SecuGen

Programming Manual for *FDx SDK Pro* for Java

For applications using SecuGen® fingerprint modules

SG1-0040A-005 (08/18)

About SecuGen

SecuGen (www.secugen.com) provides biometric products and development tools for development organizations that are creating physical and network security systems employing advanced fingerprint recognition technology. The company's comprehensive product line includes high quality optical fingerprint readers and sensor component, software and development kits that are used for developing innovative applications including Internet, enterprise network and desktop security, physical access control, time and attendance management and financial and medical records control. SecuGen patented products are renowned for their accuracy, reliability, ruggedness, and affordability. Based in Silicon Valley, SecuGen has been serving the global biometric community since 1998.

SecuGen Sensor Qualities

- Excellent Image Quality: Clear, distortion-free fingerprint images are generated using advanced, patented optical methods. Quality imaging yields better sampling for minutiae data extraction.
- Durability: Mechanical strength tests show resistance to impact, shock and scratches.
- Powerful Software: Precise, fast processing algorithm ensures efficiency and reliability.
- Ruggedness and Versatility: Solid engineering and superior materials allows for use under extreme conditions.
- Ergonomic Design: Compact, modular design for seamless integration into small devices, ease of use, and compatibility make SecuGen sensors ideal for a broad range of applications.
- Low Cost: Products are developed to deliver high performance, with zero maintenance at very affordable prices for general and industrial use.

Advantages of SecuGen Sensors over Other Fingerprint Sensors

- Unique optical method captures fine details, even from dry skin
- Extremely low image-distortion for greater accuracy
- Resistance to damaging electrostatic discharge, moisture or corrosion
- Superior mechanical strength, wear-resistance and durability with no need for costly coatings
- Broad range of applicability, especially for use in extreme conditions and climates
- Low cost, long life, and no maintenance requirements – suitable for mass deployments

Contents

Chapter 1. Overview

SecuGen's FDx SDK Pro is designed to provide low level access to SecuGen's fingerprint readers using SecuGen's next-generation algorithm module. Programming with SecuGen's FDx SDK Pro is simple and easy and gives the most development flexibility among all SecuGen SDKs.

1.1. Features

- Uses SecuGen's new and improved next-generation algorithms
- Supports three kinds of fingerprint minutiae formats (or templates):
  - SG400: SecuGen's proprietary fingerprint minutiae format
  - ANSI378: Finger Minutiae Format for Data Exchange (ANSI-INCITS 378-2004)
  - ISO19794-2: Biometric Data Interchange Formats--Finger Minutiae Data (ISO/IEC 19794-2:2005)
- Provides low-level APIs for image capture, feature extraction and matching
  - The following extraction and matching algorithms, which are incorporated in sgfpamx.so in this SDK, support the ANSI-INCITS 378-2004 standard and have been tested by NIST and proven to be MINEX Compliant:
    - SecuGen ANSI INCITS 378 Template Generator v3.5 (feature extraction algorithm)
    - SecuGen ANSI INCITS 378 Template Matcher v3.5 (matching algorithm)
- Gives a high degree of flexibility to developers of all kinds of applications and is easy to use
- Supports WSQ Image encoding and decoding

1.2. System Requirements

The SecuGen fingerprint reader captures a fingerprint image that is digitized into an 8-bit gray-scale image at 500 DPI resolution. The host system then retrieves the image through its USB port for subsequent processing. All SecuGen USB fingerprint readers, except for those based on FDU01 sensors, are supported in this SDK.

The following are the system requirements:

- IBM-compatible PC Pentium III or later
- 1 USB port (1.1 or higher) for the SecuGen USB fingerprint reader
- 64 MB RAM
- 80 MB available hard disk space
- Windows 10/8/7
- Java SDK v1.8.0_51 or later
- Java JRE v1.8.0_51 or later

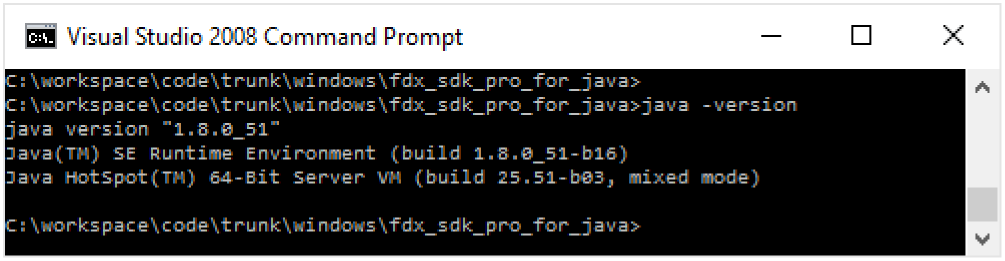
1.3. Development Environment

1.3.2. Install the Java 2 SDK v1.8.0_51

The Java SDK can be downloaded at www.oracle.com/technetwork/java. Refer to the Java documentation for detailed installation instructions.

After installing the Java SDK, verify that you have installed it correctly by launching a command prompt and running the following commands

- java –version
- javac –version



```
C:\workspace\code\trunk\windows\fdx_sdk_pro_for_java>
C:\workspace\code\trunk\windows\fdx_sdk_pro_for_java>java -version
java version "1.8.0_51"
Java(TM) SE Runtime Environment (build 1.8.0_51-b16)
Java HotSpot(TM) 64-Bit Server VM (build 25.51-b03, mixed mode)

C:\workspace\code\trunk\windows\fdx_sdk_pro_for_java>
```

1.3.3. Copy the FDx SDK Pro for Java directory to your target location

FDx SDK Pro for Java is distributed as a directory structure containing all required Jar files, the JNI library and various batch files that can be used to compile and run the included sample applications. As long as the Java SDK is correctly installed, the FDx SDK Pro for Java can be installed in any convenient location.

Chapter 2. Installation

2.1. Installation

Copy the FDx SDK Pro for Java distribution into a new directory on the development machine.

2.2. Included Files

Library Files

FDxSDKPRO.jar –FDx SDK Pro for Java jar file
jnisgfplib.dll – SecuGen JNI library. Wrapper for sgfplib.dll
jnisgwsqlib.dll – SecuGen JNI library. wrapper for sgwsqlib.dll
jnisgnfiqlib.dll – SecuGen JNI library. Wrapper for sgnfiqlib.dll
sgwsqlib.dll – SecuGen WSQ library
sgnfiqlib.dll – SecuGen NFIQ library
sgfplib.dll – SecuGen library.
sgfpamx.dll – SecuGen library.
Absolutelayout.jar – NetBeans 4.x Swing layout runtime

Sample Program Files

netbeans_sample – Sample netbeans project
extract_samples.bat – Extracts sample source code
build_samples.bat – Builds sample applications
run_JSGD.bat – Runs the JSGD sample application
run_JSGFPLibTest.bat – Runs the JFPLibTest sample application
run_JSGMultiDeviceTest.bat – Runs the JSGMultiDeviceTest sample application

Documentation

readme.txt – Latest release information for FDx SDK Pro for Java
doc/ – Directory containing JavaDoc for FDx SDK Pro for Java
FDx SDK Pro Programming Manual (Java).pdf – This document

2.3. Run-time Distribution

Please copy the FDx SDK Pro for Java runtime files as follows:

Windows 7 32bit

Copy the following files to C:\windows\system32

jnifplib\win32\jnisgfplib.dll
jnifplib\win32\jnisgwsqlib.dll
jnifplib\win32\sgwsqlib.dll
jnifplib\win32\jnisgnfiqlib.dll
jnifplib\win32\sgnfiqlib.dll
jnifplib\win32\ sgfplib.dll
jnifplib\win32\sgfpamx.dll

Windows 7 64bit

Copy the following files to C:\windows\SysWOW64

jnifplib\win32\jnisgfplib.dll
jnifplib\win32\jnisgwsqlib.dll
jnifplib\win32\sgwsqlib.dll
jnifplib\win32\jnisgnfiqlib.dll
jnifplib\win32\sgnfiqlib.dll
jnifplib\win32\ sgfplib.dll
jnifplib\win32\sgfpamx.dll

Copy the following files to C:\windows\system32

jnifplib\x64\jnisgfplib.dll
jnifplib\x64\jnisgwsqlib.dll
jnifplib\x64\sgwsqlib.dll
jnifplib\x64\jnisgnfiqlib.dll
jnifplib\x64\sgnfiqlib.dll
jnifplib\ x64\ sgfplib.dll
jnifplib\ x64\sgfpamx.dll

Chapter 3. Programming in Java

SecuGen's FDx SDK *Pro* was designed for ease in programming and the most flexibility for developers. All SDK functions are integrated into the **JSGFPLib** class. The JSGFPLib class includes Device Initialization, Fingerprint Capture, and Minutiae Extraction and Matching functions.

3.1. Create JSGFPLib

To use JSGFPLib, call **JSGFPLib()**, which instantiates a JSGFPLib object.

```
JSGFPLib sgfplib = new
JSGFPLib((UsbManager)getSystemService(Context.USB_SERVICE));
```

3.2. Initialize JSGFPLib

After the JSGFPLib object is created, it should be initialized using **JSGFPLiB,Init()** or **JSGFPLib.InitEx()**. **JSGFPLib.Init()** takes the device name, loads the driver that corresponds to the device name and initializes the fingerprint algorithm module based on device information. **JSGFPLib.InitEx()** takes image width, image height and resolution as parameters. Call **JSGFPLib.InitEx()** when using the fingerprint algorithm module without a SecuGen reader.

The table below summarizes the correlation among device name (device type), loaded device driver and initial image size when the **Init(JSGFPLibDeviceName devName)** function is called.

