

INDIface SDK1 Reference

EclipseIR Personal Identity Recognition

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INDIface SDK1 Reference: EclipseIR Personal Identity Recognition

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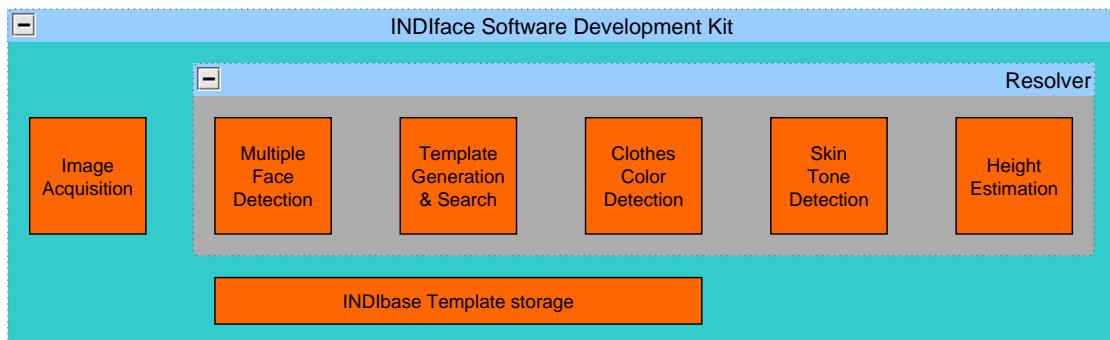
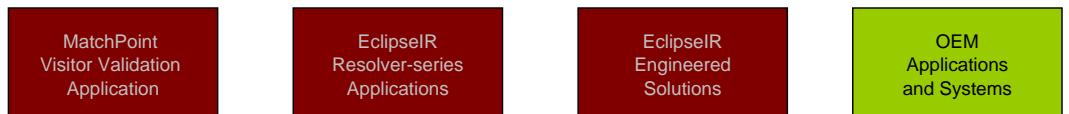
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Chapter 1. Introduction



1. Overview

Eclipse Identity Recognition Corporation™ provides *Personal Identity Recognition* via its face-based analytics known as INDIface. It is used to detect faces and facial features and then generate face templates for searching and matching. In addition, the INDIface analytics can also determine skin tone, upper and lower clothes color, and an estimated height of a person. The INDIbase system provides for the enrollment, storage, management, retrieval, and matching of INDIface templates. INDIbase also manages facial and other images as well as personal identification and characteristic data.



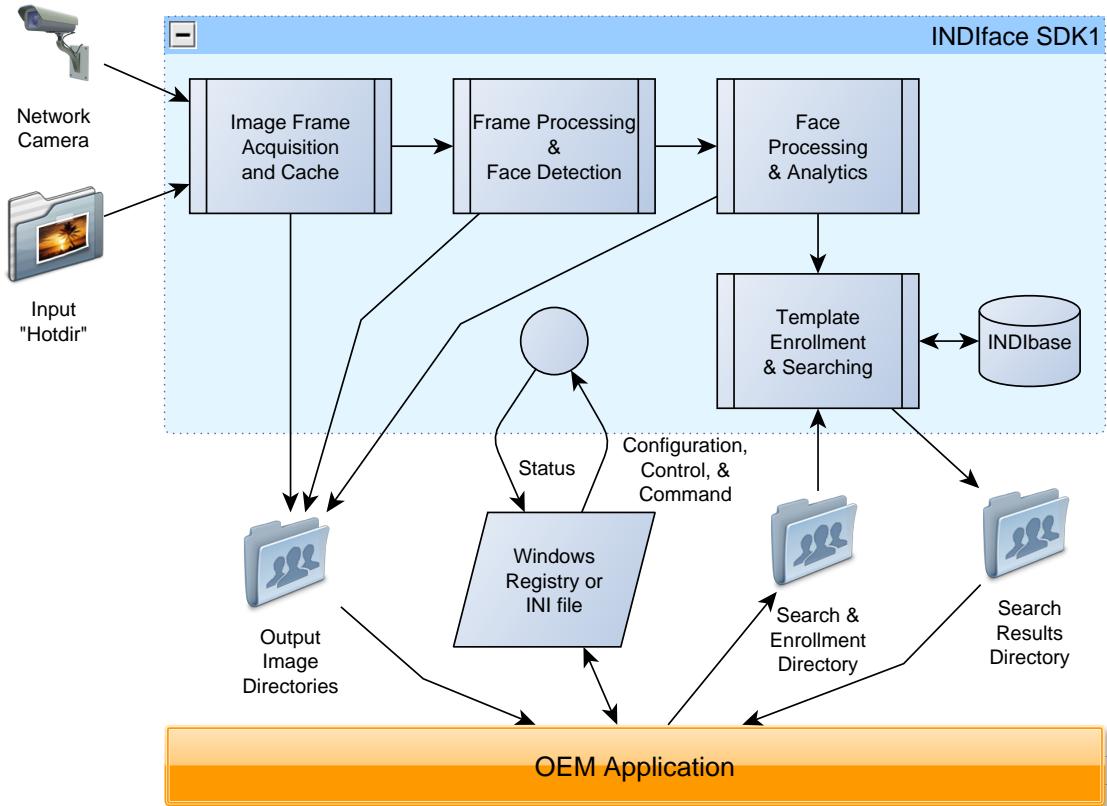
In addition to providing the base for EclipseIR's applications, the INDIface Software Development Kit (SDK) allows OEM developers to create custom applications using EclipseIR's technology. The INDIface SDK is currently for Windows-based stand-alone systems up to 50,000 enrollments. In the short term, the INDIface SDK will be made available on most Linux- or BSD-based platforms in addition to Microsoft Windows. At the same time, configuration will be taken from INI files rather than the Windows registry. EclipseIR also plans to embed portions of its technologies in "Smart Cameras" pushing more capability to the edge of the network. EclipseIR will continue to develop more face-based analytics (such as demographic estimates) and other technologies for personal identity recognition, for example, gait recognition. As well, EclipseIR will pursue complementary technologies, such as the vehicular identity recognition. These expanded capabilities will be included in the SDK and/or API as appropriate to allow third-party developers to include them in their custom applications. At the moment the binary implementation of the SDK is a Windows console application (IfSearch.exe) and a few DLLs.

1.1. C³

Configuration, Control, Command

The behavior of the INDIface SDK is currently controlled via the Windows registry. In the future we will add the ability to use INI and/or XML configuration files. The default is HKCU/Software/EclipseIR/IfSearch. Most options can also be specified on the command line.

Most of the configuration values are "volatile," that is they can be changed in the registry at any time and the executing IfSearch will automatically pick up the changes. Things that are not volatile will be documented, but it is mainly in the selection of detectors and location of initialization files.



1.2. Image Input

The SDK will take its input images from an IP camera or a "hot directory."

1.2.1. Live IP Input

Specify the input URL with "http" as the scheme, user name and password if needed, host address, and a path and file name that will result in a single frame to be returned to IfSearch. For example `/Input/URL=http://demo:demo@192.168.1.90/jpg/image.jpg`. Most of the work so far has been with Axis 210 and 240 and a trial with Arecont, but any ONVIF compliant camera should work.

1.2.2. Hot Directory Input

Specify the input URL with "dir" as the scheme; user name, password, and host are ignored; the relative path starts after the slash following the host. To be an official URL, drive separating colons should be replaced with vertical stiles and Windows-style backslashes should be replaced with forward slashes; but we'll work either way. Examples:

- `/Input/URL=dir:///.` reads from the current directory
- `/Input/URL=dir:///InputImages` reads from `\Input\Images` on the current drive
- `/Input/URL=dir:///T|/Input/Images/Today` reads from `T:\Input\Images\Today`
- `/Input/URL=dir:///T:\Input\Images\Today` ditto.

Hot directories have several advantages:

- When all images have been processed, you can start processing again-mostly useful for testing or demonstrating.
- Images can be deleted from the directory after they have been processed.
- Image files can be moved to a separate directory after they have been processed.
- Processing can be started on an empty directory and image files are processed as they are dropped in to the "hot" directory.

2. Installation

The SDK distribution is in a ZIP file with the default directory structure. Unzip it to the location of your liking.

2.1. Directory Structure

This is the default directory structure. If necessary some of the directories can be eliminated or moved to other locations with the new locations specified in the registry.

- ./INDIface/bin-w32 contains the 32-bit Windows IfSearch executable and its libraries along with necessary 3rd party libraries.
- ./INDIface/data/Face1 contains the INDIFace template generation data files.
- ./INDIface/detectors contains Detectors.XML and the actual detector XML data.
- ./INDIface/bin-w32/imageformats contains image file format translators that will be used by IfSearch at start up.
- ./INDIface/bin-w32/imageformats/extras contains other image file format translators.
- ./INIDface/bin-w32/sqldrivers will contain SQL database interface translators in the future.
- ./INDIface/FaceBase will contain person records and enrolled faces (normalized images and templates).
- ./Sample/Input contains optional sample input data.
- ./Sample/Output contains optional sample output data.
- ./SampleInput/SampleFaceBase contains an optional sample FaceBase.

You may want to add W:\whatever\INDIface\bin to the system PATH so you can start IfSearch from any current directory.

Chapter 2. Basic Steps

Every facial detection and recognition system follows the same basic steps:

1. Image Acquisition

The images for any analytic system are basically analog reflections of visible light passing through a lens and detected on some sensor. For any analysis of the image, it needs to be digitized for processing. The digitized images can be preprocessed to improve the performance of the analysis.

2. Frontal Face Detection

Areas of the image that might contain a frontal face are identified, generally by looking for patterns of light and dark areas, such as a light nose between darker eyes topped by a lighter forehead.

3. Location of Features

Different facial recognition systems identify and locate different numbers of facial features, from a few (left and right eye orbit centers, nose tip, upper mouth, etc) to as many as sixty locations.

4. Template Generation

Based upon the location of facial features, the detected face image is "normalized" and sequences of numbers ("vectors") that represents the subjects face are calculated. Multiple vectors can be combined into a template.

5. Template Storage and Searching

The templates can then be stored in a database or other storage mechanism, such as a smart card. The stored templates can then be compared to one or a few templates of a new subject to sort the database by closeness of face match or to determine the difference for verification purposes.

The INDIface system blends some of these basic steps since it can use template generation to "qualify" a detected face and the location of features. Also INDIface can perform face-based analytics after the face has been qualified.

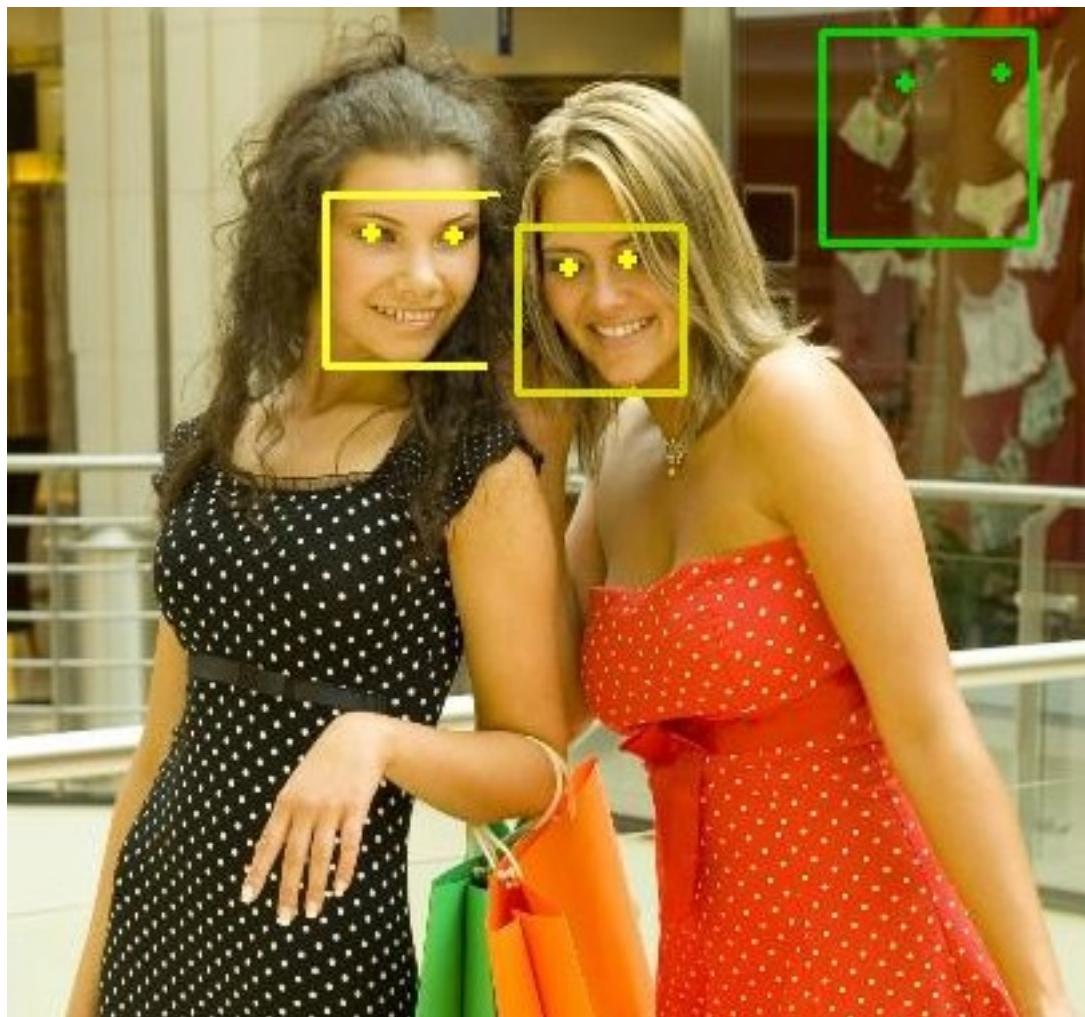
1. Image Acquisition

The INDIface SDK accepts single still images or sequences of frames, such as Motion JPEG. Image formats supported include BMP, PNG, and JPG. The image source can be a live IP camera or a "hot directory." Live IP input expects an HTTP-scheme URL that will return a single frame. The SDK has been used with Axis 210-series cameras (and 240-series NTSC video encoders) and Arecont IP cameras. It should be compatible with ONVIF compliant cameras.

Stored images (whether individual stills or sequences) are processed from a "hot directory." Hot directories have several advantages: When all images have been processed, you can start processing again-mostly useful for testing or demonstrating. Images can be deleted from the directory after they have been processed. Image files can be moved to a separate directory after they have been processed. Processing can be started on an empty directory and image files are processed as they are dropped in to the "hot" directory.

The input frames can be preprocessed after they are acquired. The INDIface SDK supports scaling, rotation, and aspect ratio correction.

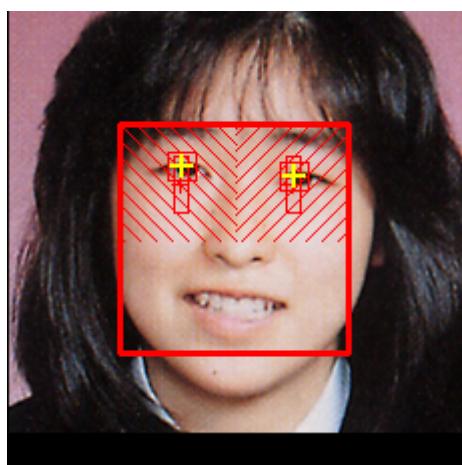
Figure 2.1. Multiple Face Detection



2. Face Detection and Feature Location

Once a single frame has been collected from an IP camera or hot directory, a frontal face detector is used to scan for potential faces in the image. Each of the potential faces is extracted from the original frame, optionally scaled and filtered, and a face feature detector is applied.

Figure 2.2. Feature Location



3. Template Generation

From the detected location of facial features the face image is “normalized” by aligning the eyes to fixed points. From the normalized image, an INDIface template generation will be performed.

