE_TOO_SMALL	–6
FSDKE_FACE_NOT_FOUND	–7
FSDKE_INSUFFICIENT_BUFFER_SIZE	–8
FSDKE_UNSUPPORTED_IMAGE_EXTENSION	–9
FSDKE_CANNOT_OPEN_FILE	–10
FSDKE_CANNOT_CREATE_FILE	–11
FSDKE_BAD_FILE_FORMAT	–12
FSDKE_FILE_NOT_FOUND	–13
FSDKE_CONNECTION_CLOSED	-14
FSDKE_CONNECTION_FAILED	-15
FSDKE_IP_INIT_FAILED	-16
FSDKE_NEED_SERVER_ACTIVATION	-17
FSDKE_ID_NOT_FOUND	-18
FSDKE_ATTRIBUTE_NOT_DETECTED	-19
FSDKE_INSUFFICIENT_TRACKER_MEMORY_LIMIT	-20
FSDKE_UNKNOWN_ATTRIBUTE	-21
FSDKE_UNSUPPORTED_FILE_VERSION	-22
FSDKE_SYNTAX_ERROR	-23
FSDKE_PARAMETER_NOT_FOUND	-24
FSDKE_INVALID_TEMPLATE	-25
FSDKE_UNSUPPORTED_TEMPLATE_VERSION	-26

Library Information

The FaceSDK library uses libjpeg-turbo © Miyasaka Masaru, TigerVNC and VirtualGL projects, libcurl © Daniel Stenberg;libpng © Glenn Randers-Pehrson;easybmp © The

EasyBMP Project (http://easybmp.sourceforge.net); RSA Data Security, Inc. MD5 Message-Digest Algorithm.