Device Name, Device Driver and Image Size

Device Name	Value	Device driver	Image Size (pixels)
SG_DEV_UNKNOWN	0	Default	Based on Attached Device
SGDEV_FDP02	1	Parallel device driver	260*300
SGDEV_FDU02	3	USB FDU02 driver	260*300
SGDEV_FDU03	4	USB FDU03 / SDU03 driver	260*300
SGDEV_FDU04	5	USB FDU04 / SDU04 driver	258*336
SGDEV_FDU05	6	USB U20 driver	300*400
SGDEV_FDU06	7	USB UPx driver	260*300
SGDEV_FDU07	8	USB U10 driver	252*330
SGDEV_FDU07A	9	USB U10-AP driver	252*330

SGDEV_FDU08	10	USB U20-AP driver	300*400

JSGFPLib.Init()

```
long error = sgfplib.Init( SGFDxDeviceName.SG_DEV_AUTO);
```

3.3. Terminate JSGFPLib

JSGFPLib.Close() must be called prior to terminating the application. It frees up the memory used by the JSGFPLib object.

```
long error = JSGFPLib.Close();
```

3.4. Open the SecuGen Fingerprint Reader

To use a SecuGen fingerprint reader, call **JSGFPLib.OpenDevice()**. The parameter (**devId**) of **JSGFPLib.OpenDevice()** can have different meanings depending on which type of fingerprint reader is used.

If only one USB fingerprint reader is connected to the PC, devId will be 0. If multiple USB fingerprint readers are connected to one PC, devId can range from 0 to 9. The maximum number of SecuGen USB readers that can be connected to one PC is 10.

In general, if only one USB reader is connected to the PC, then **USB_AUTO_DETECT** is recommended.

```
long error = sgfplib.OpenDevice(USB_AUTO_DETECT);
```

3.5. Get Device Information

Device information can be retrieved by calling **JSGFPLib.GetDeviceInfo()**, which obtains required device information such as image height and width. The device information is contained in the **SGDeviceInfoParam** structure.

```
SGDeviceInfoParam device_info;
error = JSGFPLib.GetDeviceInfo(device_info);

if (error == SGFDxErrorCode.SGSGFDX_ERROR_NONE)
{
    m_ImgWidth = device_info.ImageWidth;
    m_ImgHeight = device_info.ImageHeight;
}
```

3.6. Capture a Fingerprint Image

After the reader is initialized, a fingerprint image can be captured. The SGFPM object provides three types of fingerprint image capture functions listed below. Captured fingerprints are 256 gray-level images, and image width and height can be retrieved by calling **SGFPM_GetDeviceInfo()**. The image buffer should be allocated by the calling application.

JSGFPLib.GetImage() captures an image without checking for the presence of a finger or checking image quality.

[Example]

```
byte[] buffer = new byte[m_ImageWidth*m_ImageHeight];
if (JSGFPLib.GetImage(buffer) ==
SGFDxErrorCode.SGSGFDX_ERROR_NONE) // Get image data from device
{
   // Display image
   // Process image
}
```

JSGFPLib.GetImageEx() captures fingerprint images continuously, checks the image quality against a specified quality value and ignores the image if it does not contain a fingerprint or if the quality of the fingerprint is not acceptable. If a quality image is captured within the given time (the second parameter), **JSGFPLib.GetImageEx()** ends its processing. If a window handle is provided by the application, the drivers will draw a fingerprint image in the provided window using the handle value.

[Example]

```
byte[] buffer = new byte[m_ImageWidth*m_ImageHeight];
long timeout = 10000;
long quality = 80;
if(JSGFPLib.GetImageEx(buffer, timeout, null, quality) ==
SGFDxErrorCode.SGFDX_ERROR_NONE)
{
   // Display image
}
```

3.7. Get Image Quality

To determine the fingerprint image quality, use **GetImageQuality()**.

JSGFPLib.GetImageQuality()

```
Int[] img_qlty;
```

```
JSGFPLib.GetImageQuality(ImageWidth, m_ImageHeight, fp_image,
mg_qlty);
if (img_qlty[0] < 80)
    // Capture again
```

3.8. Use Smart Capture™ or Control Brightness Manually

Depending on the fingerprint reader used, environmental factors and the specifications of the host system, the brightness of a fingerprint image may vary. The SecuGen device drivers use a technology called Smart Capture™ to dynamically adjust brightness to ensure the best image quality. Smart Capture is enabled by default.

To manually control the quality of a captured image, the image brightness should be adjusted by changing the brightness setting of the reader using **JSGFPLib.SetBrightness()**. This function is ignored if Smart Capture is enabled.

JSGFPLib. SetBrightness()

```
JSGFPLib.SetBrightness(70);// Set from 0 to 100.
```

3.9. Create a Template

To register or verify a fingerprint, a fingerprint image is first captured, and then feature data (minutiae) is extracted from the image into a **template**. Minutiae are the unique core points near the center of every fingerprint, such as ridges, ridge endings, bifurcations, valleys and whorls.

Use **JSGFPLib.CreateTemplate()** to extract minutiae from a fingerprint image to form a template. The buffer should be assigned by the application. To get the buffer size of the minutiae, call **JSGFPLib.GetMaxTemplateSize()**. It will return the maximum buffer size for data in one template. The actual template size can be obtained by calling **JSGFPLib.GetTemplateSize()** after the template is created. The **JSGFPLib.CreateTemplate()** API creates only one set of data from an image.

Note: Templates having the ANSI378 or ISO19794-2 format may be merged.

JSGFPLib.CreateTemplate()

```
// Get a fingerprint image
err = JSGFPLib.GetImage(m_ImgBuf);

// Create template from captured image
```

```
err = JSGFPLib.GetMaxTemplateSize(maxTemplateSize);
byte[] minBuffer = new byte[maxTemplateSize[0]];

// Set information about template
SGFingerInfo finger_info;
finger_info.FingerNumber = SGFingerPosition.SG_FINGPOS_LI;
finger_info.ImageQuality = qlty[0];
finger_info.ImpressionType = SG_IMPTYPE_LP;
finger_info.ViewNumber = 1;

err = JSGFPLib.CreateTemplate(finger_info, m_ImgBuf, minBuffer);
```

3.10. Match Templates

Templates are matched during both registration and verification processes. During registration, it is recommended to capture at least two image samples per fingerprint for a higher degree of accuracy. The minutiae data from each image sample can then be compared against each other (i.e. matched) to confirm the quality of the registered fingerprints. This comparison is analogous to a password confirmation routine that is commonly required for entering a new password.

During verification, newly input minutiae data is compared against registered minutiae data. Similar to the registration process, verification requires the capture of a fingerprint image followed by extraction of the minutiae data from the captured image into a template.

To match templates, FDx SDK *Pro* provides four kinds of matching functions. Each function requires two sets of template data for matching.

JSGFPLib.MatchTemplate(): This function matches templates having the same format as the default format. When calling this function, each template should include only one sample (or view) per template. The default format is SG400 (SecuGen proprietary format) but can be changed by calling JSGFPLib.SetTemplateFormat().

JSGFPLib.MatchTemplateEx(): This function can match templates having different template formats. This function can also specify the template format for each template and can match templates that have multiple views per template.

JSGFPLib.MatchAnsiTemplate(): This function is the same as JSGFPLib.MatchTemplateEx() except that it supports only ANSI378 templates.

JSGFPLib.MatchIsoTemplate(): This function is the same as JSGFPLib.MatchTemplateEx() except that it supports only ISO19794-2 templates.

Function	Template Format	Can match templates with different formats?
SGFPM_MatchTemplate	SG400 (System default)	No
SGFPM_MatchTemplateEx	Specified template format	Yes
SGFPM_MatchAnsiTemplate	ANSI378	No
SGFPM_MatchIsoTemplate	ISO19794-2	No

JSGFPLib.MatchTemplate()

```
byte[]RegTemplate1= new byte[maxTemplateSize[0]];
byte[]RegTemplate2= new byte[maxTemplateSize[0]];

// Get first fingerprint image and create template from image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_RegTemplate1);

// Get second fingerprint image and create template from image
err = JSGFPLib.GetImageEx(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_RegTemplate2);

long sl = SGFDxSecurityLevel.SL_NORMAL;     // Set security level
                                            as NORMAL
boolean[] matched = new boolean[1];
err = JSGFPLib.MatchTemplate(m_ RegTemplate1, m_ RegTemplate2,
sl, matched);
```

JSGFPLib.MatchTemplateEx()

```
byte[]RegTemplate1= new byte[maxTemplateSize[0]];
byte[]RegTemplate2= new byte[maxTemplateSize[0]];

// Make SG400 template
err =
JSGFPLib.SetTemplateFormat(SGFDxTemplateFormat.TEMPLATE_FORMAT_SG
400);
err = JSGFPLib.GetImage(m_ImgBuf, 5000, NULL, qlty);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_RegTemplate1);

// Make ANSI378 template
err = JSGFPLib.SetTemplateFormat(TEMPLATE_FORMAT_ANSI378);
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_RegTemplate2);

long sl = SGFDxSecurityLevel.SL_NORMAL;     // Set security level
                                            as NORMAL
boolean[] matched = new boolean[1];
```

```
err = JSGFPLib.MatchTemplateEx(RegTemplate1,
                  SGFDxTemplateFormat TEMPLATE_FORMAT_SG400,
                  0,   // Must be 0 if template format is SG400
                  RegTemplate2,
                  SGFDxTemplateFormat TEMPLATE_FORMAT_ANSI378,
                  0,   // Currently only one sample
                  sl,
                  &matched);
```