Figure 2.3. Normalized Face Image

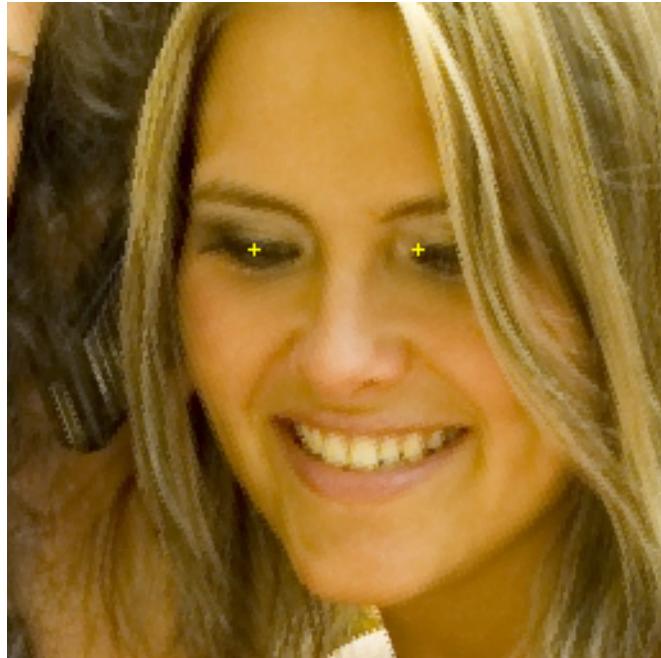


Figure 2.4. INDIface Vector Graph

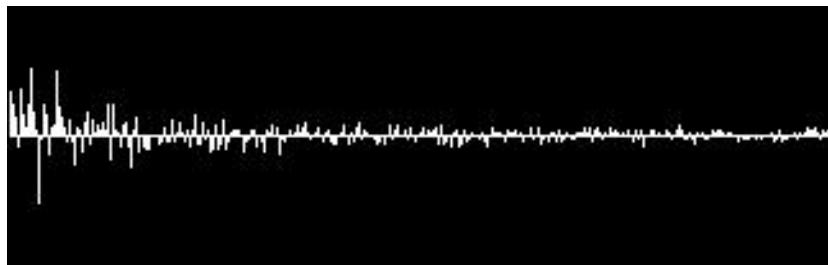


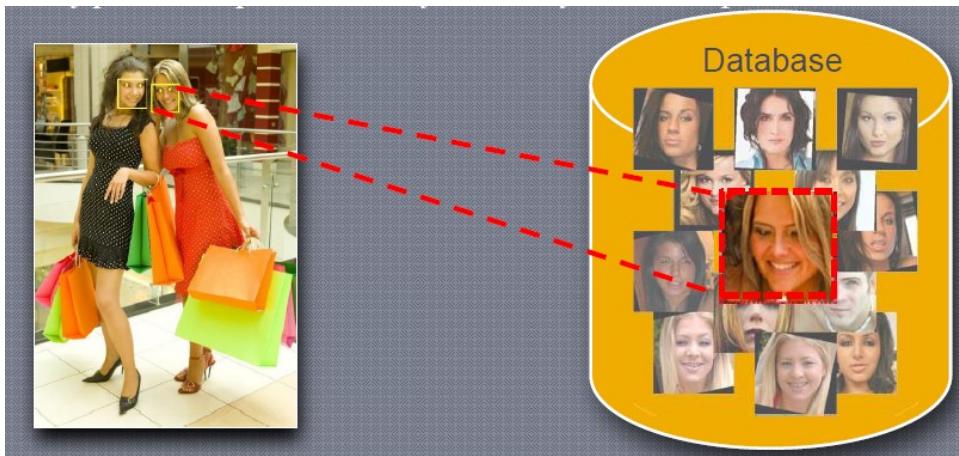
Figure 2.5. Reconstruction from Vector



4. Informal Matching

This template can be enabled for informal matching where a one-to-many search is executed against any active INDIBase enrollments.

Figure 2.6. Matching against INDIbase



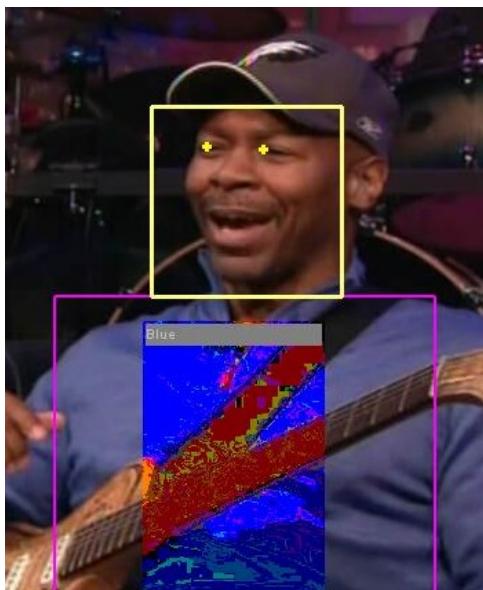
5. Face-based Analytics

If the template generation process confirms a likely human face, then other analytic data can be collected

5.1. Clothes Color

The location of the upper and lower body can be determined and the characteristic color of those areas can be collected and compared against specified target colors.

Figure 2.7. Clothes Color Detection



5.2. Face Skin Color

Representative areas of the face can be sampled to collect an average skin tone for comparison against multiple specified target colors.

5.3. Height Estimation

The face position and size can be applied to calibration data for fixed camera positions to interpolate an estimated height of the person.

5.4. Resolver

The quality of the detected potential face, the consistency of the generated template, and the confidences of informal face match, upper and lower close color matches, height estimation, and skin tone match can then be fed to the resolver. The (positive or negative) weighted average of each of these factors can be combined to a resolved confidence value.

6. Output

Output data consists of frame images, cropped face images, normalized face images, and XML data files. Frame images and XML data files are identified by an Image ID. For frames captured from IP cameras, the image ID consists of a date stamp to the thousands of the second optionally prepended with a specified Camera ID. For images read from a directory, the image ID is the base file name. Cropped and normalized face image files are identified by a Face ID. The face ID consists of the image ID appended with the x,y coordinates of the position of the face in the original image and the quality and consistency values for the detected face. The output files are distributed to a set of directories specified in the configuration.

7. INDIbase

The SDK console has three command modes to allow applications to interact with the active INDIbase enrollment.

7.1. Enroll

In Enroll mode, an application can use the Enroll command to:

1. Enroll new unidentified (not associated with a person) faces to the INDIbase.
2. Create a new person and enroll faces for that person.
3. Add more faces to an existing person's enrollment.

In addition the Delete command can:

1. Delete an unidentified face from enrollment.
2. Delete a specific face from a specified person's enrollment.

And, the Remove command will remove a specified person and all enrolled faces for that person from the INDIbase.

7.2. Retrieve

In Retrieve mode and application can retrieve single enrollment images (from a specified person or unidentified) or all faces enrolled for a person.

7.3. Search

In Search mode, and application can submit faces to be searched against the current INDIbase enrollment.

1. With the Verify command, the submitted faces are compared to a specified person and a single confidence level is returned.
2. With the VerifyList command (to be implemented soon), submitted faces are compared to a specified list of a few persons. The results are the list of persons sorted by their confidence.
3. With the Search command the submitted faces are compared to the entire INDIbase enrollment. The results are a list of the best matching faces sorted by confidence. In Person Search Mode, results for the same enrolled person are grouped together.

7.4. Person Mode

When templates are known to be of the same person, they can be enrolled in the INDIbase in "person mode." Later when searching an INDIbase, "person mode" can be used to group the best results for an enrolled person together to improve confidence in the results of a search.

Chapter 3. Getting Started

The idea is to give you enough basic information to actually start working with INDIface. The information here is intentionally skeletal; you can find the details in the control and command reference chapter of this book.

1. First Steps

The best way to learn is by doing, let's get started.

1.1. Running IfSearch for the first time

Try to execute IfSearch. If we have the DLLs placed and registered correctly, it should start running and displaying messages to a DOS console window.

```
+16:55:36.205 IfSearch v1.60H built Mon Jul 12 16:05:55 2010
-16:55:36.205 INDIface Search processor Copyright (c) 2003-2010 Anthony H. Otto dba ...
+16:55:36.205 IJMcore v1.60H built Mon Jul 12 16:05:55 2010
-16:55:36.205 IJM Core Library Copyright (c) 2003-2010 Anthony H. Otto dba Dynamic ...
```

If the INDIface data files are in the expected locations, the detector and template generator data will be loaded.

```
-16:55:36.237 Reading detectors from D:/SVN2/trunk/IJM/release./Detectors/Detectors.XML
+16:55:36.237 Initializing INDIface Face Detector
+16:55:36.283 Face Detector loaded: Aim8A-320 32x32
-16:55:36.283 Description: Aim8 A-series with no splits (32x32)
+16:55:36.285 Initializing INDIface Data and Parameters
-16:55:36.286 Creating INDIface data from D:/SVN2/trunk/IJM/release/Data/Face1
```

While the data files are being read, we will create the output directories. Since this is the first run, the output directories are all blank.

```
-16:55:38.203 Charcol directory set to [None]
-16:55:38.226 Detect directory set to [None]
-16:55:38.249 Skin directory set to [None]
-16:55:38.272 Enroll directory set to [None]
-16:55:38.289 Generate directory set to [None]
-16:55:38.320 BadFace directory set to [None]
-16:55:38.343 Body directory set to [None]
-16:55:38.367 Capture2 directory set to [None]
-16:55:38.390 Capture directory set to [None]
-16:55:38.413 Clothes directory set to [None]
-16:55:38.431 FaceCache directory set to [None]
-16:55:38.462 Face directory set to [None]
-16:55:38.485 Height directory set to [None]
-16:55:38.503 Image directory set to [None]
-16:55:38.534 Marked directory set to [None]
-16:55:38.557 MarkedFace directory set to [None]
-16:55:38.573 Match directory set to [None]
-16:55:38.603 NoEyes directory set to [None]
-16:55:38.626 NoFace directory set to [None]
-16:55:38.642 NoMatch directory set to [None]
-16:55:38.673 Xml directory set to [None]
-16:55:38.697 ResolveFace directory set to [None]
-16:55:38.714 ResolveMarked directory set to [None]
-16:55:38.744 Retrieve directory set to [None]
-16:55:38.767 Search directory set to [None]
```

And shortly, the INDIface initialization will be complete and the local FaceBase will be read. Initialization can take 15-45 seconds depending upon the systems capabilities and resources. Reading the FaceBase will, of course, depend upon the number of enrollments. In my example below, I had a small test enrollment and it took 200ms for 141 faces and 73 people. However, it can take up to ten minutes to load 50,000 enrolled faces. Since this is your first time, you will have zero people or faces.

```
+16:55:49.392 Initializing INDIface Template Generators
+16:55:49.392 Initializing INDIface Matcher
+16:55:49.392 Initializing INDI FaceBase
-16:55:49.392 from ../FaceBase
-16:55:49.532 INDI FaceBase Initialized: 73 People, 141 Faces, 10 Non-searchable
```

Once the FaceBase is loaded, we are ready to start processing, but first it logs the settings:

```
-16:55:49.532 [V ] {Clothes/Enable} = false
-16:55:49.532 [V ] {Detect/CharcoalDir} = empty
-16:55:49.532 [V ] {Detect/Enable} = false
-16:55:49.532 [V ] {Detect/InputOverCrop} = 0
-16:55:49.532 [V ] {Detect/OutputDir} = empty
-16:55:49.532 [V ] {Detect/SkinDir} = empty
-16:55:49.532 [V ] {Enroll/Command} = empty
-16:55:49.532 [V ] {Enroll/OutputDir} = empty
-16:55:49.532 [V ] {FaceColor/Enable} = false
-16:55:49.532 [V ] {Generate/Enable} = false
-16:55:49.532 [V ] {Generate/OutputDir} = empty
-16:55:49.532 [V ] {Height/Enable} = false
-16:55:49.532 [V ] {Input/Pause} = false
-16:55:49.532 [V ] {Input/URL} = empty
-16:55:49.532 [V ] {Match/Enable} = false
-16:55:49.532 [ ] {Options/NoPrompt} = true
-16:55:49.532 [V ] {Options/Shutdown} = false
-16:55:49.532 [V ] {Output/BadFaceDir} = empty
-16:55:49.532 [V ] {Output/BaseDir} = ../Output
-16:55:49.532 [V ] {Output/BodyDir} = empty
-16:55:49.532 [V ] {Output/Capture2Dir} = empty
-16:55:49.532 [V ] {Output/CaptureDir} = empty
-16:55:49.548 [V ] {Output/ClothesDir} = empty
-16:55:49.548 [V ] {Output/FaceCacheDir} = empty
-16:55:49.548 [V ] {Output/FaceDir} = empty
-16:55:49.548 [V ] {Output/FaceFormat} = PNG
-16:55:49.548 [V ] {Output/FaceQuality} = -1
-16:55:49.548 [V ] {Output/ForceMarked} = false
-16:55:49.548 [V ] {Output/Format} = JPG
-16:55:49.548 [V ] {Output/HeightDir} = empty
-16:55:49.548 [V ] {Output/ImageDir} = empty
-16:55:49.548 [ ] {Output/LogDetail} = Info
-16:55:49.563 [ ] {Output/LogFile} = ../Output/log/@.log
-16:55:49.563 [V ] {Output/MarkAllColor} = #000000
-16:55:49.563 [V ] {Output/MarkBackgroundColor} = #000000
-16:55:49.563 [V ] {Output/MarkBackgroundFile} = empty
-16:55:49.563 [V ] {Output/MarkBackgroundTransparency} = 100
-16:55:49.563 [V ] {Output/MarkBadFaceColor} = #00ff00
-16:55:49.563 [V ] {Output/MarkClothes} = false
-16:55:49.563 [V ] {Output/MarkedDir} = empty
-16:55:49.563 [V ] {Output/MarkedFaceDir} = empty
-16:55:49.563 [V ] {Output/MarkEyeColor} = #ffff00
-16:55:49.579 [V ] {Output/MarkEyeRoiColor} = #000000
-16:55:49.579 [V ] {Output/MarkFaceColor} = #ffff00
-16:55:49.579 [V ] {Output/MarkNoEyesColor} = #0000ff
-16:55:49.579 [V ] {Output/MarkOverCrop} = 133
-16:55:49.579 [V ] {Output/MatchDir} = empty
-16:55:49.579 [V ] {Output/MaxCache} = 64
-16:55:49.579 [V ] {Output/NoEyesDir} = empty
-16:55:49.579 [V ] {Output/NoFaceDir} = empty
-16:55:49.579 [V ] {Output/NoMatchDir} = empty
-16:55:49.579 [V ] {Output/Quality} = -1
-16:55:49.579 [V ] {Output/WriteFaceInfo} = true
-16:55:49.579 [V ] {Output/XmlDir} = empty
-16:55:49.579 [V ] {Resolve/Consistency} = 0
-16:55:49.579 [V ] {Resolve/Enable} = false
-16:55:49.579 [V ] {Resolve/FaceColor} = 0
-16:55:49.579 [V ] {Resolve/FaceDir} = empty
-16:55:49.579 [V ] {Resolve/Height} = 0
-16:55:49.579 [V ] {Resolve/LowerClothes} = 0
-16:55:49.579 [V ] {Resolve/MarkedDir} = empty
-16:55:49.579 [V ] {Resolve/MaxConfidence} = 0
```

```
-16:55:49.595 [V      ] {Resolve/MinConfidence} = 0
-16:55:49.595 [V      ] {Resolve/Quality} = 0
-16:55:49.595 [V      ] {Resolve/UpperClothes} = 0
-16:55:49.595 [V      ] {Retrieve/Command} = empty
-16:55:49.595 [V      ] {Retrieve/OutputDir} = empty
-16:55:49.595 [V      ] {Search/Command} = empty
-16:55:49.595 [V      ] {Search/OutputDir} = empty
```