JSGFPLib.MatchAnsiTemplate()

```
Long err err;
boolean[] matched = new boolean[1];
matched[0] = false;
SGANSITemplateInfo sample_info = new SGANSITemplateInfo();
err = JSGFPLib.GetAnsiTemplateInfo(m_EnrollTemplate,
sample_info);

boolean finger_found = false;
for (int i = 0; i < sample_info.TotalSamples; i++)
{
  if(sample_info.SampleInfo[i].FingerNumber == finger_pos)  //
Try match for same finger
 {
    finger_found = true;
    err = JSGFPLib.MatchAnsiTemplate(m_EnrollTemplate,
                i,
                m_FetBufM,
                0,
                SGFDxSecurityLevel.SL_NORMAL
                matched);
    if (matched)
      break;
  }
}
```

JSGFPLib.MatchIsoTemplate()

```
long err;
boolean[] matched = new boolean[1];
matched[0] = false;

// ISO19794-2
SGISOTemplateInfo sample_info = new SGISOTemplateInfo();
err = JSGFPLib.GetIsoTemplateInfo(m_StoredTemplate, sample_info);

int found_finger = -1;
for (int i = 0; i < sample_info.TotalSamples; i++)
{
      // ISO19794-2
     err = JSGFPLib.MatchIsoTemplate(m_StoredTemplate,
                i,
                m_FetBufM,
                0,
                SGFDxSecurityLevel.SL_NORMAL,
                matched);
      if (matched)
      {
         found_finger = sample_info.SampleInfo[i].FingerNumber;
         break;
      }
 }
```

3.11. Register a Fingerprint

To register a fingerprint, a fingerprint image is first captured, and then feature data (minutiae) is extracted from the image to create a template. It is recommended to capture at least two image samples per fingerprint for a higher degree of accuracy. The minutiae data from each image can then be compared against each other (i.e. matched) to confirm the quality of the registered fingerprints. This comparison of two fingerprints is analogous to a password confirmation routine that is commonly required for entering a new password.

Fingerprint Registration Process

1. Capture fingerprint images: **JSGFPLib.GetImage()**
2. Extract minutiae from captured fingerprint to create a template: **JSGFPLib.CreateTemplate()**
3. Match newly made template to determine if it is acceptable for registration: **JSGFPLib.MatchTemplate()**
4. Save templates to file or database to complete registration

Example: Using two fingerprint images to register one fingerprint

```
err = JSGFPLib.GetMaxTemplateSize(m_MaxTemplateSize);
byte[] m_RegTemplate1 = new byte [MaxTemplateSize[0]];
BYTE*   m_RegTemplate2 = new byte [MaxTemplateSize[0]];

// Get first fingerprint image and create template from the image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_RegTemplate1);

// Get second fingerprint image and create template from the
image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_RegTemplate2);

DWORD sl = SGFDxSecurityLevel.SL_NORMAL; // Set security level as
NORMAL
Boolean[] matched = new Boolean[1];
err = JSGFPLib.MatchTemplate(m_RegTemplate1, m_RegTemplate2, sl,
matched);

if (matched)
 // Save these templates somewhere
```

3.12. Verify a Fingerprint

The process of verifying a fingerprint involves matching newly input minutiae data against registered minutiae data. Similar to the registration process, verification requires the capture of a fingerprint image followed by extraction of the minutiae data from the captured image and the creation of a template.

Fingerprint Verification Process

1. Capture fingerprint image: **JSGFPLib.GetImage()**
2. Extract minutiae data from captured fingerprint to create a template: **JSGFPLib.CreateTemplate()**
3. Match newly made template against registered template(s): **JSGFPLib.MatchTemplate()**

- Adjust the security level according to the type of application. For example, if fingerprint-only authentication is used, set the security level higher than **SL_NORMAL** to reduce the chances for false acceptance (FAR).

Example: Input minutiae data is matched against two registered minutiae data samples

```
DWORD err;
err = JSGFPLib.GetMaxTemplateSize(m_hFPM, &m_MaxTemplateSize);
byte[] m_ VrfTemplate1= new byte[m_MaxTemplateSize];

// Get first fingerprint image and create template from the image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_ VrfTemplate1);

DWORD sl = SGFDxSecurityLevel.SL_NORMAL; // Set security level
depending on applications.
boolean[] matched1 = new boolean[1];
boolean[] matched2 = new boolean[1];
err = JSGFPLib.MatchTemplate(m_RegTemplate1, m_ VrfTemplate1, sl,
matched1);
err = JSGFPLib.MatchTemplate(m_RegTemplate2, m_ VrfTemplate1, sl,
matched2);

if (err == SGFDxErrorCode.SGSGFDX_ERROR_NONE)
{
   if (matched1 && matched2)
      // Matched
   else
      // Not matched
}
```

3.13. Get Matching Score

For improved quality control during the registration or verification process, a matching score can be used instead of a security level setting to determine the success of the operation. The matching score can be specified so that only sets of minutiae data that exceed the score will be accepted; data below the score will be rejected. The matching score may have a value from 0 to 199. **JSGFPLib.GetMatchingScore()** requires two sets of minutiae data of the same template format. **JSGFPLib.GetMatchingScoreEx()** requires two sets of minutiae data, but they can take different template formats.

```
int[] score = new int[1];
if (JSGFPLib.GetMatchingScore(m_RegTemplate1, m_RegTemplate2,
score) == SGFDXErrorCode.SGFDX_ERROR_NONE)
{
    if (score > 100)
     // Enroll these fingerprints to database
    else
     // Try again
}
```

To understand how the matching score correlates with typical security levels, refer to the chart below.

Security Level vs. Corresponding Matching Score

Constant	Value	Corresponding Matching Score
SL_NONE	0	0
SL_LOWEST	1	30
SL_LOWER	2	50
SL_LOW	3	60
SL_BELOW_NORMAL	4	70
SL_NORMAL	5	80
SL_ABOVE_NORMAL	6	90
SL_HIGH	7	100
SL_HIGHER	8	120
SL_HIGHEST	9	140

Note: Starting from version 3.53 of FDx SDK Pro for Windows, the Corresponding Matching Scores have changed.

3.14. Template Format

The FDx SDK Pro supports three types of fingerprint template formats:

- SecuGen's proprietary template format ("**SG400**")
- ANSI INCITS 378-2004 "Finger Minutiae Format for Data Exchange" ("**ANSI378**")
- ISO/IEC 19794-2:2005 "Biometric Data Interchange Formats – Finger Minutiae Data" ("**ISO19794-2**")

As default, JSGFPLib creates SecuGen proprietary templates (TEMPLATE_FORMAT_SG400). To change the template format, use **JSGFPLib.SetTemplateFormat()**.

SG400 templates are encrypted for high security and have a size of 400 bytes. ANSI378 templates are not encrypted, and their size is variable depending on how many fingers are registered in the structure and how many minutiae points are found.

For more information about the ANSI378 template, refer to the standard document titled "Information technology – Finger Minutiae Format for Data Interchange," document number ANSI INCITS 378-2004, available at the ANSI website http://webstore.ansi.org.

For more information about the ISO19794-2 template, refer to the standard document titled "Information technology – Biometric Data Interchange Formats – Part 2: Finger Minutiae Data," document number ISO/IEC 19794-2:2005, available at the ISO website under Subcommittee JTC 1 / SC 37 (Biometrics):

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38746.

Once the template format is set, it will affect the execution of the JSGFPLib module.

The following APIs are affected by **JSGFPLib.SetTemplateFormat()**:

- JSGFPLib.GetMaxTemplateSize()
- JSGFPLib.CreateTemplate()
- JSGFPLib.GetTemplateSize()
- JSGFPLib.MatchTemplate()
- JSGFPLib.GetMatchingScore()

The following APIs work only when the template format is **TEMPLATE_FORMAT_ANSI378**:

- JSGFPLib.GetTemplateSizeAfterMerge()

- JSGFPLib.MergeAnsiTemplate()
- JSGFPLib.GetAnsiTemplateInfo()
- JSGFPLib.MatchAnsiTemplate()
- JSGFPLib.GetAnsiMatchingScore()

The following APIs work only when the template format is **TEMPLATE_FORMAT_ISO19794**:

- JSGFPLib.GetIsoTemplateSizeAfterMerge()
- JSGFPLib.MergeIsoTemplate()
- JSGFPLib.GetIsoTemplateInfo()
- JSGFPLib.MatchIsoTemplate()
- JSGFPLib.GetIsoMatchingScore()

The following APIs work with any template format:

- JSGFPLib.MatchTemplateEx()
- JSGFPLib.GetMatchingScoreEx()

Set template format to ANSI378

```
JSGFPLib.SetTemplateFormat(SGFDxTemplateFormat
TEMPLATE_FORMAT_ANSI378);
```

Set template format to SG400

```
JSGFPLib.SetTemplateFormat(SGFDxTemplateFormat
TEMPLATE_FORMAT_SG400);
```

Set template format to ISO19794

```
JSGFPLib.SetTemplateFormat(SGFDxTemplateFormat
TEMPLATE_FORMAT_ISO19794);
```

3.15. Manipulate ANSI378 Templates

The ANSI378 template format allows multiple fingers and multiple views per finger to be stored in one template. To support this feature, FDx SDK Pro provides the following special APIs:

- JSGFPLib.GetTemplateSizeAfterMerge()
- JSGFPLib.MergeAnsiTemplate()
- JSGFPLib.GetAnsiTemplateInfo()
- JSGFPLib.MatchAnsiTemplate()

- JSGFPLib.GetAnsiMatchingScore()