And properties:

```
-16:55:49.595 [V      ] {Clothes/Ankle} for 943408 = 0
-16:55:49.595 [V      ] {Clothes/LowerColor} for 943408 = empty
-16:55:49.595 [V      ] {Clothes/LowerConfidence} for 943408 = 0
-16:55:49.610 [V      ] {Clothes/Shoulder} for 943408 = 0
-16:55:49.610 [V      ] {Clothes/UnderCrop} for 943408 = 0
-16:55:49.610 [V      ] {Clothes/UpperColor} for 943408 = empty
-16:55:49.610 [V      ] {Clothes/UpperConfidence} for 943408 = 0
-16:55:49.610 [V      ] {Clothes/Waist} for 943408 = 0
-16:55:49.610 [V      ] {Clothes/Width} for 943408 = 0
-16:55:49.610 [V      ] {Detect/Factor} for 95a520 = 0
-16:55:49.610 [V      ] {Detect/MaxAcross} for 95a520 = 0
-16:55:49.610 [V      ] {Detect/MaxPixels} for 95a520 = 0
-16:55:49.610 [V      ] {Detect/MaxResults} for 95a520 = 0
-16:55:49.626 [V      ] {Detect/MinAcross} for 95a520 = 0
-16:55:49.626 [V      ] {Detect/MinPixels} for 95a520 = 0
-16:55:49.626 [V      ] {Detect/MinQuality} for 95a520 = 0
-16:55:49.626 [V      ] {Generate/EyeScale} for 94f230 = 0
-16:55:49.626 [      ] {Generate/LeftDetector} for 94f230 = empty
-16:55:49.626 [V      ] {Generate/MinConsistency} for 94f230 = 0
-16:55:49.626 [      ] {Generate/RightDetector} for 94f230 = empty
-16:55:49.626 [V      ] {Generate/RoiScale} for 94f230 = 0
-16:55:49.626 [V      ] {Height/GridCols} for 94fc88 = 0
-16:55:49.626 [V      ] {Height/GridFile} for 94fc88 = empty
-16:55:49.626 [V      ] {Height/GridRows} for 94fc88 = 0
-16:55:49.626 [V      ] {Height/HeightScale} for 94fc88 = 0
-16:55:49.626 [V      ] {Height/MinConfidence} for 94fc88 = 0
-16:55:49.626 [V      ] {Height/MinConsistency} for 94fc88 = 0
-16:55:49.626 [V      ] {Height/TargetEyePixels} for 94fc88 = 0
-16:55:49.626 [V      ] {Height/TargetHeight} for 94fc88 = 0
-16:55:49.626 [V      ] {Input/DeleteAfter} for a4ebd0 = false
-16:55:49.626 [V A     ] {Input/Loop} for a4ebd0 = false
-16:55:49.626 [V A     ] {Input/MaxCache} for a4ebd0 = 0
-16:55:49.626 [V A     ] {Input/MaxCache} for 946230 = 0
-16:55:49.641 [V      ] {Input/MoveAfter} for a4ebd0 = empty
-16:55:49.641 [V A     ] {Input/NewestOnly} for a4ebd0 = false
-16:55:49.641 [V      ] {Input/NewOnly} for a4ebd0 = false
-16:55:49.641 [V      ] {Input/SampleMsec} for a4ebd0 = 0
-16:55:49.641 [V      ] {Input/SampleMsec} for 946230 = 0
-16:55:49.641 [V      ] {Match/DuplicateThreshold} for 28fd58 = 6
-16:55:49.641 [V      ] {Match/MaxDistance} for 28fd58 = 0
-16:55:49.641 [V      ] {Match/MaxFaces} for 28fd58 = 0
-16:55:49.641 [V      ] {Match/MaxPersonFaces} for 28fd58 = 5
-16:55:49.641 [V      ] {Match/MaxResults} for 28fd58 = 0
-16:55:49.657 [V      ] {Match/MinConfidence} for 28fd58 = 0
-16:55:49.657 [V      ] {Match/MinDistance} for 28fd58 = 0
-16:55:49.657 [V      ] {Match/PersonMethod} for 28fd58 = 0
-16:55:49.657 [V      ] {Match/PersonMode} for 28fd58 = true
-16:55:49.657 [V      ] {Options/UpdateMsec} for 948c68 = 0
-16:55:49.657 [V      ] {Search/DuplicateThreshold} for 28fd90 = 6
-16:55:49.657 [V      ] {Search/MaxDistance} for 28fd90 = 0
-16:55:49.657 [V      ] {Search/MaxFaces} for 28fd90 = 0
-16:55:49.657 [V      ] {Search/MaxPersonFaces} for 28fd90 = 5
-16:55:49.657 [V      ] {Search/MaxResults} for 28fd90 = 0
-16:55:49.673 [V      ] {Search/MinConfidence} for 28fd90 = 0
-16:55:49.673 [V      ] {Search/MinDistance} for 28fd90 = 0
-16:55:49.673 [V      ] {Search/PersonMethod} for 28fd90 = 0
-16:55:49.673 [V      ] {Search/PersonMode} for 28fd90 = true
```

IfSearch is ready to rock and roll, but since we haven't set any controls in the registry, it is pretty well emulating a brick now.

1.2. The Log File

The log is an important place to start to learn about IfSearch and to request assistance. By default the log is written to `../Output/log/@.log` relative to where IfSearch was started. If you started IfSearch from its bin directory, then look for the log file at `w:\hatever\INDIFace\Output\log\20100710-T1655.log`. Note that the at-sign in the file name specification is replaced by the date and time that IfSearch is started. If you would like to move the log file elsewhere, specify `LogFile` in the `Output` key of the registry, for example: `/Output/LogFile=../Output/@/IfSearch.log`. The detail level of the log file defaults to "Info," as does the output to the console window. Sometimes for debugging purposes it is useful to set the detail level to something else by setting the `LogDetail` value in the `Output` key, for example `/Output/LogDetail=Detail`. `Output/File` and `Output/LogDetail` are not, however, volatile registry entries; if you change those values, you need to start IfSearch again.

You will note that it isn't happy because we haven't given it any configuration, such as where to get its input.

```
-16:10:25.165 Input/URL changed to %2
>16:10:25.165 IfSearchSlots 139 Input/URL is empty
-16:10:25.165 Input/Pause changed to false
+16:10:25.166 ---RESUME---
>16:10:25.166 IfSearchSlots 82 Nothing for InputHotdir::cacheFirst()
```

1.3. Making the Registry Volatile

It is handy to be able to change most configuration values on the fly. To have IfSearch recognize the changes, the registry needs to be "volatile." Set the `UpdateMsec` value in the `Options` key to a non-zero number of milliseconds of how often to scan the registry for changed values. For example: `/Options/UpdateMsec=1000` will check for changes ever second; good values range from 500 to 5000.

It may take several seconds for it to acknowledge the change to `UpdateMsec`, but after that it will scan as often as you specified.

```
-16:11:25.186 Options/UpdateMsec changed to 1000
```

1.4. Getting Input

Now that the registry is volatile, we can change values and have IfSearch respond the next time the registry is scanned. Let's tell it where to get input images. We can add an `Input` key to the registry then add a string value for `URL` and set the contents. For example, `/Input/URL=http://demo:demo@192.168.85.90/jpg/image.jpg` will start it grabbing images from an Axis camera.

```
-16:12:04.726 Input/URL changed to http://demo:demo@192.168.85.90/jpg/image.jpg
+16:12:09.231 http://demo:demo@192.168.85.90/jpg/image.jpg Started
+16:12:10.487 ===Processing D20100714-T161210477
-16:12:10.487 ^^^No faces in D20100714-T161210477
+16:12:11.338 ===Processing D20100714-T161211327
-16:12:11.338 ^^^No faces in D20100714-T161211327
+16:12:12.358 ===Processing D20100714-T161212348
-16:12:12.359 ^^^No faces in D20100714-T161212348
+16:12:13.399 ===Processing D20100714-T161213388
-16:12:13.399 ^^^No faces in D20100714-T161213388
+16:12:14.381 ===Processing D20100714-T161214371
-16:12:14.381 ^^^No faces in D20100714-T161214371
+16:12:15.411 ===Processing D20100714-T161215401
-16:12:15.411 ^^^No faces in D20100714-T161215401
+16:12:16.439 ===Processing D20100714-T161216429
-16:12:16.439 ^^^No faces in D20100714-T161216429
+16:12:17.429 ===Processing D20100714-T161217419
-16:12:17.429 ^^^No faces in D20100714-T161217419
+16:12:18.474 ===Processing D20100714-T161218464
-16:12:18.474 ^^^No faces in D20100714-T161218464
```

Sometimes it is handy to be able to pause image input to analyze what is happening. Setting `/Input/Pause=true` will do this.

```
-16:12:18.922 Input/Pause changed to 1
```

Warning

Setting `/Input/Pause=true` will do this. But don't forget to un-pause later (`/Input/Pause=false`), especially if you restart IfSearch with it paused in the registry. I can't count the times I've had the following conversation: "Tony, it's completely broken, I'm getting zero output." "Is it paused?" "Oh, never mind."

1.5. Writing Output

Now that we have input, lets do something with our results. The base output directory defaults to `../Output`; I like to change it slightly while learning and debugging and you can relocate it to a temporary area if you like. Set `Output/BaseDir=../Output/@` or `Output/BaseDir=T:/Temp/INDIout/@`. Once again the at-sign is converted to a date/time stamp, this time for the subdirectory name. This allows you to have the results of recent runs separated and you can delete early unproductive runs. Also, you might want to change `Output/LogFile=./IfSearch.log` to keep the log file with the output directories.

Warning

Remember that changes to `LogFile` and `LogDetail` do not take effect until IfSearch is started again. And lets capture our input frames by setting `Output/CaptureDir=Capture`.

```
-17:20:25.189 Output/BaseDir changed to ../Output/@
-17:20:25.314 AvgFace directory set to [None]
-17:20:25.314 Charcol directory set to [None]
-17:20:25.314 Detect directory set to [None]
-17:20:25.314 Skin directory set to [None]
-17:20:25.314 Enroll directory set to [None]
-17:20:25.314 Generate directory set to [None]
-17:20:25.314 BadFace directory set to [None]
-17:20:25.314 Body directory set to [None]
-17:20:25.314 Capture2 directory set to [None]
-17:20:25.314 Capture directory set to [None]
-17:20:25.314 Clothes directory set to [None]
-17:20:25.314 FaceCache directory set to [None]
-17:20:25.314 Face directory set to [None]
-17:20:25.314 Height directory set to [None]
-17:20:25.314 Image directory set to [None]
-17:20:25.314 Marked directory set to [None]
-17:20:25.314 MarkedFace directory set to [None]
-17:20:25.314 Match directory set to [None]
-17:20:25.314 NoEyes directory set to [None]
-17:20:25.314 NoFace directory set to [None]
-17:20:25.314 NoMatch directory set to [None]
-17:20:25.314 Xml directory set to [None]
-17:20:25.314 ResolveFace directory set to [None]
-17:20:25.314 ResolveMarked directory set to [None]
-17:20:25.314 Retrieve directory set to [None]
-17:20:25.314 Search directory set to [None]
-17:20:31.273 Output/CaptureDir changed to Capture
-17:20:31.476 Capture directory set to D:/SVN2/trunk/IJM/Output/D20100715-T1719/Capture
-17:20:41.416 Input/Pause changed to 0
+17:20:41.416 ---RESUME---
>17:20:41.416 IfSearchSlots 82 Nothing for InputHotdir::cacheFirst()
+17:20:42.182 ===Processing D20100715-T172042166
-17:20:42.182 ^^^No faces in D20100715-T172042166
+17:20:43.012 ===Processing D20100715-T172042996
-17:20:43.012 ^^^No faces in D20100715-T172042996
+17:20:44.044 ===Processing D20100715-T172044029
-17:20:44.044 ^^^No faces in D20100715-T172044029
+17:20:45.061 ===Processing D20100715-T172045046
-17:20:45.061 ^^^No faces in D20100715-T172045046
+17:20:46.063 ===Processing D20100715-T172046047
-17:20:46.063 ^^^No faces in D20100715-T172046047
+17:20:47.080 ===Processing D20100715-T172047064
-17:20:47.080 ^^^No faces in D20100715-T172047064
+17:20:48.112 ===Processing D20100715-T172048097
```

```
-17:20:48.112 ^^^No faces in D20100715-T172048097
+17:20:49.098 ===Processing D20100715-T172049082
-17:20:49.098 ^^^No faces in D20100715-T172049082
+17:20:50.162 ===Processing D20100715-T172050146
-17:20:50.162 ^^^No faces in D20100715-T172050146
+17:20:51.161 ===Processing D20100715-T172051146
-17:20:51.161 ^^^No faces in D20100715-T172051146
-17:20:51.554 Input/Pause changed to 1
```

What did we get? Looking at/Output/Capture, you got images like these two:



So we now have a poor-man's MJPEG capture facility to capture live video from an IP camera to a directory of JPG files. If you were using a hot directory for input, you've just invented the copy command.

2. Finding Faces

2.1. Detecting Possible Faces

The first step in the INDIface process is detection of potential frontal faces in the capture image. We will enable it, but without any other parameters it will accept almost anything as a potential face: Any size, any quality, and any number per frame. Set `/Output/FaceDir=Face`, then create a new IfSearch registry key for Detect if necessary, and set `/Detect/Enable=true`. Now we're detecting potential faces.

```
-17:28:25.833 Output/FaceDir changed to Face
-17:27:31.078 Detect/Enable changed to true
-17:28:25.958 Face directory set to D:/SVN2/trunk/IJM/Output/D20100715-T1719/Face
-17:28:36.987 Input/Pause changed to false
+17:28:36.987 ---RESUME---
>17:28:36.987 IfSearchSlots 82 Nothing for InputHotdir::cacheFirst()
+17:28:37.737 ===Processing D20100715-T172837722
+17:28:37.957 ---75-pixel face at 414, 332 Q94
-17:28:37.957     Good Consistency 0
-17:28:37.989 ^^^Processing complete: D20100715-T172837722
+17:28:38.587 ===Processing D20100715-T172838571
+17:28:39.009 ---130-pixel face at 333, 144 Q985
-17:28:39.009     Good Consistency 0
+17:28:39.148 ---232-pixel face at 451, 202 Q510
-17:28:39.148     Good Consistency 0
+17:28:39.560 ---70-pixel face at 643, 441 Q391
-17:28:39.560     Good Consistency 0
+17:28:39.590 ---78-pixel face at 488, 435 Q354
-17:28:39.590     Good Consistency 0
+17:28:39.631 ---66-pixel face at 216, 134 Q342
-17:28:39.631     Good Consistency 0
+17:28:39.666 ---69-pixel face at 647, 225 Q314
-17:28:39.666     Good Consistency 0
+17:28:39.701 ---154-pixel face at 151, 281 Q300
-17:28:39.701     Good Consistency 0
+17:28:39.895 ---57-pixel face at 244, 72 Q284
-17:28:39.895     Good Consistency 0
+17:28:39.921 ---86-pixel face at 636, 296 Q250
-17:28:39.921     Good Consistency 0
+17:28:39.967 ---89-pixel face at 44, 436 Q212
-17:28:39.967     Good Consistency 0
+17:28:40.009 ---66-pixel face at 322, 332 Q189
-17:28:40.009     Good Consistency 0
+17:28:40.041 ---37-pixel face at 580, 458 Q189
-17:28:40.041     Good Consistency 0
+17:28:40.056 ---134-pixel face at 551, 200 Q164
-17:28:40.056     Good Consistency 0
+17:28:40.223 ---62-pixel face at 500, 404 Q164
-17:28:40.223     Good Consistency 0
+17:28:40.257 ---75-pixel face at 402, 96 Q134
-17:28:40.257     Good Consistency 0
+17:28:40.306 ---69-pixel face at 163, 130 Q134
-17:28:40.306     Good Consistency 0
+17:28:40.345 ---62-pixel face at 82, 84 Q134
-17:28:40.345     Good Consistency 0
+17:28:40.377 ---63-pixel face at 631, 199 Q134
-17:28:40.377     Good Consistency 0
+17:28:40.409 ---59-pixel face at 631, 355 Q134
-17:28:40.409     Good Consistency 0
+17:28:40.432 ---52-pixel face at 661, 355 Q134
-17:28:40.432     Good Consistency 0
+17:28:40.451 ---47-pixel face at 151, 185 Q134
-17:28:40.451     Good Consistency 0
+17:28:40.469 ---35-pixel face at 343, 421 Q134
-17:28:40.469     Good Consistency 0
```