Merge two ANSI378 templates

After creating an ANSI378 template from a fingerprint image, additional ANSI378 templates can be merged into one template. To do this, use **JSGFPLib.MergeAnsiTemplate()**, which takes two ANSI378 templates and merges them into one template. The merged template size will be less than the sum of the sizes of all input templates. Call **JSGFPLib.GetTemplateSizeAfterMerge()** to obtain the exact template size of the merged template before using **JSGFPLib.MergeAnsiTemplate()**.

```
err = JSGFPLib.GetMaxTemplateSize(m_hFPM, &m_MaxTemplateSize);
byte[] m_Template1 = new byte[m_MaxTemplateSize];
byte[] m_Template2 = new byte[m_MaxTemplateSize];

// Get first fingerprint image and create template from the image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_Template1);

// Get second fingerprint image and create template from the
image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_Template2);

// Save template after merging two templates - m_Template1,
m_Template2
int[]  buf_size = new int[1];
err = JSGFPLib.GetTemplateSizeAfterMerge(m_Template1,
m_Template2, buf_size);
byte[]  merged_template = new byte[buf_size[0]];
err = JSGFPLib.MergeAnsiTemplate(m_Template1, m_Template2,
merged_template);
```

Get information about an ANSI378 template

The ANSI378 template format allows multiple fingers and multiple views per finger to be stored in one template. To match one sample (view) against a sample in other template, information about the template may be needed. To get sample information about a template, use JSGFPLib.GetAnsiTemplateInfo().

```
long err;
int matched_samples = 0;

SGANSITemplateInfo sample_info1 = new SGANSITemplateInfo;
SGANSITemplateInfo sample_info2 = new SGANSITemplateInfo;
```

```
err = JSGFPLib.GetAnsiTemplateInfo(g_EnrollData, sample_info1);
err = JSGFPLib.GetAnsiTemplateInfo(g_VrfData, sample_info2);

for (int i = 0; i < sample_info1.TotalSamples; i++)
{
   for (int j = 0; j < sample_info2.TotalSamples; j++)
   {
      boolean[] matched = new Boolean[1];
      err = JSGFPLib.MatchAnsiTemplate(g_EnrollData, i,
g_VrfData, 0, sl, matched);
      if (matched[0])
            matched_samples++;
   }
}

if (err == SGFDxErrorCode.SGFDX_ERROR_NONE)
{
   if (matched_samples > 0)
      System.out.writeln("Found " + matched_samples + "matched
samples");
   else
      System.out.writeln("Cannot find matching sample");
}
else
   System.out.writeln("MatchTemplate() failed. Error = " + err);
```

3.16. Manipulate ISO19794-2 Templates

The ISO19794-2 template format allows multiple fingers and multiple views per finger to be stored in one template. To support this feature, FDx SDK *Pro* provides the following special APIs:

- JSGFPLib.GetIsoTemplateSizeAfterMerge()
- JSGFPLib.MergeIsoTemplate()
- JSGFPLib.GetIsoTemplateInfo()
- JSGFPLib.MatchIsoTemplate()
- JSGFPLib.GetIsoMatchingScore()

Merge two ISO19794-2 templates

After creating an ISO19794-2 template from a fingerprint image, additional ISO19794-2 templates can be merged into one template. To do this, use **JSGFPLib.MergeIsoTemplate()**, which takes two ISO19794-2 templates and merges them into one template. The merged template size will be less than the sum of the sizes of all input templates. Call **JSGFPLib.GetIsoTemplateSizeAfterMerge()** to obtain the exact template size of the merged template before using **JSGFPLib.MergeIsoTemplate()**.

```
err = JSGFPLib.GetMaxTemplateSize(m_hFPM, &m_MaxTemplateSize);
byte[] m_Template1 = new byte[m_MaxTemplateSize];
byte[] m_Template2 = new byte[m_MaxTemplateSize];

// Get first fingerprint image and create template from the image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_Template1);

// Get second fingerprint image and create template from the
image
err = JSGFPLib.GetImage(m_ImgBuf);
err = JSGFPLib.CreateTemplate(null, m_ImgBuf, m_Template2);

// Save template after merging two templates - m_Template1,
m_Template2
int[]  buf_size = new int[1];
err = JSGFPLib.GetTemplateSizeAfterMerge(m_Template1,
m_Template2, buf_size);
byte[]  merged_template = new byte[buf_size[0]];
err = JSGFPLib.MergeIsoTemplate(m_Template1, m_Template2,
merged_template);
```

Get information about an ISO19794-2 template

The ISO19794-2 template format allows multiple fingers and multiple views per finger to be stored in one template. To match one sample (view) against a sample in other template, information about the template may be needed. To get sample information about a template, use **JSGFPLib.GetIsoTemplateInfo()**.

```
DWORD err;
BOOL matched = FALSE;

// ISO19794-2
SGISOTemplateInfo sample_info = {0};
err = JSGFPLib.GetIsoTemplateInfo(m_hFPM, m_StoredTemplate,
&sample_info);

matched = FALSE;
int found_finger = -1;
for (int i = 0; i < sample_info.TotalSamples; i++)
{
    // ISO19794-2
    err = JSGFPLib.MatchIsoTemplate(m_hFPM, m_StoredTemplate, i,
m_FetBufM, 0, SL_NORMAL, &matched);
            if (matched)
     {
         found_finger = sample_info.SampleInfo[i].FingerNumber;
         break;
     }
}

if (err == SGFDX_ERROR_NONE)
{
   if (found_finger >= 0)
     m_ResultEdit.Format("The fingerprint data found. Finger
Position: %s", g_FingerPosStr[found_finger]);
   else
     m_ResultEdit.Format("Cannot find matched fingerprint data");
}
else
{
   m_ResultEdit.Format("MatchIsoTemplate() failed. Error = %d ",
err);
}
```

3.17. Get Version Information of MINEX Compliant Algorithms

To obtain version information about the MINEX Compliant algorithms, use **JSGFPLib.GetMinexVersion()**. Currently, the extractor version number is 0x000A0035, and the matcher version number is 0x000A8035.

```
Long[] extractor = new long[1];
Long[]matcher = new long[1];
err = JSGFPLib.GetMinexVersion(extractor, matcher);

System.out.println("(Extractor:” +  extractor [0] + “Matcher:” +
matcher);
```

Chapter 4. JSGFPLib Function Reference

4.1. JSGFPLib Creation and Termination

public JSGFPLib()

Instantiates the JSGFPLib object.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_CREATION_FAILED = Failed to instantiate object

public long Open()

Opens the SecuGen native library.

Return values

SGFDX_ERROR_NONE = No error

public long Close()

Closes the SecuGen native library.

Return values

SGFDX_ERROR_NONE = No error

4.2. Initialization

public long Init(long devName)

Initializes JSGFPLib with device name information. The JSGFPLib object loads appropriate drivers with device name (devName) and initializes fingerprint algorithm module based on the device information.

Parameters

devName*:* Specifies the device name

SG_DEV_FDU03: device name for USB FDU03 and SDU03-based readers

SG_DEV_FDU04: device name for USB FDU04 and SDU04-based readers

SG_DEV_FDU05: device name for USB U20-based readers

SG_DEV_FDU06: device name for USB UPx-based readers

SG_DEV_FDU07: device name for USB U10-based readers

SG_DEV_FDU07A: device name for USB U10-AP-based readers

SG_DEV_FDU08: device name for USB U20-AP-based readers

SG_DEV_AUTO: automatically determines the device name

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_CREATION_FAILED = Failed to create JSGFPLib object

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_DRVLOAD_FAILED = Failed to load driver

public long InitEx(long width, long height, long dpi)

Initializes JSGFPLib with image information. Use when running fingerprint algorithm module without a SecuGen reader.

Parameters

width: Image width in pixels

height: Image height in pixels

dpi: Image resolution in DPI

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_CREATION_FAILED = Failed to create JSGFPLib object

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_DLLLOAD_FAILED = Failed to load algorithm DLL

public long SetTemplateFormat(short format)

Sets template format. Default format is SecuGen proprietary format (TEMPLATE_FORMAT_SG400).

Parameters

format: Specifies template format

TEMPLATE_FORMAT_ANSI378: ANSI INCITS 378-2004 format

TEMPLATE_FORMAT_ISO19794: ISO/IEC 19794-2:2005 format

TEMPLATE_FORMAT_SG400: SecuGen proprietary format

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_CREATION_FAILED = Failed to create JSGFPLib object

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template format

4.3. Device and Capture Functions

public long EnumerateDevice(int[] ndevs, SGDeviceList[] devList)

Enumerates currently attached reader to the system.

Parameters

ndevs: The number of attached USB readers

devList: Buffer that contains device ID and device serial number.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_FUNCTION_FAILED = General function fail error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

public long OpenDevice(long devId)

Initializes the fingerprint reader.

Parameters

devId: Specifies the device ID for USB readers. The value can be from 0 to 9. The maximum number of supported readers attached at the same time is 10.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_SYSLOAD_FAILED = Failed to loading system files

SGFDX_ERROR_INITIALIZE_FAILED = Failed to initialize chip

SGFDX_ERROR_DEVICE_NOT_FOUND = Device not found

public long CloseDevice()

Closes the opened device. **OpenDevice()** must be called before this function is used.

Parameters

Return values

SGFDX_ERROR_NONE = No error

public long GetDeviceInfo(SGDeviceInfoParam Info)

Gets device information from the driver (before device initialization)

Parameters

info: An instantiated SGDeviceInfoParam object.

Return values

SGFDX_ERROR_NONE = No error

public long SetBrightness(int brightness)

Controls brightness of image sensor. This function will only work if Smart Capture is disabled.

Parameters

brightness: Must be set to a value from 0 to 100

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

public long SetLedOn(boolean on)

Turns optic unit LED on/off.