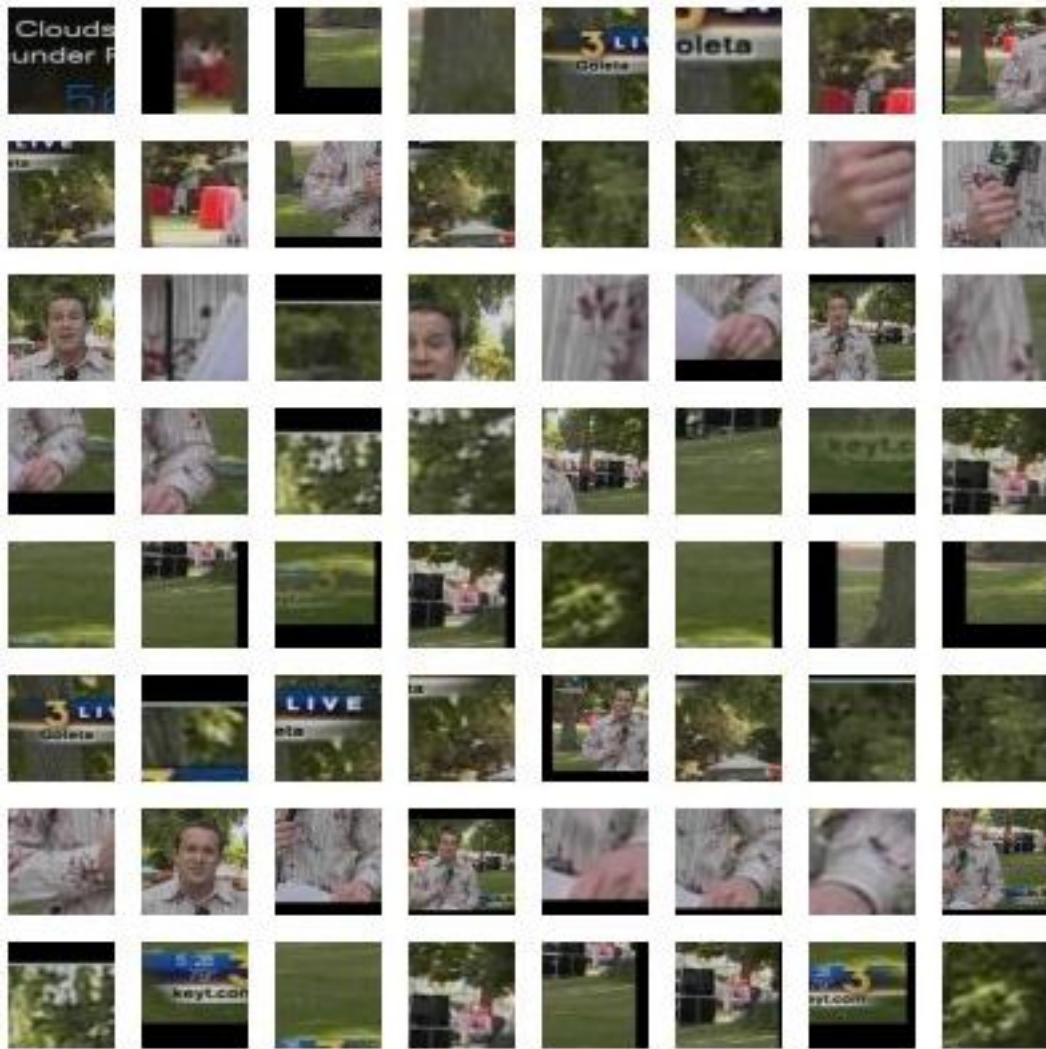
```
+17:28:40.501 ---122-pixel face at 208, 383 Q94
-17:28:40.501   Good Consistency 0
+17:28:40.609 ---57-pixel face at 166, 218 Q94
-17:28:40.609   Good Consistency 0
+17:28:40.637 ---57-pixel face at 442, 446 Q94
-17:28:40.637   Good Consistency 0
+17:28:40.658 ---52-pixel face at 575, 299 Q94
-17:28:40.658   Good Consistency 0
+17:28:40.676 ---43-pixel face at 21, 207 Q94
-17:28:40.676   Good Consistency 0
+17:28:40.688 ---39-pixel face at 347, 29 Q94
-17:28:40.688   Good Consistency 0
+17:28:40.698 ---39-pixel face at 521, 31 Q94
-17:28:40.698   Good Consistency 0
+17:28:40.709 ---39-pixel face at 235, 67 Q94
-17:28:40.709   Good Consistency 0
+17:28:40.722 ---39-pixel face at 79, 307 Q94
-17:28:40.722   Good Consistency 0
+17:28:40.734 ---35-pixel face at 543, 63 Q94
-17:28:40.734   Good Consistency 0
+17:28:40.832 ---35-pixel face at 651, 101 Q94
-17:28:40.833   Good Consistency 0
+17:28:40.842 ---32-pixel face at 107, 99 Q94
-17:28:40.842   Good Consistency 0
+17:28:40.850 ---32-pixel face at 485, 327 Q94
-17:28:40.850   Good Consistency 0
+17:28:40.858 ---32-pixel face at 429, 341 Q94
-17:28:40.858   Good Consistency 0
+17:28:40.866 ---32-pixel face at 315, 363 Q94
-17:28:40.866   Good Consistency 0
-17:28:40.875 ^^^Processing complete: D20100715-T172838571
+17:28:40.888 ===Processing D20100715-T172840501
+17:28:41.321 ---277-pixel face at 421, 228 Q999
-17:28:41.321   Good Consistency 0
+17:28:41.908 ---261-pixel face at 214, 270 Q379
-17:28:41.908   Good Consistency 0
+17:28:42.404 ---88-pixel face at 404, 413 Q284
-17:28:42.404   Good Consistency 0
+17:28:42.462 ---196-pixel face at 482, 305 Q268
-17:28:42.462   Good Consistency 0
+17:28:42.749 ---72-pixel face at 644, 442 Q268
-17:28:42.749   Good Consistency 0
+17:28:42.781 ---66-pixel face at 216, 136 Q268
-17:28:42.781   Good Consistency 0
+17:28:42.839 ---67-pixel face at 641, 233 Q268
-17:28:42.839   Good Consistency 0
+17:28:42.871 ---85-pixel face at 639, 299 Q232
-17:28:42.872   Good Consistency 0
+17:28:42.918 ---122-pixel face at 345, 159 Q212
-17:28:42.918   Good Consistency 0
+17:28:43.040 ---62-pixel face at 84, 82 Q212
-17:28:43.040   Good Consistency 0
+17:28:43.070 ---59-pixel face at 633, 353 Q212
-17:28:43.070   Good Consistency 0
+17:28:43.129 ---40-pixel face at 237, 69 Q212
-17:28:43.129   Good Consistency 0
+17:28:43.144 ---59-pixel face at 581, 449 Q189
-17:28:43.144   Good Consistency 0
+17:28:43.170 ---57-pixel face at 162, 132 Q134
-17:28:43.170   Good Consistency 0
+17:28:43.198 ---54-pixel face at 664, 356 Q134
-17:28:43.198   Good Consistency 0
+17:28:43.217 ---83-pixel face at 51, 435 Q94
-17:28:43.217   Good Consistency 0
+17:28:43.256 ---62-pixel face at 440, 426 Q94
-17:28:43.257   Good Consistency 0
+17:28:43.286 ---57-pixel face at 636, 200 Q94
-17:28:43.286   Good Consistency 0
+17:28:43.311 ---52-pixel face at 145, 87 Q94
-17:28:43.311   Good Consistency 0
```

```
+17:28:43.332 ---52-pixel face at 29, 317 Q94
-17:28:43.332   Good Consistency 0
+17:28:43.372 ---52-pixel face at 247, 389 Q94
-17:28:43.373   Good Consistency 0
+17:28:43.393 ---39-pixel face at 519, 33 Q94
-17:28:43.393   Good Consistency 0
+17:28:43.404 ---35-pixel face at 423, 455 Q94
-17:28:43.404   Good Consistency 0
+17:28:43.413 ---32-pixel face at 103, 25 Q94
-17:28:43.413   Good Consistency 0
+17:28:43.421 ---32-pixel face at 227, 39 Q94
-17:28:43.421   Good Consistency 0
+17:28:43.429 ---32-pixel face at 649, 103 Q94
-17:28:43.430   Good Consistency 0
+17:28:43.438 ---32-pixel face at 471, 431 Q94
-17:28:43.438   Good Consistency 0
-17:28:43.446 ^^^Processing complete: D20100715-T172840501
```

You see that the log reports each possible face noting the width (in pixels) of the detected face, the x- and y-coordinates of the center, and a "Quality" of face detection, ranging here from 999 down to 94.

What did we get in the Face directory? There are a few good faces in there, probably the ones with the 999 quality; but there are some that really only look like a face to a computer.





2.2. Better Faces

Let's only look at fairly good quality possible face detections. Set `/Detect/MinQuality=400` and maybe `/Detect/MaxResults=5` to limit the bad faces.

```
-18:20:02.771 Input/URL changed to http://demo:demo@192.168.85.90/jpg/image.jpg
+18:20:07.624 http://demo:demo@192.168.85.90/jpg/image.jpg Started
-18:20:07.624 Input/Pause changed to 1
-18:20:07.624 Options/Shutdown changed to false
-18:21:49.234 Detect/MinQuality changed to
-18:21:50.248 Detect/MinQuality changed to 0
-18:21:51.262 Detect/MinQuality changed to 400
-18:21:59.374 Detect/MaxResults changed to
-18:22:00.388 Detect/MaxResults changed to 0
-18:22:01.402 Detect/MaxResults changed to
-18:22:02.416 Detect/MaxResults changed to 0
-18:22:03.430 Detect/MaxResults changed to 5
-18:22:20.668 Input/Pause changed to 0
+18:22:20.668 ---RESUME---
>18:23:53.948 IfSearchSlots 82 Nothing for InputHotdir::cacheFirst()
+18:23:55.010 ===Processing D20100715-T182354995
+18:23:55.370 ---169-pixel face at 348, 167 Q994
-18:23:55.370 Good Consistency 0
-18:23:55.531 ^^^Processing complete: D20100715-T182354995
+18:23:55.858 ===Processing D20100715-T182355842
+18:23:56.233 ---155-pixel face at 353, 214 Q999
-18:23:56.233 Good Consistency 0
```

```
-18:23:56.396 ^^^Processing complete: D20100715-T182355842
+18:23:56.878 ===Processing D20100715-T182356862
+18:23:57.331 ---151-pixel face at 348, 198 Q999
-18:23:57.331     Good Consistency 0
-18:23:57.506 ^^^Processing complete: D20100715-T182356862
+18:23:57.911 ===Processing D20100715-T182357895
+18:23:58.426 ---179-pixel face at 323, 225 Q999
-18:23:58.426     Good Consistency 0
-18:23:58.714 ^^^Processing complete: D20100715-T182357895
+18:23:58.895 ===Processing D20100715-T182358879
+18:23:59.442 ---194-pixel face at 362, 202 Q999
-18:23:59.442     Good Consistency 0
-18:23:59.746 ^^^Processing complete: D20100715-T182358879
+18:23:59.927 ===Processing D20100715-T182359911
+18:24:00.427 ---164-pixel face at 363, 195 Q884
-18:24:00.427     Good Consistency 0
-18:24:00.646 ^^^Processing complete: D20100715-T182359911
+18:24:00.953 ===Processing D20100715-T182400938
+18:24:01.422 ---181-pixel face at 360, 176 Q782
-18:24:01.422     Good Consistency 0
+18:24:01.657 ---70-pixel face at 210, 96 Q434
-18:24:01.657     Good Consistency 0
-18:24:01.698 ^^^Processing complete: D20100715-T182400938
+18:24:01.936 ===Processing D20100715-T182401920
+18:24:02.311 ---156-pixel face at 353, 206 Q999
-18:24:02.311     Good Consistency 0
+18:24:02.482 ---76-pixel face at 169, 103 Q444
-18:24:02.483     Good Consistency 0
-18:24:02.523 ^^^Processing complete: D20100715-T182401920
+18:24:02.984 ===Processing D20100715-T182402969
+18:24:03.469 ---158-pixel face at 348, 204 Q999
-18:24:03.469     Good Consistency 0
+18:24:03.679 ---93-pixel face at 608, 184 Q454
-18:24:03.679     Good Consistency 0
-18:24:03.765 ^^^Processing complete: D20100715-T182402969
+18:24:04.017 ===Processing D20100715-T182404002
+18:24:04.440 ---156-pixel face at 353, 211 Q999
-18:24:04.440     Good Consistency 0
+18:24:04.628 ---91-pixel face at 641, 243 Q483
-18:24:04.628     Good Consistency 0
-18:24:04.693 ^^^Processing complete: D20100715-T182404002
+18:24:04.978 ===Processing D20100715-T182404962
+18:24:05.447 ---183-pixel face at 367, 177 Q999
-18:24:05.447     Good Consistency 0
-18:24:05.664 ^^^Processing complete: D20100715-T182404962
+18:24:06.010 ===Processing D20100715-T182405995
+18:24:06.401 ---173-pixel face at 367, 199 Q999
-18:24:06.401     Good Consistency 0
-18:24:06.624 ^^^Processing complete: D20100715-T182405995
+18:24:07.021 ===Processing D20100715-T182407006
-18:24:07.272 ^^^No faces in D20100715-T182407006
+18:24:08.023 ===Processing D20100715-T182408007
-18:24:08.273 ^^^No faces in D20100715-T182408007
+18:24:09.071 ===Processing D20100715-T182409055
-18:24:09.321 ^^^No faces in D20100715-T182409055
+18:24:10.088 ===Processing D20100715-T182410072
-18:24:10.338 ^^^No faces in D20100715-T182410072
+18:24:11.058 ===Processing D20100715-T182411042
-18:24:11.309 ^^^No faces in D20100715-T182411042
+18:24:12.107 ===Processing D20100715-T182412092
-18:24:12.358 ^^^No faces in D20100715-T182412092
+18:24:13.124 ===Processing D20100715-T182413093
-18:24:13.359 ^^^No faces in D20100715-T182413093
+18:24:14.110 ===Processing D20100715-T182414094
-18:24:14.361 ^^^No faces in D20100715-T182414094
```

This time we have a much higher percentage of good versus bad possible face detection.