Parameters

on: True: Turns on LED. False: Turns off LED

Return values

SGFDX_ERROR_NONE = No error

public long GetImage(byte[] buffer)

Captures a 256 gray-level fingerprint image from the reader. The image size can be retrieved by calling **GetDeviceInfo()**. **JSGFPLib.GetImage()** does not check for image quality. To get image quality of a captured image, use **GetImageQuality()**.

Parameters

buffer: A byte array containing a fingerprint image. The image size can be retrieved by calling **GetDeviceInfo()**.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_WRONG_IMAGE = Capture image is not a real fingerprint image

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_LINE_DROPPED = Image data lost

public long GetImageQuality(long width, long height, byte[] imgBuf, int[] quality)

Gets the quality of a captured (scanned) image. The value is determined by two factors. One is the ratio of the fingerprint image area to the whole scanned area, and the other is the ridge quality of the fingerprint image area. A quality value of 50 or higher is recommended for registration. A quality value of 40 or higher is recommended for verification.

Parameters

width: Image width in pixels

height: Image height in pixels

imgBuf: Fingerprint image data

quality: The single element array to contain image quality

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

Public long GetImageEx(byte[] buffer, long timeout, long dispWnd , long quality)

Captures fingerprint images from the reader until the quality of the image is greater than the value of the quality parameter. The captured fingerprint is a 256 gray-level image; image size can be retrieved by calling the **SGFPM_GetDeviceInfo()** function. A quality value of 50 or higher is recommended for registration. A quality value of 40 or higher is recommended for verification.

Note: The returned quality value is different from the value used in **SGFPM_GetImage().** The quality value in **GetImageEx()** represents only the ratio of the fingerprint image area to the whole scanned area.

Parameters

buffer: A byte array containing a fingerprint image. The image size can be retrieved by calling **GetDeviceInfo()**.

timeout: The timeout value (in milliseconds) used to specify the amount of time the function will wait for a valid fingerprint to be input on the fingerprint reader

dispWnd: null. Not used in Java

quality: The minimum quality value of an image, used to determine whether to accept the captured image

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_LINE_DROPPED = Image data lost

SGFDX_ERROR_TIME_OUT = No valid fingerprint captured in the given time

4.4. Extraction Functions

public long GetMaxTemplateSize(int[] size)

Gets the maximum size of a fingerprint template (view or sample). Use this function before using **CreateTemplate()** to obtain an appropriate buffer size. If the template format is SG400, it returns fixed length size 400.

Note: The returned template size means the maximum size of one view or sample.

Parameters

size: The single element array to contain template size

Return values

SGFDX_ERROR_NONE = No error

public long CreateTemplate(SGFingerInfo fpInfo, byte[] rawImage, byte[] minTemplate)

Extracts minutiae from a fingerprint image to form a template having the default format.

Parameters

fpInfo: Fingerprint information stored in a template. For **ANSI378** templates, this information can be retrieved from the template using **GetAnsiTemplateInfo()**. For **ISO19794** templates, this information can be retrieved from the template using **GetIsoTemplateInfo()**. For **SG400** templates, this information cannot be seen in the template.

rawImg: A byte array containing 256 Gray-level fingerprint image data

minTemplate: A byte array containing minutiae data extracted from a fingerprint image

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_FEAT_NUMBER = Inadequate number of minutia

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = 103 = Error while decoding template 1

SGFDX_ERROR_INVALID_TEMPLATE2 = 104 = Error while decoding template 2

public long GetTemplateSize(byte[] minTemplate, int[] size)

Gets template size. If the template format is SG400, it will return 400. If the template format is ANSI378 or ISO19794, template size may vary.

Parameters

minTemplate: A byte array containing minutiae data extracted from a fingerprint image

size: A byte array that will contain template size

Return values

SGFDX_ERROR_NONE = No error

4.5. Matching Functions

public long MatchTemplate(byte[] minTemplate1, byte[] minTemplate2, long secuLevel, Boolean[] matched)

Compares two sets of minutiae data of the **same** template format. The template format should be the same as that set by **SetTemplateFormat()** and should include only one sample. To match templates that have more than one sample, use **MatchTemplateEx()** or **MatchAnsiTemplate()**.

It returns TRUE or FALSE as a matching result (**matched**). Security level (**secuLevel**) affects matching result. The security level may be adjusted according to the security policy required by the user or organization.

Parameters

minTemplate1: A byte array containing minutiae data extracted from a fingerprint image

minTempate2: A byte array containing minutiae data extracted from a fingerprint image

secuLevel: A security level as specified in "SGFDxSecurityLevel" by one the following nine security levels: SL_LOWEST, SL_LOWER, SL_LOW, SL_BELOW_NORMAL, SL_NORMAL, SL_ABOVE_NORMAL, SL_HIGH, SL_HIGHER and SL_HIGHEST. SL_NORMAL is recommended in usual case.

matched: A byte array that contains matching result. If passed templates are matching templates, **TRUE** is returned. If not, **FALSE** is returned.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long MatchTemplateEx(byte[] minTemplate1, short tempateType1, long sampleNum1, byte[] minTemplate2, short tempateType2, long sampleNum2, long secuLevel, boolean[] matched)

Compares two sets of minutiae data, which can be of different template formats (SG400 or ANSI378). It returns TRUE or FALSE as a matching result (**matched**). Security level (**secuLevel**) affects matching result. The security level may be adjusted according to the security policy required by the user or organization.

Parameters

minTemplate1: A byte array containing minutiae data extracted from a fingerprint image

templateType1: Specifies format of minTemplate1. Should be either TEMPLATE_FORMAT_SG400 or TEMPLATE_FORMAT_ANSI378.

sampleNum1: Position of a sample to be matched in minTemplate1. If templateType1 is TEMPLATE_FORMAT_ANSI378, it can have a value from 0 to (number of samples -1) in minTemplate1. If templateType1 is TEMPLATE_FORMAT_SG400, this value is ignored.

minTemplate2: A byte array containing minutiae data extracted from a fingerprint image

templateType2: Specifies format of minTemplate2. Should be either TEMPLATE_FORMAT_SG400 or TEMPLATE_FORMAT_ANSI378.

sampleNum2: Position of a sample to be matched in minTemplate2. If templateType2 is TEMPLATE_FORMAT_ANSI378, it can have a value from 0 to (number of samples -1) in minTemplate2. If templateType2 is TEMPLATE_FORMAT_SG400, this value is ignored.

secuLevel:A security level as specified in "fplibnew.h" by one the following nine security levels: SL_LOWEST, SL_LOWER, SL_LOW, SL_BELOW_NORMAL, SL_NORMAL, SL_ABOVE_NORMAL, SL_HIGH, SL_HIGHER, and SL_HIGHEST. SL_NORMAL is recommended in usual case.

matched: TRUE: Same template. FALSE: Not same template

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long JSGFPLib.GetMatchingScore(byte[] minTemplate1, byte[] minTemplate2, int[] score)

Gets matching score of two sets of minutiae data of the **same** template format.

Parameters

minTemplate1: A pointer to the buffer containing minutiae data extracted from a fingerprint image

minTemplate2: A pointer to the buffer containing minutiae data extracted from a fingerprint image

score: Matching score. Returned score has a value from 0 to 199.

Returned values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long GetMatchingScoreEx(byte[] minTemplate1, short tempateType1, long sampleNum1, byte[] minTemplate2, short tempateType2, long sampleNum2, int[] score);

Gets matching score of two sets of minutiae data, which can be of different template formats (SG400 or ANSI378).

Parameters

minTemplate1: A byte array containing minutiae data extracted from a fingerprint image

templateType1: Specifies format of minTemplate1. Should be either TEMPLATE_FORMAT_SG400 or TEMPLATE_FORMAT_ANSI378.

sampleNum1: Position of a sample to be matched in minTemplate1. If templateType1 is TEMPLATE_FORMAT_ANSI378, it can have a value from 0 to (number of samples -1) in minTemplate1. If templateType1 is TEMPLATE_FORMAT_SG400, this value is ignored.

minTemplate2: A byte array containing minutiae data extracted from a fingerprint image

templateType2: Specifies format of minTemplate2. Should be either TEMPLATE_FORMAT_SG400 or TEMPLATE_FORMAT_ANSI378.

sampleNum2: Position of a sample to be matched in minTemplate2. If templateType2 is TEMPLATE_FORMAT_ANSI378, it can have a value from 0 to (number of samples -1) in minTemplate2. If templateType2 is TEMPLATE_FORMAT_SG400, this value is ignored.

score: Matching score. Returned score has a value from 0 to 199.

Returned values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

4.6. Functions for ANSI378 Templates

public long GetTemplateSizeAfterMerge(byte[] ansiTemplate1,byte[] ansiTemplate2, int[] size)

Calculates template size if two templates – ansiTemplate1 and ansiTemplate2 – are merged. Use this function to determine exact buffer size before using **MergeAnsiTemplate()**.

Parameters

ansiTemplate1: A byte array containing minutiae data. A template can have more than one sample.

ansiTempate2: A byte array containing minutiae data. A template can have more than one sample.

size: Template size if two templates are merged

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long MergeAnsiTemplate(byte[] ansiTemplate1,byte[] ansiTemplate2, byte[] outTemplate)

Merges two ANSI378 templates and returns a new merged template. The merged template (**outTemplate**) size will be less than sum of the sizes of the two input templates (size of ansiTemplate1 + size of ansiTemplate2). Call **GetTemplateSizeAfterMerge**() to determine the exact buffer size for **outTemplate** before calling **MergeAnsiTemplate()**.

Parameters

ansiTemplate1: A byte array containing minutiae data. A template can have more than one sample.

asniTempate2: A byte array containing minutiae data. A template can have more than one sample.

outTempate: The byte array containing merged data. The buffer should be assigned by the application. To determine the exact buffer size, call **JSGFPLib.GetTemplateSizeAfterMerge()**.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long GetAnsiTemplateInfo(byte[] ansiTemplate, SGANSITemplateInfo templateInfo)

Gets information of an ANSI378 template. Call this function before **MatchAnsiTemplate()** to obtain information about a template.