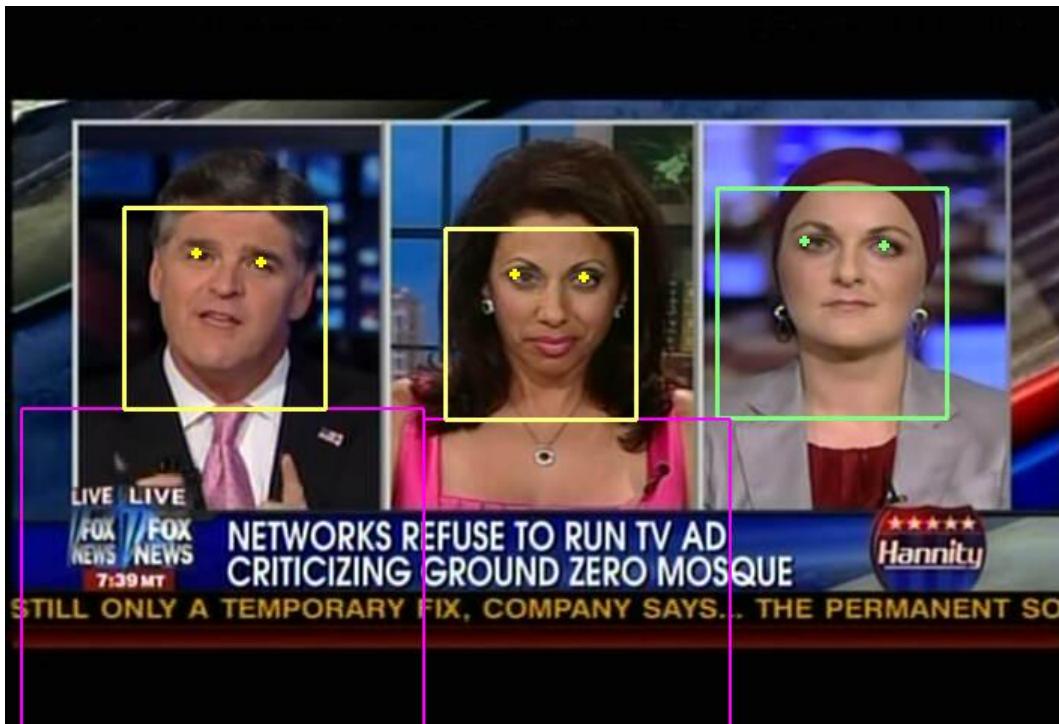
2.3. Faces with Eyes

The next step for INDIface is looking in the area of the detected potential faces and detecting eyes and other features in preparation for INDIface template generation. Lets enable it and set a threshold to separate the "good" eye locations from the bad by `/Generate/Enable=true` and `/Generate/MinConsistency=400`. Also set `/Output/MarkedDir=Marked` so we can separate the good, the bad, and the ugly.

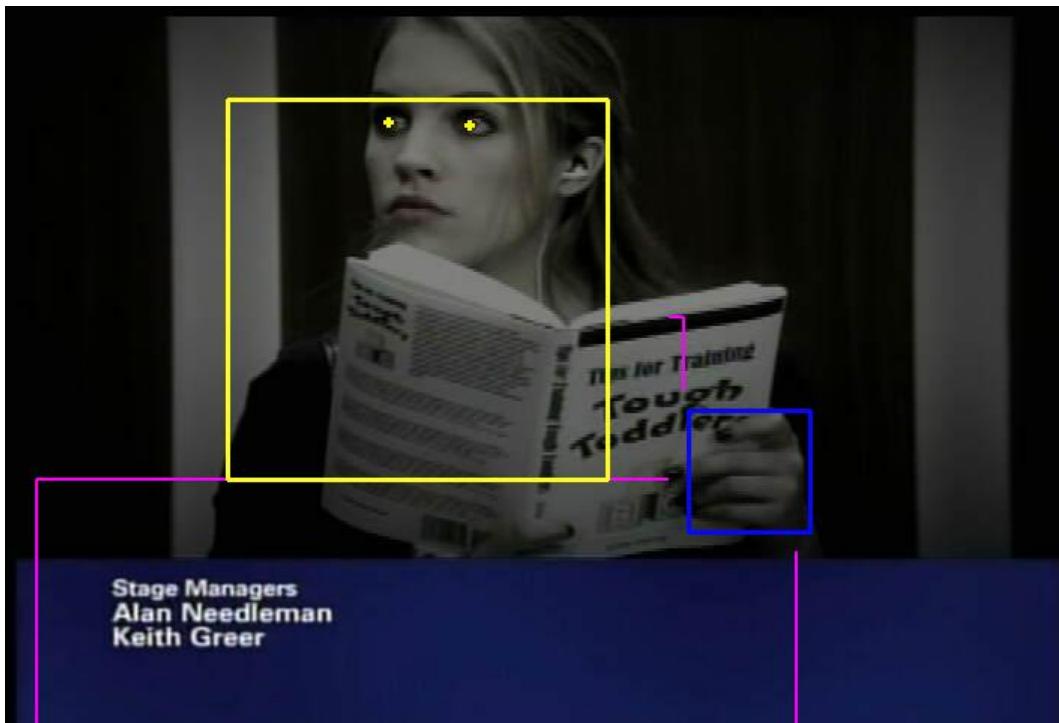
This time we got only "good" faces.



And what of the "marked" image?



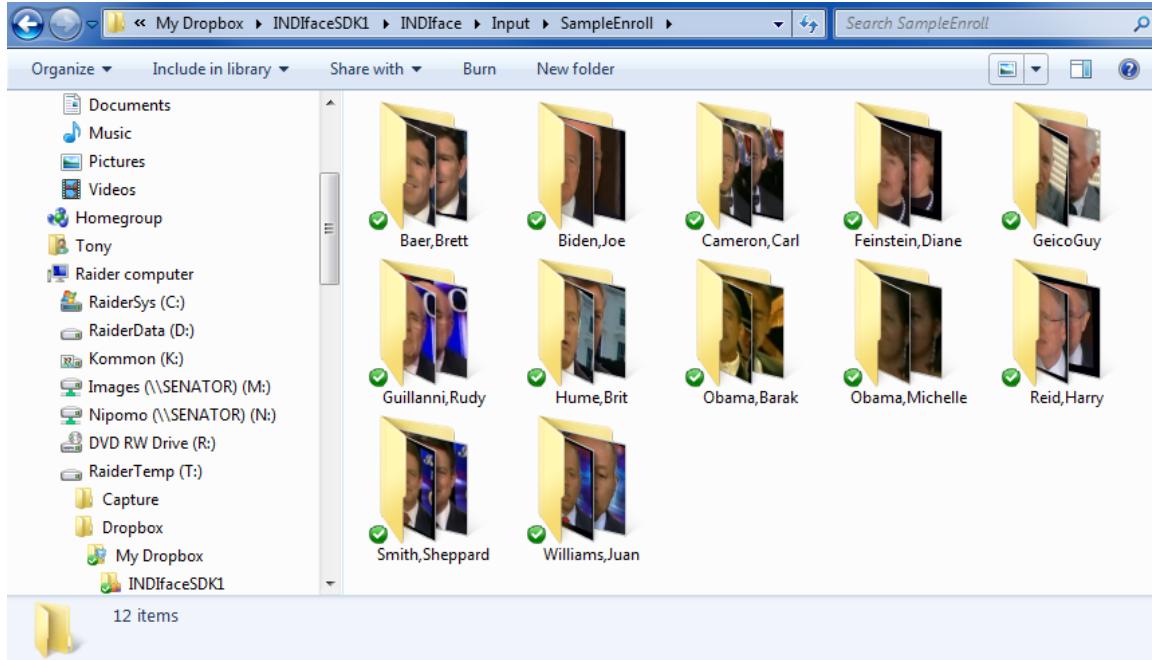
The yellow boxes indicate the potential detected face location with the yellow eyes where we found the eyes; these were considered to be "good" enough faces to generate useful templates. The green boxes and eyes indicate the detected face and eye locations, but they fell (slightly) below the threshold for a good template. If there were potential faces detected (above the /Detect/Quality=400 we set above), they would be indicated with blue boxes, as shown below:



3. Enrolling

3.1. Gathering Faces for Enrollment

The Face output directory contains faces that have been detected, confirmed as reasonably consistent, and had INDIface templates generated for them. (This also applies to the FaceCache and MarkedFace output directories as well). Gather up faces from these sources and separate them by person.



Note

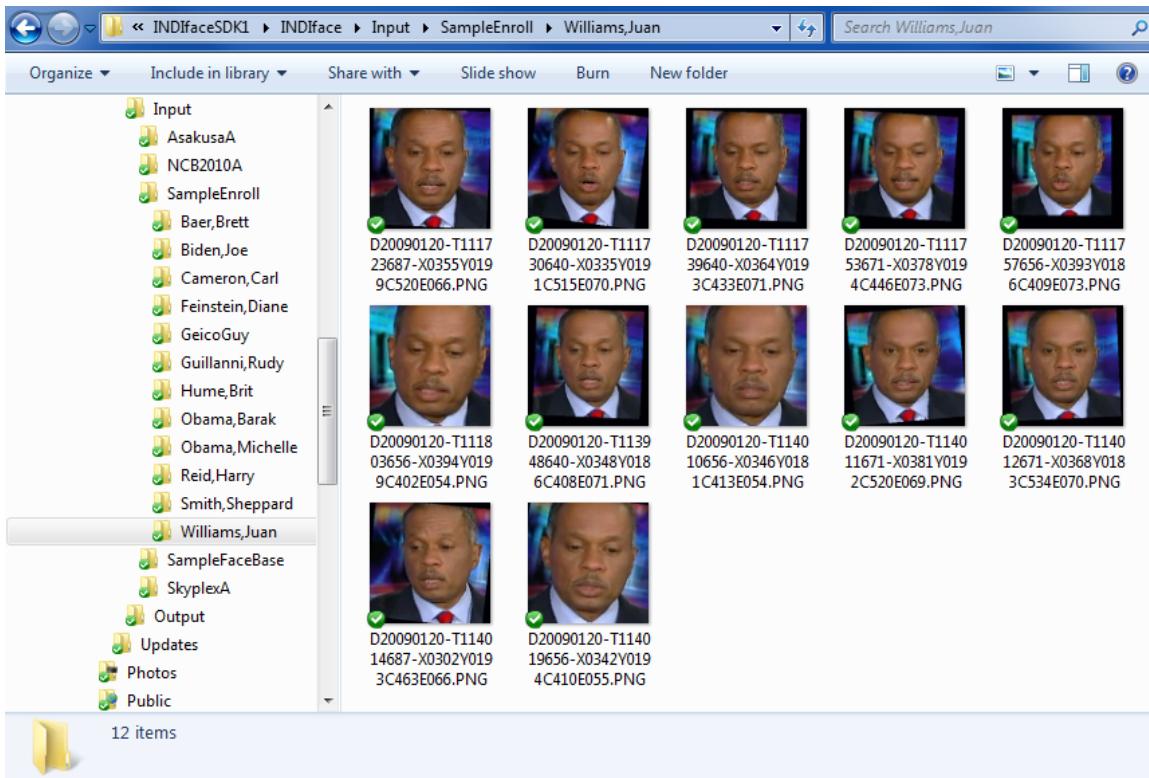
This directory is available in the SDK at `./Sample/Input/SampleEnroll`.

3.2. Enrolling

Set up a temporary enrollment directory and add the following to the current registry key: `Enroll/InputDir=T:/Enroll`.

To enroll each person:

1. Ensure the temporary enrollment directory is empty when you start.
2. Copy five to ten distinctive images for one person to the temporary enrollment directory.



3. Set `Input/Pause=true`; this isn't required, but will give more consistent time performance if you can pause regular input during enrollment.
4. Set `Enroll/PersonId=Williams,Juan` and then set `Enroll/Command=Enroll` to start the enrollment process for Juan Williams.

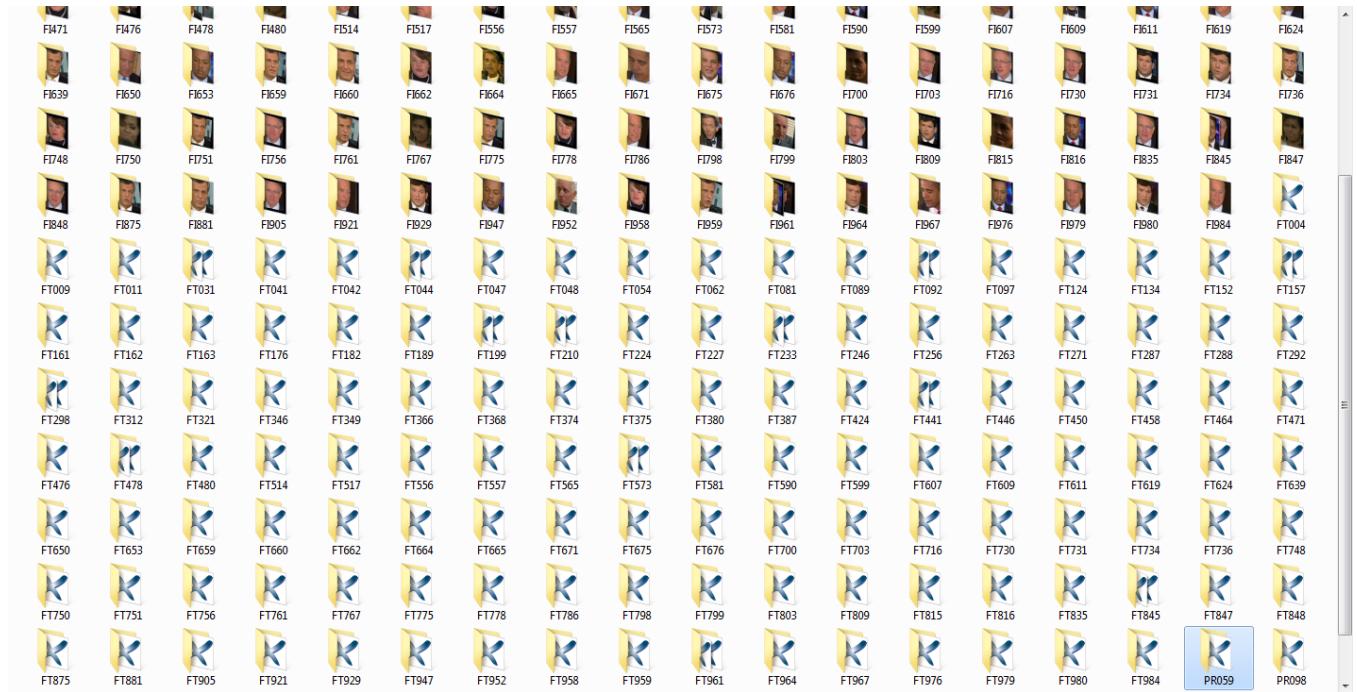
```
-17:52:17.537 Enroll/Command changed to Enroll
+17:52:17.553 [ENROLL] Started
-17:52:17.611 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.643 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.675 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.707 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.755 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.787 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.819 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.851 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.884 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.916 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.948 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
-17:52:17.980 INDI EigenFace enrolled: 1 vector(s) 0 duplicates
+17:52:18.028 [ENROLL] Done - Results:
-17:52:18.028 PersonId=Williams,Juan PersonKey=126628
-17:52:18.028 D20090120-T111723687-X0355Y0199C520E066 enrolled as 126628:321929 Active
-17:52:18.028 D20090120-T111730640-X0335Y0191C515E070 enrolled as 126628:590766 Active
-17:52:18.028 D20090120-T111739640-X0364Y0193C433E071 enrolled as 126628:816254 Active
-17:52:18.028 D20090120-T111753671-X0378Y0194C446E073 enrolled as 126628:961995 Active
-17:52:18.028 D20090120-T111757656-X0393Y0186C409E073 enrolled as 126628:233770 Active
-17:52:18.028 D20090120-T111803656-X0394Y0199C402E054 enrolled as 126628:947711 Active
-17:52:18.030 D20090120-T113948640-X0348Y0186C408E071 enrolled as 126628:349037 Active
-17:52:18.030 D20090120-T114010656-X0346Y0181C413E054 enrolled as 126628:653962 Active
-17:52:18.030 D20090120-T114011671-X0381Y0192C520E069 enrolled as 126628:976974 Active
-17:52:18.030 D20090120-T114012671-X0368Y0183C534E070 enrolled as 126628:44626 Active
-17:52:18.030 D20090120-T114014687-X0302Y0193C463E066 enrolled as 126628:611922 Active
-17:52:18.030 D20090120-T114019656-X0342Y0194C410E055 enrolled as 126628:676765 Active
-17:52:18.560 Enroll/Command changed to
```

5. Wait for `Enroll/Status` to be "Done" or "Error". If "Done", monitor `Enroll/Result` for successful results. If "Error", `Enroll/Reason` will contain the basis of the error. Here is an example of an error, I mistakenly

set Enroll/PersonKey=Williams,Juan and issued an enrollment command. It interpreted PersonKey (which should be numeric) as zero and PersonId was missing. Renaming the PersonKey to PersonId registry value succeeded and generated the results above.

```
-17:49:00.820 Enroll/Command changed to Enroll
+17:49:00.836 [ENROLL] Started
*17:49:00.836 IfSearchEnroll 311 [ENROLL] Error: PersonId must be specified for new person
-17:49:01.835 Enroll/Command changed to
```

Repeat for each person that you wish to enroll. This will fill your INDIBase (by default at .. /FaceBase relative to the directory where **IfSearch** is run, ./INDIFace/FaceBase relative to ./INDIFace/bin) with normalized face image files (FI folders), template XML files (FT folders), and person XML files (PR folders) as well as your internal matcher memory. For basic purposes, the FaceBase directory have no user serviceable parts inside.