Parameters

anisiTemplate: ANSI378 template

templateInfo: The object that contains template information. For more information see **SGANSITemplateInfo** structure.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

public long MatchAnsiTemplate(byte[] ansiTemplate1, long sampleNum1, byte[] ansiTemplate2, long sampleNum2, long secuLevel, Boolean[] matched)

Compares two sets of ANSI378 templates. It returns TRUE or FALSE as a matching result (**matched**). Security level (**secuLevel**) affects matching result. The security level may be adjusted according to the security policy required by the user or organization.

Parameters

ansiTemplate1: A byte array containing minutiae data. A template can have more than one sample.

sampleNum1: Position of sample to be matched in **ansiTemplate1**. It can be from 0 to (number of samples -1) in **ansiTemplate1**

ansiTempate2: A byte array containing minutiae data. A template can have more than one sample.

sampleNum2: Position of sample to be matched in **ansiTemplate2**. It can be from 0 to (number of samples -1) in **ansiTemplate2**

secuLevel: A security level as specified in **SGFDxSecurityLevel** by one the following nine security levels: SL_LOWEST, SL_LOWER, SL_LOW, SL_BELOW_NORMAL, SL_NORMAL, SL_ABOVE_NORMAL, SL_HIGH, SL_HIGHER and SL_HIGHEST. SL_NORMAL is recommended in usual case.

matched: TRUE: Same template. FALSE: Not same template

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in ansiTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in ansiTemplate2

public long GetAnsiMatchingScore(byte[] ansiTemplate1, long sampleNum1, byte[] ansiTemplate2, long sampleNum2, int[] score)

Gets matching score.

Parameters

ansiTemplate1: A byte array containing minutiae data. A template can have more than one sample.

sampleNum1: Position of sample to be matched in **ansiTemplate1**. It can be from 0 to (number of samples -1) in **ansiTemplate1**

ansiTempate2: A byte array containing minutiae data. A template can have more than one sample.

sampleNum2: Position of sample to be matched in **ansiTemplate2**. It can be from 0 to (number of samples -1) in **ansiTemplate2**

score: Matching score. Returned score has a value from 0 to 199.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in ansiTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in ansiTemplate2

4.7. Functions for ISO19794-2 Templates

public long GetIsoTemplateSizeAfterMerge(byte[] isoTemplate1, byte[] isoTemplate2, int[] size)

Calculates template size if two templates – isoTemplate1 and isoTemplate2 – are merged. Use this function to determine exact buffer size before using **MergeIsoTemplate()**.

Parameters

isoTemplate1: A byte array containing minutiae data. A template can have more than one sample.

isoTempate2: A byte array containing minutiae data. A template can have more than one sample.

size: Template size if two templates are merged

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long MergeIsoTemplate(byte[] isoTemplate1, byte[] isoTemplate2,byte[] outTemplate)

Merges two ISO19794-2 templates and returns a new merged template. The merged template (**outTemplate**) size will be less than sum of the sizes of the two input templates (size of isoTemplate1 + size of isoTemplate2). Call **GetTIsoemplateSizeAfterMerge**() to determine the exact buffer size for **outTemplate** before calling **MergeIsoTemplate()**.

Parameters

isoTemplate1: A byte array containing minutiae data. A template can have more than one sample.

isoTempate2: A byte array containing minutiae data. A template can have more than one sample.

outTempate: The byte array containing merged data. The buffer should be assigned by the application. To determine the exact buffer size, call **GetIsoTemplateSizeAfterMerge()**.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in minTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in minTemplate2

public long GetIsoTemplateInfo(byte[] isoTemplate, SGISOTemplateInfo templateInfo)

Gets information of an ISO19794-2 template. Call this function before **MatchIsoTemplate()** to obtain information about a template.

Parameters

isoTemplate: ISO19794-2 template

templateInfo: The object that contains template information. For more information see **SGISOTemplateInfo** structure.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_PARAM = Invalid parameter used

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

public long MatchIsoTemplate(byte[] isoTemplate1, long sampleNum1, byte[] isoTemplate2, long sampleNum2, long secuLevel, boolean[] matched)

Compares two sets of ISO19794-2 templates. It returns TRUE or FALSE as a matching result (**matched**). Security level (**secuLevel**) affects matching result. The security level may be adjusted according to the security policy required by the user or organization.

Parameters

isoTemplate1: A byte array containing minutiae data. A template can have more than one sample.

sampleNum1: Position of sample to be matched in **isoTemplate1**. It can be from 0 to (number of samples -1) in **isoTemplate1**

isoTempate2: A byte array containing minutiae data. A template can have more than one sample.

sampleNum2: Position of sample to be matched in **isoTemplate2**. It can be from 0 to (number of samples -1) in **isoTemplate2**

secuLevel: A security level as specified in **SGFDxSecurityLevel** by one the following nine security levels: SL_LOWEST, SL_LOWER, SL_LOW, SL_BELOW_NORMAL, SL_NORMAL, SL_ABOVE_NORMAL, SL_HIGH, SL_HIGHER and SL_HIGHEST. SL_NORMAL is recommended in usual case.

matched: TRUE: Same template. FALSE: Not same template

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in isoTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in isoTemplate2

public long GetIsoMatchingScore(byte[] isoTemplate1, long sampleNum1, byte[] isoTemplate2, long sampleNum2, int[] score)

Gets matching score.

Parameters

isoTemplate1: A byte array containing minutiae data. A template can have more than one sample.

sampleNum1: Position of sample to be matched in **isoTemplate1**. It can be from 0 to (number of samples -1) in **isoTemplate1**

isoTempate2: A byte array containing minutiae data. A template can have more than one sample.

sampleNum2: Position of sample to be matched in **isoTemplate2**. It can be from 0 to (number of samples -1) in **isoTemplate2**

score: Matching score. Returned score has a value from 0 to 199.

Return values

SGFDX_ERROR_NONE = No error

SGFDX_ERROR_INVALID_TEMPLATE_TYPE = Wrong template type

SGFDX_ERROR_INVALID_TEMPLATE1 = Error in isoTemplate1

SGFDX_ERROR_INVALID_TEMPLATE2 = Error in isoTemplate2

4.8. Other Functions

public long GetMinexVersion(long[] extractor, long[] matcher)

Gets version of MINEX Compliant algorithms used in this SDK.

Parameters

extractor: Version of MINEX Compliant extractor (template generator)

matcher: Version of MINEX Compliant matcher (template matcher)

Return values

SGFDX_ERROR_NONE = No error

public long WSQGetDecodedImageSize (int[] fingerImageOutSize, byte[] wsqImage, int wsqImageSize)

Get the size of the RAW image contained in the WSQ image file. This function must be called before WSQDecode is called to allocate the size needed for the fingerimageOut buffer that will be populated with the raw image.

Parameters

fingerImageOutSize: Integer array that will be populated with the size of the WSQ image

wsqImage: Byte array containing the WSQ image

wsqImageSize: The size of the WSQ image file

Return values

SGFDX_ERROR_NONE = No error

public long WSQDecode (byte[] fingerImageOut, int[] width, int[] height, int[] pixelDepth, int[] ppi, int[] lossyFlag, byte[] wsqImage, int wsqImageSize)

Decode the WSQ image and return the RAW image. WSQGetDecodedImageSize() must be called first to allocate the size needed for the fingerimageOut buffer that will be populated with the raw image.

Parameters

fingerImageOut: Integer array that will be populated with the RAW image

width: Integer array that will be populated with the RAW image width.

height: Integer array that will be populated with the RAW image height.

pixelDepth: Integer array that will be populated with the RAW image pixelDepth. Example 8 bits per pixel.

ppi: Integer array that will be populated with the RAW image resolution. Example 500 ppi.

lossyFlag: Integer array that will be populated with the RAW image width.

wsqImage: Byte array containing the WSQ image

wsqImageSize: The size of the WSQ image file

Return values

SGFDX_ERROR_NONE = No error

public long WSQGetEncodedImageSize (int[] wsqImageOutSize, float wsqBitRate, byte[] fingerImage, int width, int height, int pixelDepth, int ppi)

Get the size of the compressed WSQ image that will be returned when the RAW image file is compressed. This function must be called before WSQEncode() is called to allocate the size needed for the wsqImageOut buffer that will be populated with the raw image..

Parameters

wsqImageOutSize: Integer array that will be populated with the size of the WSQ image

wsqBitRate:Compression bitrate to be used. Either BITRATE_5_TO_1 or BITRATE_15_TO_1.

fingerImage: Byte array containing a RAW fingerprint image

width: Width of the RAW image in pixels.

height: Height of the RAW image in pixels.

pixelDepth:Pixel depth of the image. Example - 8 bits per pixel.

ppi: Image resolution.

Return values

SGFDX_ERROR_NONE = No error

public long WSQEncode (byte[] wsqImageOut, float wsqBitRate, byte[] fingerImage, int width, int height, int pixelDepth, int ppi)

Get the size of the compressed WSQ image that will be returned when the RAW image file is compressed. This function must be called before WSQEncode() is called to allocate the size needed for the wsqImageOut buffer that will be populated with the raw image.

Parameters

wsqImageOut: Integer array that will be populated with the WSQ image

wsqBitRate: Compression bitrate to be used. Either BITRATE_5_TO_1 or BITRATE_15_TO_1.

fingerImage: Byte array containing a RAW fingerprint image

width:Width of the RAW image in pixels.

height: Height of the RAW image in pixels.

pixelDepth: Pixel depth of the image. Example - 8 bits per pixel.

ppi:Image resolution.