Note

This FaceBase data is available in the SDK at `./INDIFace/Input/SampleFaceBase`.

4. Matching

4.1. Casual Matching

Now that we have faces enrolled in an INDIBase, we can have the SDK compare each face found in every frame against all of the enrolled faces in the current INDIBase. This is not the most reliable form for accurate facial recognition, but allows your application to show some eye candy and may provide some useful data. To enable casual matching, set Match/Enable=true, Match/MinConfidence=500, Match/MaxResults=12, Output/ImageDir=Image, and Output/MatchDir=Match. You can point Input/URL to ./Sample/Input/ObamaS-peach and, if you were paused while enrolling, set Input/Pause=false.

In the Image output directory, you will find composite images with the face found in the current frame in the center surrounded by the (up to twelve) best matches starting at the upper left and continuing clockwise. Examples are:

Getting Started



D20090324-T170447234-X0337Y0152C736E054.JPG



D20090324-T170448250-X0296Y0153C739E055.JPG



D20090324-T170450218-X0349Y0149C654E051.JPG



D20090324-T170452250-X0350Y0150C666E053.JPG

In the following image, you will note that the automatic eye detection failed. (The left--as viewed by the camera--eye is on the ear and the right eye is on the left.) So, you will also note that the matching results are less than stellar.



The individual enrolled normalized images of the closest enrolled match for each person matching the face from the current frame are also written to the Match output directory.



In the image above, the highlighted file, D20090324-T1704 52250-X0350Y015 0C666E053-M03.PNG, is the best enrolled match for the face found at 350,150 in the original image captured at 5:04:52.250 PM on March 24, 2009. The following ten files (-R02 to -R11) are the next best matches from the enrollment.

4.1.1. Formal Search

The best results are obtained when you can gather a few faces of the same person for searching against the enrolled FaceBase. Create a temporary directory, place a few faces (gathered from FaceDir, FaceCacheDir, or MarkedFaceDir) in the directory, and set Search/InputDir to point to that directory. You can set parameters such as MaxResults or MinConfidence to limit the results and you can set OutputDir to receive enrolled face results. Then set Search/Command=Search and wait for Search/Status to be "Done" or "Error". Search/Reason will explain an "Error" or Search/Results will contain the results if "Done".

```

-18:23:43.585 Input/Pause changed to 1
-18:26:43.073 Search/OutputDir changed to T:\SearchOutput
-18:26:43.120 Search directory set to T:/SearchOutput
-18:27:46.958 Search/Command changed to Search
+18:27:46.974 [SEARCH] Started for Search
-18:27:47.132 [SEARCH] 44 writes pending
-18:27:47.244 [SEARCH] 41 writes pending
-18:27:47.362 [SEARCH] 34 writes pending
-18:27:47.474 [SEARCH] 31 writes pending
-18:27:47.573 [SEARCH] 25 writes pending
-18:27:47.689 [SEARCH] 19 writes pending
-18:27:47.804 [SEARCH] 13 writes pending
-18:27:47.920 [SEARCH] 7 writes pending
-18:27:48.034 [SEARCH] 1 writes pending
+18:27:48.145 [SEARCH] Done - Results:
-18:27:48.145
-18:27:48.145 D20090119-T200050562-X0169Y0244C583E087.PNG search image Active
-18:27:48.145 D20090119-T200109578-X0234Y0192C573E044.PNG search image Active
-18:27:48.145 D20090119-T200114562-X0269Y0189C623E034.PNG search image Active
-18:27:48.145 D20090119-T200115609-X0386Y0184C680E046.PNG search image Active
-18:27:48.145 D20090119-T200441593-X0284Y0258C506E126.PNG search image Active
-18:27:48.145 10 results
-18:27:48.145 1. 793 316057 Hume,Brit
-18:27:48.145 2. 793 970578 Biden,Joe
-18:27:48.145 3. 789 98797 Obama,Barak
-18:27:48.145 4. 773 707299 Baer,Brett
-18:27:48.145 5. 728 126628 Williams,Juan
-18:27:48.145 6. 710 59290 Obama,Michelle
-18:27:48.145 7. 682 305166 Smith,Sheppard
-18:27:48.145 8. 642 657519 Reid,Harry
-18:27:48.145 9. 593 837859 Giuliani,Rudy
-18:27:48.145 10. 548 170123 GeicoGuy
-18:27:48.988 Search/Command changed to

```

The "Verify" and "VerifyList" (future) commands can be used to limit the results to one person or a handful of enrolled persons of interest.

4.2. Formal Search

The best results are obtained when you can gather a few faces of the same person for searching against the enrolled FaceBase. Create a temporary directory, place a few faces (gathered from FaceDir, FaceCacheDir, or MarkedFaceDir) in the directory, and set Search/InputDir to point to that directory. You can set parameters such as MaxResults or MinConfidence to limit the results and you can set OutputDir to receive enrolled face results. Then set Search/Command=Search and wait for Search/Status to be "Done" or "Error". Search/Reason will explain an "Error" or Search/Results will contain the results if "Done".

```
-18:23:43.585 Input/Pause changed to 1
-18:26:43.073 Search/OutputDir changed to T:\SearchOutput
-18:26:43.120 Search directory set to T:/SearchOutput
-18:27:46.958 Search/Command changed to Search
+18:27:46.974 [SEARCH] Started for Search
-18:27:47.132 [SEARCH] 44 writes pending
-18:27:47.244 [SEARCH] 41 writes pending
-18:27:47.362 [SEARCH] 34 writes pending
-18:27:47.474 [SEARCH] 31 writes pending
-18:27:47.573 [SEARCH] 25 writes pending
-18:27:47.689 [SEARCH] 19 writes pending
-18:27:47.804 [SEARCH] 13 writes pending
-18:27:47.920 [SEARCH] 7 writes pending
-18:27:48.034 [SEARCH] 1 writes pending
+18:27:48.145 [SEARCH] Done - Results:
-18:27:48.145
-18:27:48.145 D20090119-T200050562-X0169Y0244C583E087.PNG search image Active
-18:27:48.145 D20090119-T200109578-X0234Y0192C573E044.PNG search image Active
-18:27:48.145 D20090119-T200114562-X0269Y0189C623E034.PNG search image Active
-18:27:48.145 D20090119-T200115609-X0386Y0184C680E046.PNG search image Active
-18:27:48.145 D20090119-T200441593-X0284Y0258C506E126.PNG search image Active
-18:27:48.145 10 results
-18:27:48.145 1. 793 316057 Hume,Brit
-18:27:48.145 2. 793 970578 Biden,Joe
-18:27:48.145 3. 789 98797 Obama,Barak
-18:27:48.145 4. 773 707299 Baer,Brett
-18:27:48.145 5. 728 126628 Williams,Juan
-18:27:48.145 6. 710 59290 Obama,Michelle
-18:27:48.145 7. 682 305166 Smith,Sheppard
-18:27:48.145 8. 642 657519 Reid,Harry
-18:27:48.145 9. 593 837859 Guilianni,Rudy
-18:27:48.145 10. 548 170123 GeicoGuy
-18:27:48.988 Search/Command changed to
```

The "Verify" and "VerifyList" (future) commands can be used to limit the results to one person or a handful of enrolled persons of interest.

5. Managing

5.1. INDIbase Retrieval

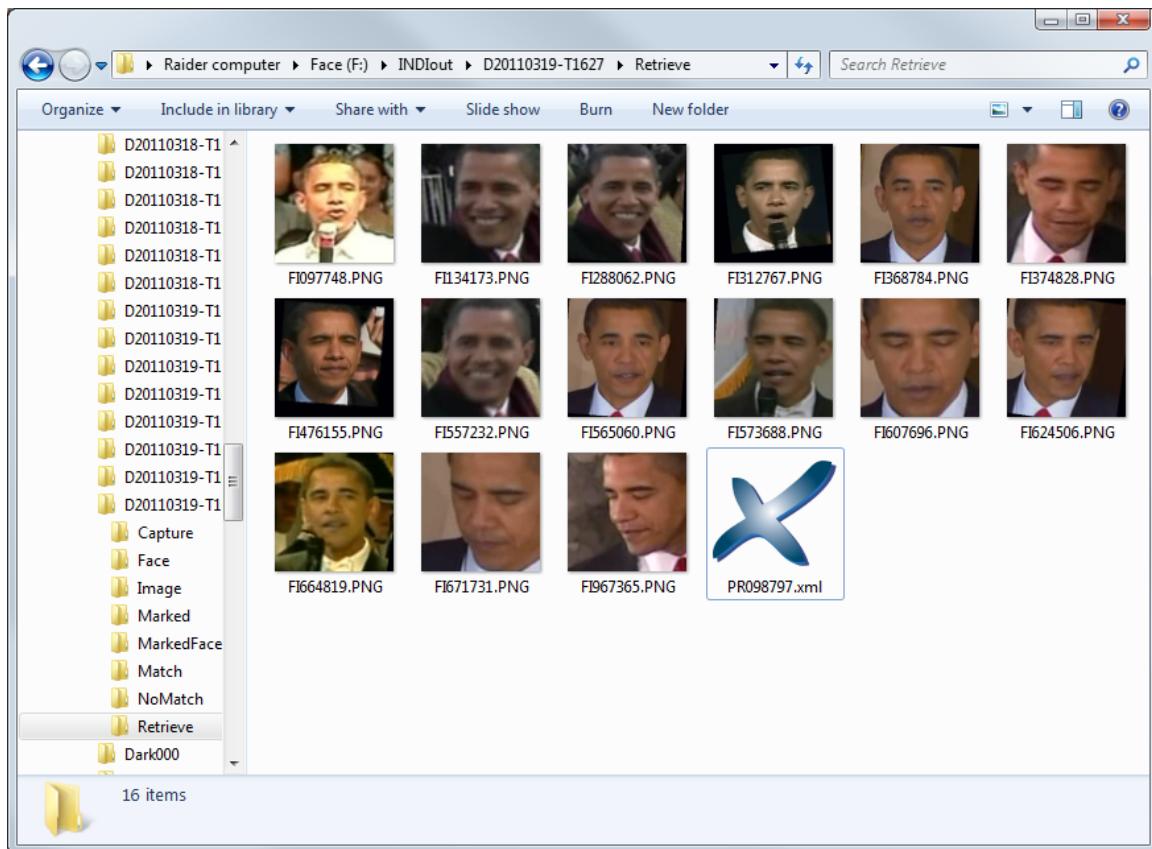
To retrieve enrollments from the FaceBase, use the Retrieve commands. If you want the images and Person XML files, set Retrieve/OutputDir (to F:/INDIout/@/Retrieve in this example). Set Retrieve/PersonId (to "Obama,Barak" in this example) and set Retrieve/Command=Retrieve. Wait for Retrieve/Status to be either "Done", "Error", or "NotFound". If "Done", you will find the results in Retrieve/Results and, if set, files in the retrieve directory. If "Error", the reason will be in Retrieve/Reason.

```
-16:33:08.885 Retrieve/Command changed to Retrieve
+16:33:08.895 [RETRIEVE] Started
-16:33:08.984 [RETRIEVE] 16 writes pending
-16:33:09.085 [RETRIEVE] 16 writes pending
-16:33:09.197 [RETRIEVE] 16 writes pending
-16:33:09.308 [RETRIEVE] 16 writes pending
```

```

.16:33:09.351 IfSearchSlots 36 0 grabs in cache
~16:33:09.355 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/PR098797.xml written
.16:33:09.355 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/PR098797.xml
~16:33:09.460 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI097748.PNG written
.16:33:09.460 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI097748.PNG
-16:33:09.462 [RETRIEVE] 14 writes pending
~16:33:09.534 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI134173.PNG written
.16:33:09.535 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI134173.PNG
-16:33:09.570 [RETRIEVE] 13 writes pending
~16:33:09.593 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI288062.PNG written
.16:33:09.593 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI288062.PNG
.16:33:09.594 ImageSource 240 Paused
~16:33:09.661 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI312767.PNG written
.16:33:09.662 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI312767.PNG
-16:33:09.679 [RETRIEVE] 11 writes pending
~16:33:09.741 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI368784.PNG written
.16:33:09.741 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI368784.PNG
-16:33:09.788 [RETRIEVE] 10 writes pending
~16:33:09.807 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI374828.PNG written
.16:33:09.807 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI374828.PNG
.16:33:09.850 ImageSource 240 Paused
~16:33:09.882 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI476155.PNG written
.16:33:09.882 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI476155.PNG
.16:33:09.883 IfSearchSlots 36 0 grabs in cache
-16:33:09.897 [RETRIEVE] 8 writes pending
~16:33:09.961 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI557232.PNG written
.16:33:09.961 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI557232.PNG
-16:33:10.011 [RETRIEVE] 7 writes pending
~16:33:10.034 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI565060.PNG written
.16:33:10.034 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI565060.PNG
~16:33:10.088 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI573688.PNG written
.16:33:10.088 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI573688.PNG
-16:33:10.115 [RETRIEVE] 5 writes pending
.16:33:10.115 ImageSource 240 Paused
~16:33:10.148 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI607696.PNG written
.16:33:10.148 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI607696.PNG
~16:33:10.224 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI624506.PNG written
.16:33:10.224 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI624506.PNG
-16:33:10.225 [RETRIEVE] 3 writes pending
~16:33:10.291 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI664819.PNG written
.16:33:10.291 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI664819.PNG
-16:33:10.334 [RETRIEVE] 2 writes pending
~16:33:10.356 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI671731.PNG written
.16:33:10.356 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI671731.PNG
~16:33:10.414 FileWriter 458 Retrieve file: F:/INDIout/D20110319-T1627/Retrieve/FI967365.PNG written
.16:33:10.414 IfSearchSlots 109 Wrote F:/INDIout/D20110319-T1627/Retrieve/FI967365.PNG
+16:33:10.445 [RETRIEVE] Done - Results:
-16:33:10.445 Person: 98797=Obama,Barak
-16:33:10.445 Face: 54224=D20090120-T115145671-X0275Y0145C563E035 {Deleted}
-16:33:10.445 Face: 97748=D20090120-T132402781-X0439Y0104C413E036 {Active}
-16:33:10.445 Face: 134173=D20090120-T130606078-X0207Y0177C513E029 {Active}
-16:33:10.445 Face: 288062=D20090120-T130555078-X0352Y0183C510E044 {Active}
-16:33:10.445 Face: 312767=D20090120-T202239906-X0333Y0217C581E068 {Active}
-16:33:10.445 Face: 368784=D20090120-T115637640-X0364Y0170C701E057 {Active}
-16:33:10.445 Face: 374828=D20090120-T115109671-X0256Y0155C685E032 {Active}
-16:33:10.445 Face: 476155=D20090120-T203144906-X0409Y0185C421E064 {Active}
-16:33:10.448 Face: 557232=D20090120-T130557062-X0334Y0186C720E039 {Active}
-16:33:10.448 Face: 565060=D20090120-T115213640-X0370Y0156C732E051 {Active}
-16:33:10.448 Face: 573688=D20090120-T203701937-X0312Y0137C520E043 {Active}
-16:33:10.448 Face: 607696=D20090120-T115215671-X0359Y0167C655E037 {Active}
-16:33:10.448 Face: 624506=D20090120-T115231656-X0385Y0170C634E051 {Active}
-16:33:10.448 Face: 664819=D20090120-T204523906-X0313Y0122C576E036 {Active}
-16:33:10.448 Face: 671731=D20090120-T115154687-X0313Y0189C562E032 {Active}
-16:33:10.448 Face: 967365=D20090120-T115108640-X0231Y0154C462E030 {Active}

```



```
<!DOCTYPE INDIface-Person> <PersonRecord Active="1" PersonKey="98797"> <Id>Obama,Barak</Id> </PersonRecord>
```

5.2. Enrollment Management

To delete a face from active matching, you can use the "Delete" command for enrollment. Set `Enroll/PersonId` (to "Obama,Barak" in this example) for faces that were enrolled to a person and `Enroll/FaceId` (to "D20090120-T115145671-X0275Y0145C563E035" in this example) and then set `Enroll/Command=Delete`. Wait for `Status` to be "Done" or "Error" and check either `Enroll/Results` or `Enroll/Reason`.

```
-15:58:52.306 Enroll/Command changed to Delete
+15:58:52.316 [ENROLL] Started for Delete Face
~15:58:52.319 EigenFaceFace 112 Face written: D:/SVN2/trunk/EclipseIR/FaceBase/FT054/FT054224.xml
+15:58:52.331 [ENROLL] Done - Results:
-15:58:52.331 Deleted FaceKey=54224 FaceId=D20090120-T115145671-X0275Y0145C563E035 PersonKey=98797 Person
```

You also have the option to remove all face enrollments for a person with the "Remove" command or set a new `PersonId` with the "Rename" command. The "RemoveAll" command can be used to erase a FaceBase.

Chapter 4. Control Parameter Reference

There are over 140 control parameters that you can use to tailor the SDK's actions. The control variables are broken into sections that correspond to their key in the registry (or section of an XML configuration file in the future).

Clothes	Clothes color matching
Detect	Face detection
FaceBase	Enrolled person records, face templates, and face images.
FaceColor	Face skin tone detection
Generate	Template generation
Height	Approximate height detection
Input	Image acquisition
Mark	Image marking colors and attributes
Match	Informal matching
Options	Operation of the SDK executable itself
Output	Location of output files and method of marking marked files
PreProcess	Transformation
Resolve	Controls for combining the face-based analytics.

Note

The Enroll, Retrieve, and Search keys in the registry will be discussed in the next chapter.

1. Command Line

When we utilize the Windows registry, controls are placed in the HKCU/Software section of the registry under `OrgName` and `AppName` keys. The default is `HKCU\Software\EclipseIR\IfSearch` but it can be specified on the command line as `%OrgName/AppName` or `%AppName`. Control parameters can be specified on the command line, and will override what is read from the registry, in the form `/Key/Name=Value`. Examples include `/Input/URL=http://demo:demo@192.168.1.90/jpg/image.jpg` to specify a different camera or `/FaceBase/BaseDir=W:/herever/else` could be used to load a different INDIBase for matching.

2. Control Types

The controls are strings (URLs, directory names, file names, etc.), numbers, booleans, or colors. All can be in REG_SZ format in the Windows registry. Integer numbers can be in REG_DWORD format.

2.1. Specifying Directories

All input or output directories can be specified in absolute (starting from the root) or relative (from a base directory) terms. The Output/BaseDir control parameter can be used to specify a the base directory upon which all other input or output directories can be specified in relative terms. In addition, it can be relative to the current directory at the time that the SDK console was started. An at sign (@) can be specified anywhere in the directory name and it will be replaced by the time stamp of when the console was started in "Dyymmdd-Thhmm" format.

Note

Multiple output directories for the same class of files can be specified, delimited with a semicolon.

2.2. Specifying Colors

Colors can be specified in three ways.

- A blank entry (value name present, but empty data in the registry) will be interpreted as an "empty" color which will disable the particular function.
- A string value in the form #RRGGBB to specify RR as two hex digits for red, GG for green, and BB for blue. The hash sign is required.
- A string value with a named SVG color, such as "black" "salmon" or "blanchedalmond". See the W3 SVG standard for a list of named colors.

Note

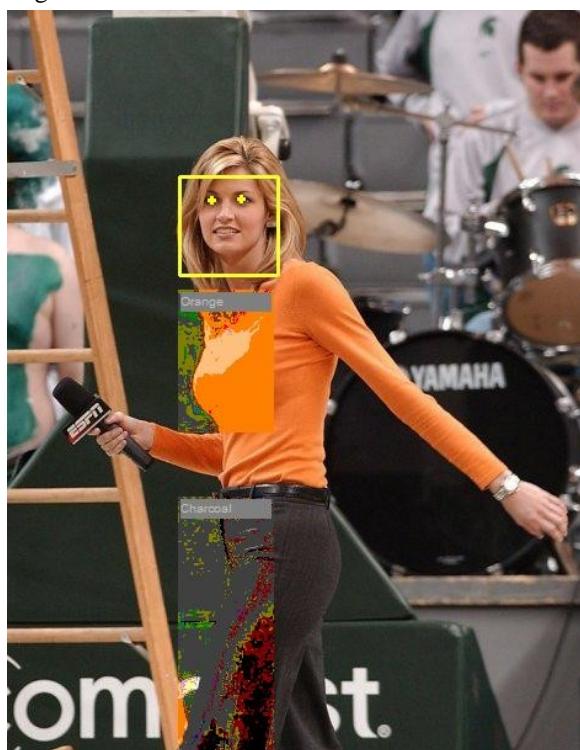
If an entry is missing (not present at all in the registry), then the default specified for the control below is used. If no default is specified then that item would be disabled.

2.3. Specifying Booleans

Boolean values can be specified as REG_SZs with "true" or "1" versus "false" or "0". They can also be specified as REG_DWORDs with value zero or one. Other combinations may work, but have not been tested.

3. Clothes Color Controls

If clothes color testing is enabled, once the eyes have been located and confirmed to match a reasonable face template, the location in the input image of the upper and lower parts of the body are estimated. The predominate characteristic color is then collected from both of those areas to the extent they are present in the input image. A confidence value is calculated for each area based upon the preponderance of pixels that are near the specified target colors.



The shoulder, waist, and ankle controls are used to estimate the vertical boundaries of the upper and lower body rectangles. The width control provides the horizontal size of those rectangles. These values are basically in number of millimeters below the center of the face (nose tip). The UnderCrop control is used to determine how far inside the upper/lower body rectangles is sampled for characteristic color.

The calling application provides a target color and minimum confidence level for either or both upper and lower clothes. If the colors match above the specified confidence levels, it is considered a match and an input image with the face marked is written to the Clothes output directory.

Note

If both upper and lower confidence values are specified, both have to be present in the input image for a match to be declared.

The following images show the matches at 900, 800, and 700 to the background color of the image.

Figure 4.1. Pink 900 Confidence



Figure 4.2. Pink 800 Confidence

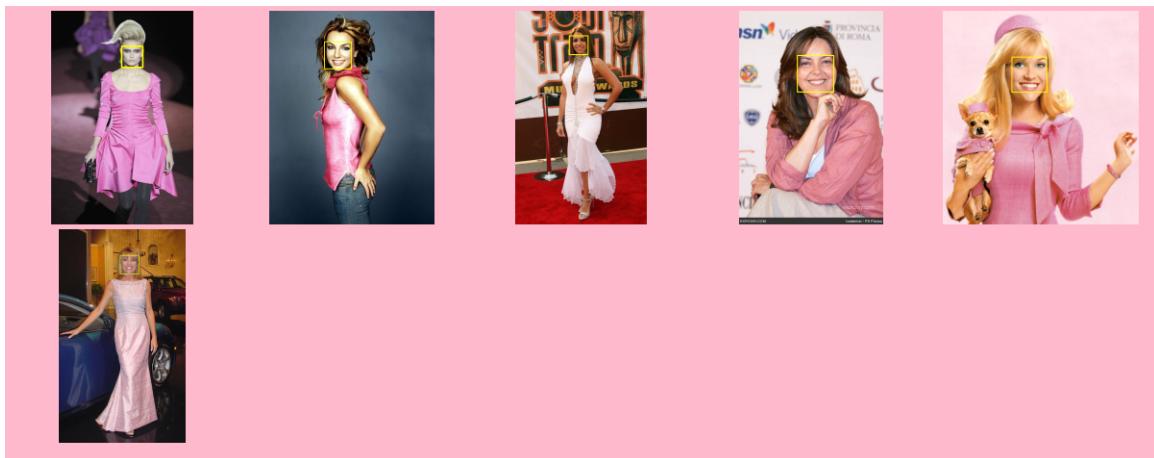


Figure 4.3. Pink 700 Confidence

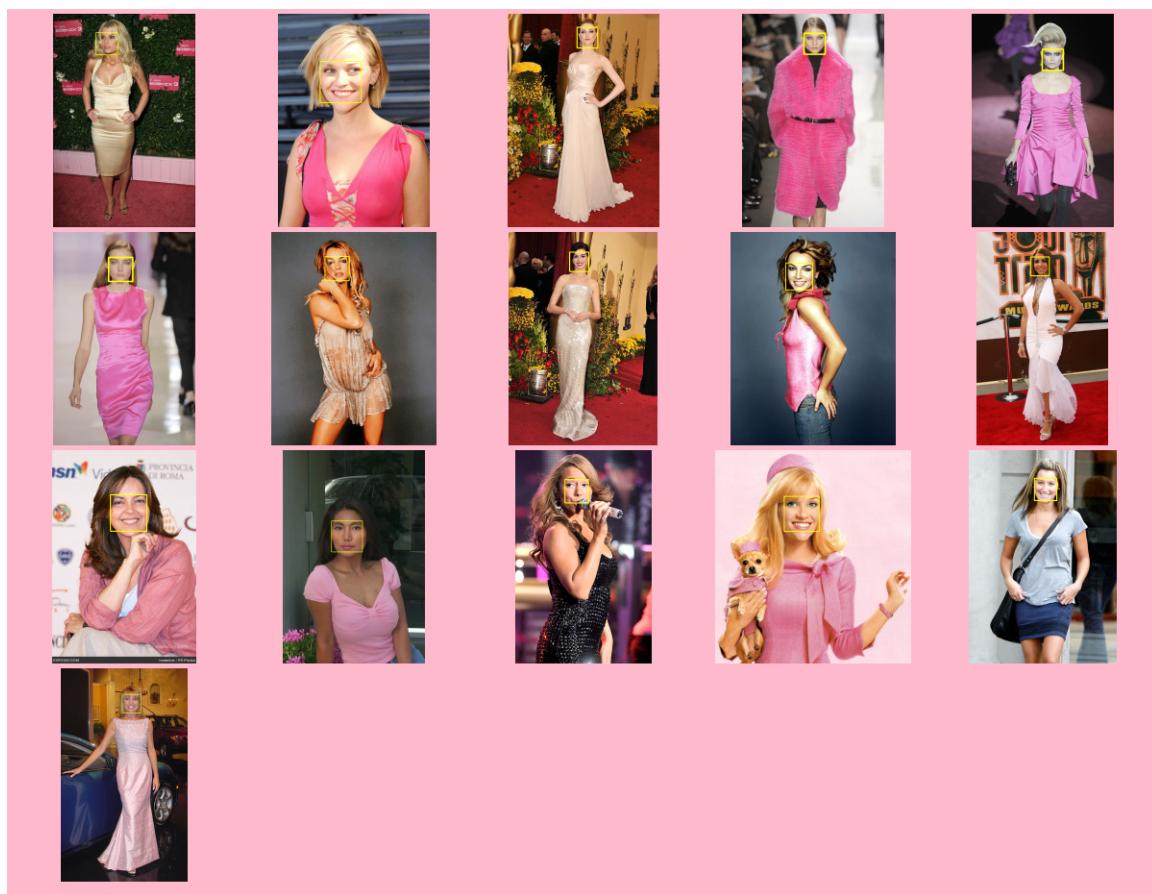


Figure 4.4. Navy 700 Confidence

3.1. Ankle

The approximate distance below the center of the detected face for the lower boundary of the lower clothes color sampling in millimeters.

Special Value: 0 translates to 1536.

Default: 0 (translates to 1536mm or approximately 5 feet).

3.2. Enable

Set to true to enable upper or lower clothes color detection.

Default: false (disabled).

3.3. LowerColor

The target color for the lower clothes color. See also Specifying Colors above.

Default: none (Upper clothes color is not tested for match.)

3.4. LowerConfidence

The minimum confidence level accepted for a match of the detected lower clothes color to the specified target from 1 to 999.

Default: 0 (Lower clothes color is not tested for match.)

3.5. Shoulder

The approximate distance below the center of the detected face for the upper boundary of the upper clothes color sampling in millimeters.

Special Value: 0 translates to 128.

Default: 0 (translates to 128mm or approximately 5 inches).

3.6. UnderCrop

The percentage that the rectangles determined by Ankle, Waist, Shoulder, and Width will be reduced for characteristic color sampling.

Special Value: 0 translates to 80.

Default: 0 (translates to 80%).

3.7. UpperColor

The target color for the lower clothes color. See also Specifying Colors above.

Default: none (Upper clothes color is not tested for match.)

3.8. UpperConfidence

The minimum confidence level accepted for a match of the detected upper clothes color to the specified target from 1 to 999.

Default: 0 (Upper clothes color is not tested for match.)

3.9. Waist

The approximate distance below the center of the detected face for the boundary between the upper and lower clothes color sampling in millimeters.

Special Value: 0 translates to 512.

Default: 0 (translates to 512mm or approximately 20 inches).

3.10. Width

The approximate width of the upper and lower clothes color sampling area in millimeters.

Special Value: 0 translates to 256.

Default: 0 (translates to 256).

4. Detect Controls

The `MinAcross`, `MaxAcross`, and `Factor` controls affect how the raw detectors are generated and are interpreted. `MinAcross` and `MaxAcross` are the inverse of `MaxPixels` and `MinPixels` and are scaled by the width of the image.

They basically specify the minimum and maximum number of people shoulder to shoulder expected in a frame. At default (`MinAcross=0` and `MaxAcross=0`), the raw detectors can range from their base size (typically 20x20 to 32x32 pixels) up to the size of the entire frame. In this case, they may detect many false positives: undersize, oversize, or both.

Figure 4.5. Detect: MinAcross=0 MaxAcross=0



Pretending that this is a camera watching an entrance and we expect that people generally are walking in at six abreast, we can set `MaxAcross=8` just to be safe. Doing that eliminates the many tiny false positive detections.

Note

This also saves CPU resources by starting the raw detectors at an appropriate size.

Figure 4.6. Detect: MinAcross=0, MaxAcross=8



Now, we can eliminate the two very oversize detections by setting `MinAcross=4`.

Figure 4.7. Detect: MinAcross=4, MaxAcross=8



The detectors are appropriately sized now, so we are not using excessive CPU. We can afford to increase the Factor from the default 10 to 5 and get back the missing face.

Figure 4.8. Detect: MinAcross=4, MaxAcross=8, Factor=5

4.1. CharcolDir

Enabling this directory will output a diagnostic image of the entire input frame converted to characteristic colors that are used for clothes detection. See also Specifying Directories.

Default: blank (output disabled)

4.2. DetectorsXml

This specifies the location of the XML file that identifies and locates the various object detectors.

Warning

This is not a volatile value: It is used at startup and changes are ignored.