Return values

SGFDX_ERROR_NONE = No error

public long ComputeNFIQ(byte[] imgBuf, long width, long height)

Compute NIST Fingerprint Image Quality score for an 8 bit grayscale fingerprint image.

Parameters

imgBuf: Fingerprint image data

width: Image width in pixels

height: Image height in pixels

Return values

NFIQ score for the image that was processed

1 = highest quality fingerprint image

2 = high quality fingerprint

3 = medium quality fingerprint image

4 = low quality fingerprint ima

5 = lowest quality fingerprint image

-1 = An error occurred

public long ComputeNFIQEx(byte[] imgBuf, long width, long height, long dpi)

Compute NIST Fingerprint Image Quality score for an 8 bit grayscale fingerprint image.

Parameters

imgBuf: Fingerprint image data

width: Image width in pixels

height: Image height in pixels

dpi: Image resolution in dots (pixels) per inch

Return values

NFIQ score for the image that was processed

1 = highest quality fingerprint image

2 = high quality fingerprint

3 = medium quality fingerprint image

4 = low quality fingerprint ima

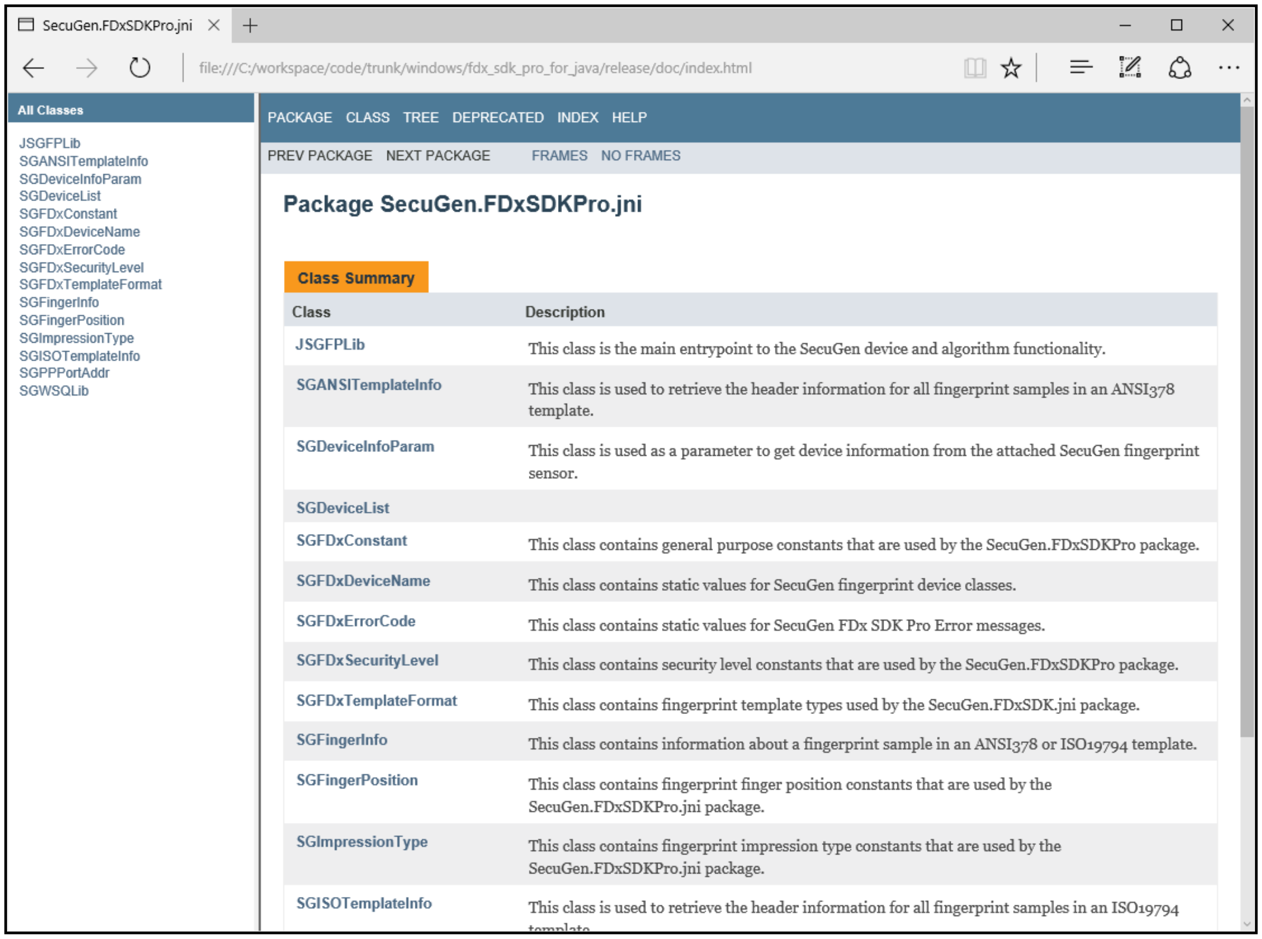
5 = lowest quality fingerprint image

-1 = An error occurred

Chapter 5. Class Reference

5.1. Java Documentation

Refer to the “doc” folder in this SDK release for the complete JavaDoc class reference.



Package SecuGen.FDxSDKPro.jni

Class Summary

Class	Description
JSGFPLib	This class is the main entrypoint to the SecuGen device and algorithm functionality.
SGANSITemplateInfo	This class is used to retrieve the header information for all fingerprint samples in an ANSI378 template.
SGDeviceInfoParam	This class is used as a parameter to get device information from the attached SecuGen fingerprint sensor.
SGDeviceList	
SGFDxConstant	This class contains general purpose constants that are used by the SecuGen.FDxSDKPro package.
SGFDxDeviceName	This class contains static values for SecuGen fingerprint device classes.
SGFDxErrorCode	This class contains static values for SecuGen FDx SDK Pro Error messages.
SGFDxSecurityLevel	This class contains security level constants that are used by the SecuGen.FDxSDKPro package.
SGFDxTemplateFormat	This class contains fingerprint template types used by the SecuGen.FDxSDK.jni package.
SGFingerInfo	This class contains information about a fingerprint sample in an ANSI378 or ISO19794 template.
SGFingerPosition	This class contains fingerprint finger position constants that are used by the SecuGen.FDxSDKPro.jni package.
SGImpressionType	This class contains fingerprint impression type constants that are used by the SecuGen.FDxSDKPro.jni package.
SGISOTemplateInfo	This class is used to retrieve the header information for all fingerprint samples in an ISO19794

Chapter 6. Constants

6.1. SGFDxDeviceName

Device Name	Value	Description
SG_DEV_UNKNOWN	0x00	Not determined
SG_DEV_FDU03	0x04	FDU03 or SDU03-based reader
SG_DEV_FDU04	0x05	FDU04 or SDU04-based reader
SG_DEV_FDU05	0x06	U20-based reader
SG_DEV_FDU06	0x07	UPx-based reader
SG_DEV_FDU07	0x08	U10-based reader
SG_DEV_FDU07A	0x09	U10-AP-based reader
SG_DEV_FDU08	0x0A	U20-AP-based reader
SG_DEV_AUTO	0xFF	Auto Detect

6.2. SGFDxSecurityLevel

Security Level	Value	Description
SL_NONE	0	No Security
SL_LOWEST	1	Lowest
SL_LOWER	2	Lower
SL_LOW	3	Low
SL_BELOW_NORMAL	4	Below normal
SL_NORMAL	5	Normal
SL_ABOVE_NORMAL	6	Above normal
SL_HIGH	7	High
SL_HIGHER	8	Higher
SL_HIGHEST	9	Highest

6.3. SGFDxTemplateFormat

Template Format	Value	Description
TEMPLATE_FORMAT_ANSI378	0x0100	ANSI INCITS 378-2004 format
TEMPLATE_FORMAT_SG400	0x0200	SecuGen proprietary format
TEMPLATE_FORMAT_ISO19794	0x0300	ISO/IEC 19794-2:2005 format

6.4. SGImpressionType

Security Level	Value	Description

SG_IMPTYPE_LP	0x00	Live-scan plain
SG_IMPTYPE_LR	0x01	Live-scan rolled
SG_IMPTYPE_NP	0x02	Non-live-scan plain
SG_IMPTYPE_NR	0x03	Non-live-scan rolled

6.5. SGFingerPosition

Security Level	Value	Description
SG_FINGPOS_UK	0x00	Unknown finger
SG_FINGPOS_RT	0x01	Right thumb
SG_FINGPOS_RI	0x02	Right index finger
SG_FINGPOS_RM	0x03	Right middle finger
SG_FINGPOS_RR	0x04	Right ring finger
SG_FINGPOS_RL	0x05	Right little finger
SG_FINGPOS_LT	0x06	Left thumb
SG_FINGPOS_LI	0x07	Left index finger
SG_FINGPOS_LM	0x08	Left middle finger
SG_FINGPOS_LR	0x09	Left ring finger
SG_FINGPOS_LL	0x0A	Left little finger

6.6. SGFDxErrorCode

Error Code	Value	Description
General Error Codes		
SGFDX_ERROR_NONE	0	No error
SGFDX_ERROR_CREATION_FAILED	1	JSGFPLib object creation failed
SGFDX_ERROR_FUNCTION_FAILED	2	Function call failed
SGFDX_ERROR_INVALID_PARAM	3	Invalid parameter used
SGFDX_ERROR_NOT_USED	4	Not used function
SGFDX_ERROR_DLLLOAD_FAILED	5	DLL loading failed
SGFDX_ERROR_DLLLOAD_FAILED_DRV	6	Device driver loading failed
SGFDX_ERROR_DLLLOAD_FAILED_ALGO	7	Algorithm DLL loading failed
Device Driver Error Codes		
SGFDX_ERROR_SYSLOAD_FAILED	51	Cannot find driver sys file
SGFDX_ERROR_INITIALIZE_FAILED	52	Chip initialization failed
SGFDX_ERROR_LINE_DROPPED	53	Image data lost
SGFDX_ERROR_TIME_OUT	54	GetImageEx() timeout
SGFDX_ERROR_DEVICE_NOT_FOUND	55	Device not found
SGFDX_ERROR_DRVLOAD_FAILED	56	Driver file load failed
SGFDX_ERROR_WRONG_IMAGE	57	Wrong image
SGFDX_ERROR_LACK_OF_BANDWIDTH	58	Lack of USB bandwidth

SGFDX_ERROR_DEV_ALREADY_OPEN	59	Device is already opened
SGFDX_ERROR_GETSN_FAILED	60	Serial number does not exist
SGFDX_ERROR_UNSUPPORTED_DEV	61	Unsupported device
Extract & Matching Error Codes		
SGFDX_ERROR_FEAT_NUMBER	101	Inadequate number of minutiae
SGFDX_ERROR_INVALID_TEMPLATE_TYPE	102	Wrong template type
SGFDX_ERROR_INVALID_TEMPLATE1	103	Error in decoding template 1
SGFDX_ERROR_INVALID_TEMPLATE2	104	Error in decoding template 2
SGFDX_ERROR_EXTRACT_FAIL	105	Extraction failed
SGFDX_ERROR_MATCH_FAIL	106	Matching failed

6.7. SGFDxConstant

- DEV_SN_LEN 15 // Device serial number length.

Chapter 7. Sample Applications

After installing the hardware and software, it is recommended that all components be checked to verify that they are working properly. The included sample applications can be used for this purpose

7.1. JSGD - Hardware Test Program

The **SecuGen Device Diagnostic Utility** program (JSGD.class) is located in the `FDxSDKPro.jar` archive. This program scans fingerprint images and also performs fingerprint registration and verification. If this program fails to capture a fingerprint image, the system is not configured correctly.

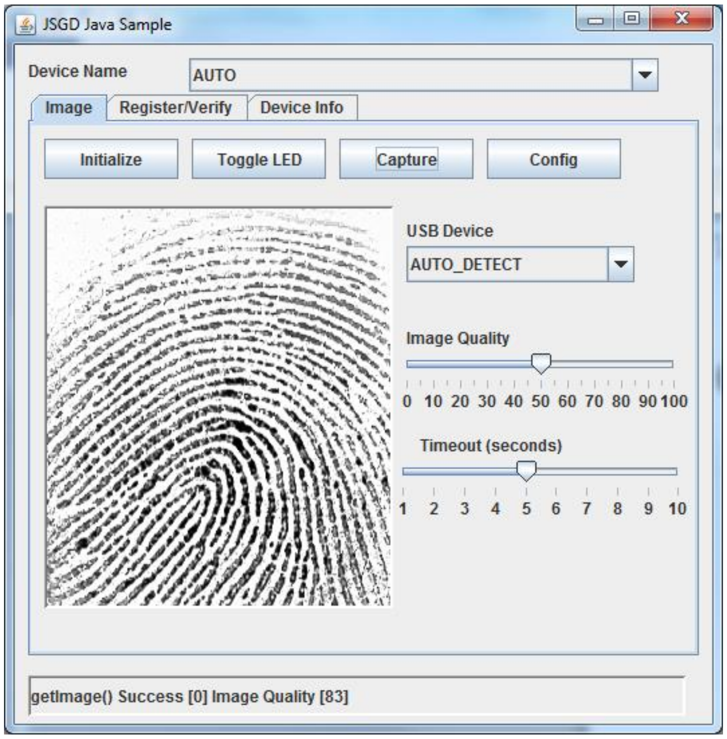
1. Launch a command prompt.

   ```
   cd <FDx_SDK_FOR_JAVA_INSTALL_DIR>
   ```

2. Type ***run_JSGD.bat*** and then **Enter**. The following command can also be used:

   ```
   java -cp ".;AbsoluteLayout.jar;FDxSDKPro.jar"
   SecuGen.FDxSDKPro.samples.JSGD
   ```

3. Click **Initialize** to initialize the reader. The result of initialization (success or failure) will be displayed in the status bar at the bottom left of the screen. If initialization fails, check the device connection and repeat the above steps.



Device Name AUTO

USB Device AUTO_DETECT

getImage() Success [0] Image Quality [83]

If initialization is successful, place your finger on the fingerprint reader, and click **Capture**. The fingerprint image should be displayed if your reader is working properly.

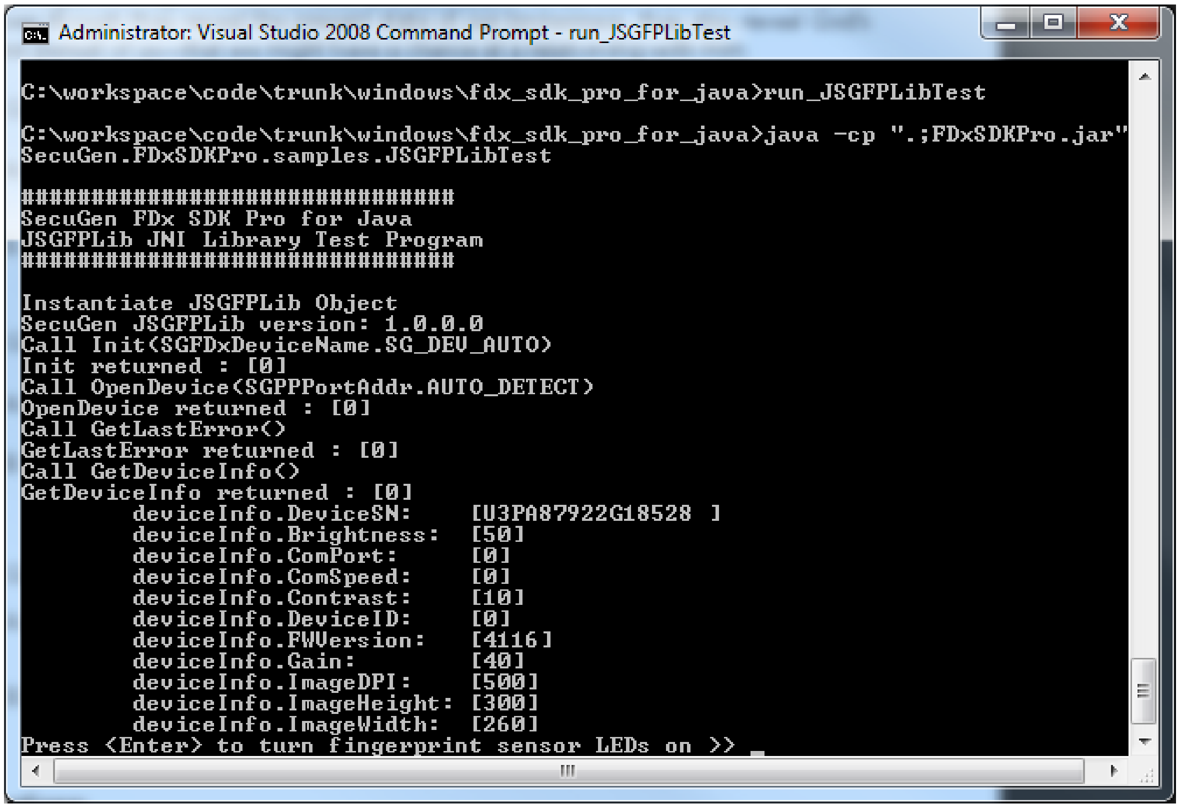
7.2. JFPLib Test Program

The **JSGFPLibTest** program demonstrates all of the functionality included in FDx SDK Pro for Java.

1. Launch a command prompt.

   ```
   cd <FDx_SDK_FOR_JAVA_INSTALL_DIR>
   ```

2. Type ***run_jsgfplibtest.bat*** and then **Enter.**



Administrator: Visual Studio 2008 Command Prompt - run_JSGFPLibTest

```
C:\workspace\code\trunk\windows\fdx_sdk_pro_for_java>run_JSGFPLibTest

C:\workspace\code\trunk\windows\fdx_sdk_pro_for_java>java -cp ".;FDxSDKPro.jar"
SecuGen.FDxSDKPro.samples.JSGFPLibTest

###################################
SecuGen FDx SDK Pro for Java
JSGFPLib JNI Library Test Program
###################################

Instantiate JSGFPLib Object
SecuGen JSGFPLib version: 1.0.0.0
Call Init(SGFDxDeviceName.SG_DEV_AUTO)
Init returned : [0]
Call OpenDevice(SGPPPortAddr.AUTO_DETECT)
OpenDevice returned : [0]
Call GetLastError()
GetLastError returned : [0]
Call GetDeviceInfo()
GetDeviceInfo returned : [0]
        deviceInfo.DeviceSN:     [U3PA87922G18528 ]
        deviceInfo.Brightness:   [50]
        deviceInfo.ComPort:      [0]
        deviceInfo.ComSpeed:     [0]
        deviceInfo.Contrast:     [10]
        deviceInfo.DeviceID:     [0]
        deviceInfo.FWVersion:    [4116]
        deviceInfo.Gain:         [40]
        deviceInfo.ImageDPI:     [500]
        deviceInfo.ImageHeight:  [300]
        deviceInfo.ImageWidth:   [260]
Press <Enter> to turn fingerprint sensor LEDs on >> _
```