Default: ../Detectors/Detectors.XML

4.3. Enable

Set this value to true to enable frontal face detection. If disabled, the SDK will assume that the entire input frame contains a face using `InputOverCrop` to scale the detected face.

Default: false

4.4. Factor

Specifies the factor by which raw detectors width are increased in each pass over the input image; this value divided by 100 is added to 1.0. Smaller numbers yield greater accuracy at the cost of more processing time. Larger

numbers yield faster processing with the greater possibility of false positive and false negative detections. Typical values are 0.5 (1.005) to 20 (1.20).

Figure 4.9. Detect/Factor default (10)

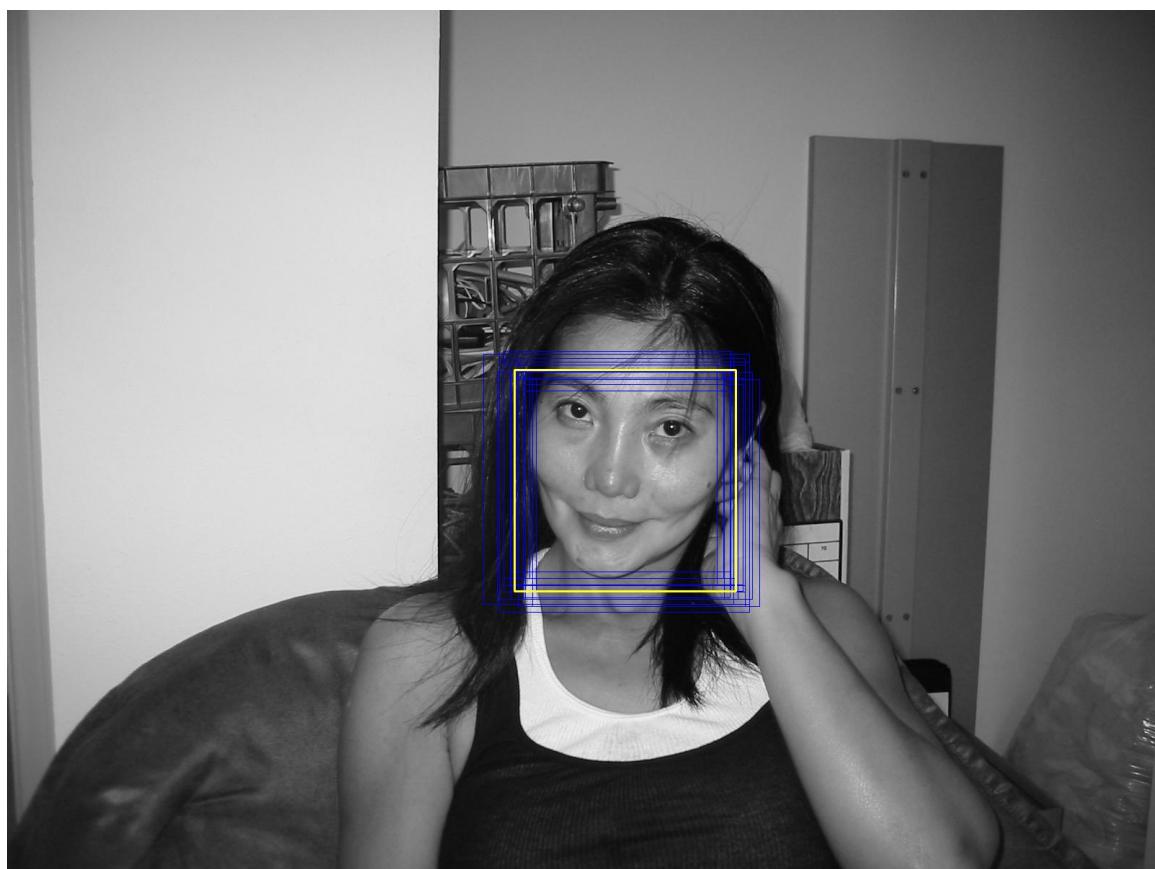


Figure 4.10. Detect/Factor=5 (denser)

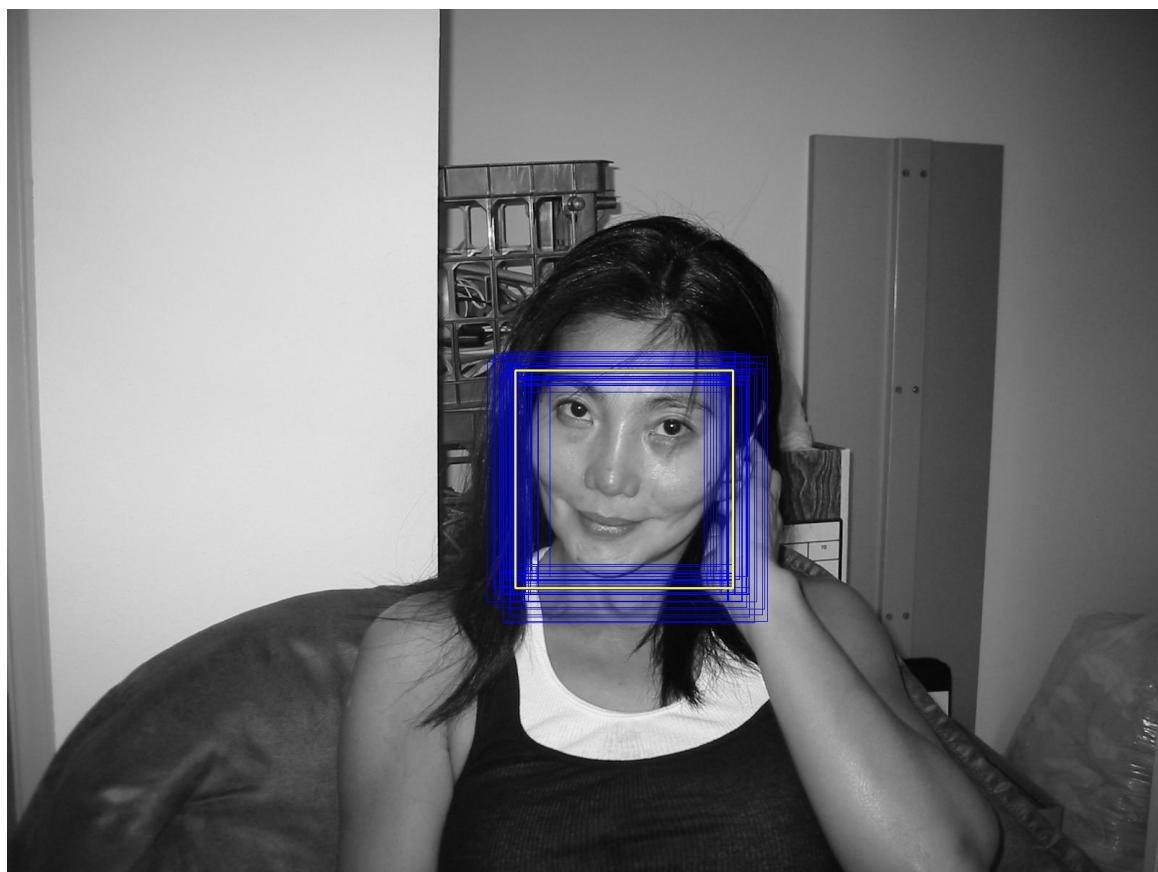
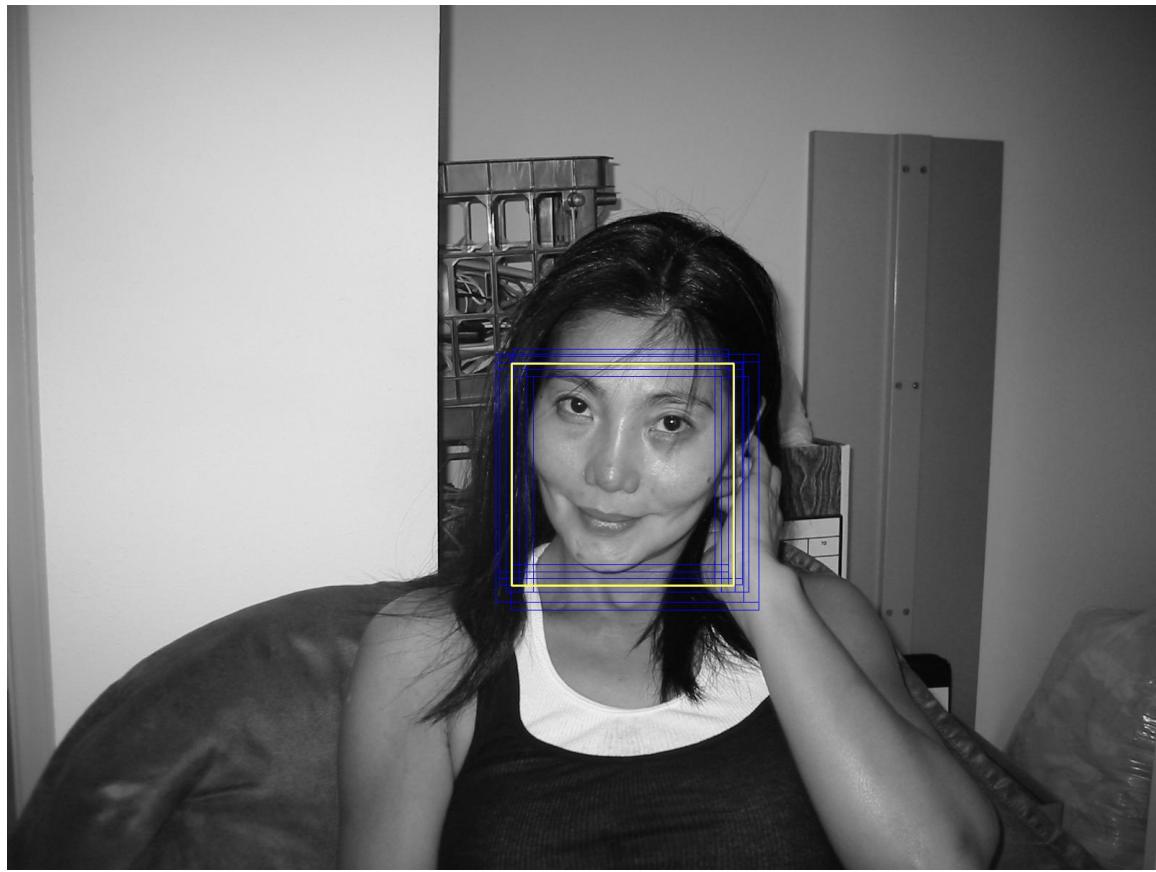


Figure 4.11. Detect/Factor=15 (sparser)

Special value: 0.0 translates to 10.0 (1.10).

Default: 0.0 (1.10).

4.5. ForceFind

Deprecated. Will be removed in future versions.

4.6. GroupMethod

Specifies how raw face detectors will be grouped to identify a possible face. Set to one of the follow values (or leave it zero):

1. GroupByCenters
2. GroupByOverlap
3. GroupByNeighbors
4. GroupInternal
5. GroupInternalAllObjects

Default: zero (let the engine decide)

4.7. GroupThreshold

Future: Controls the detection threshold for GroupMethod=4 (GroupInternal) or 5 (GroupInternalAllObjects)

4.8. InputOverCrop

This value is used when `Detect/Enable=false`. In the case when processing a set of images where face detection has already taken place. This value should match `Output/MarkOverCrop` when the previous face detection was processed.

Default: zero

4.9. Interface

Internal control. Leave at the default (zero) unless directed by an EIRC representative.

4.10. MaxAcross

The maximum number of people expected in a video frame standing shoulder to shoulder. The minimum detector size is calculated from this value.

Special value: zero uses the minimum detector size available.

Default: zero

4.11. MaxPixels

The maximum size of the detector in pixels.

Special value: zero allows the detector to grow to the smallest dimension of the input frame.

Default: zero

4.12. MaxResults

The maximum number of potential face detections per frame.

Default: zero (no limit)

4.13. MinAcross

The minimum number of people expected in a video frame standing shoulder to shoulder. The maximum detector size is calculated from this value.

Default: zero (no `MaxPixels`)

4.14. MinPixels

The minimum size of the detector.

Default: zero (use the smallest detector available)

4.15. MinQuality

Sets the minimum quality of face detection that will be allowed on a scale from 1 to 999.

Default: zero

4.16. NeighborThreshold

Future: Controls the detection threshold for GroupMethod=3 (GroupByNeighbors)

4.17. OverlapThreshold

Future: Controls the detection threshold for GroupMethod=2 (GroupByOverlap)

4.18. SkinDir

Enabling this directory will output a diagnostic image of the entire input frame masked to show only detected skin areas. See also Specifying Directories below.

Default: empty (output disabled)

5. FaceBase controls

5.1. BaseDir

Specifies the base directory for a file-based INDIbase storage of faces, templates, images, and person records. No user serviceable parts inside.

Default: ../FaceBase

5.2. MaxLoad

Limits the number of enrollments that are loaded in memory.

Tip

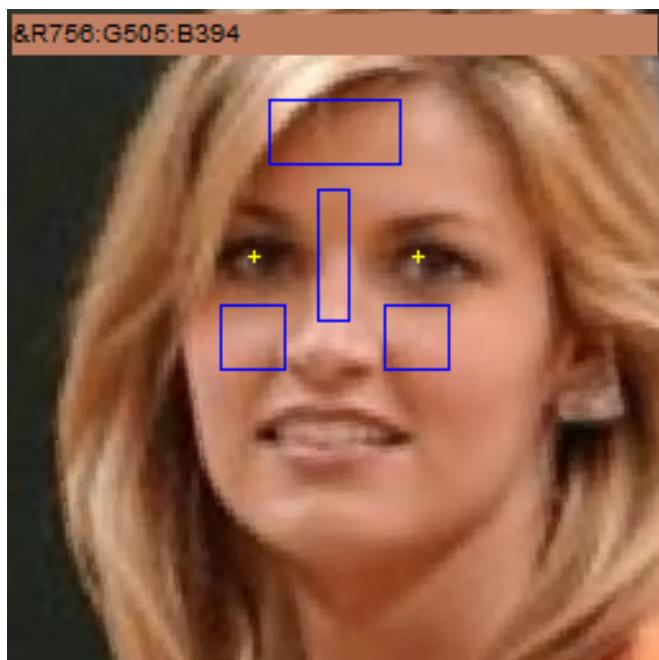
This is typically only used while debugging and developing to reduce facial database load time.

Special Value: 0 (no limit)

Default: 0 (no limit)

6. FaceColor Controls

If enabled, the skin tone of the cheeks, nose, and forehead are collected.



An application can then specify one or more named skin colors (such as "African" "Asian" "Anglo") to be compared with the detected data. The named color becomes a key in the `FaceColor` section of the registry. Within each of those keys, a `TargetColor`, a `MinConfidence` value, and an `OutputDir` are expected.

When a face is detected and a consistent template can be generated, the collected skin tone color is compared against each of the specified target colors. If any of the matches are above the individual specified minimum confidence levels, the normalized face image is written to the output directory of the closest matching color.

6.1. Enable

Set to true to enable face color detection.

Default: false (disabled).

6.2. MinConfidence

The minimum confidence level from 1 to 999 that will allow that color to be considered the best match.

Default: zero (any confidence will be considered)

6.3. OutputDir

The directory where the normalized face image will be written if this named color is considered the best match.

Default: none (nothing written)

6.4. TargetColor

The target color for a particular named skin color.

Default: none (disabled)

7. Generate Controls

7.1. DataDir

Specifies the directory where INDIface XML datafiles will be loaded.

Warning

This is not a volatile value: It is used at initialization and changes are ignored.

Default: `../Data/Face1`

7.2. Enable

Enables feature location and template generation.

Default: false

7.3. EyeScale

Can be used to adjust the minimum and maximum sizes of the eye detectors in percent. Larger numbers (> 100) will decrease the variation in eye size detectors; smaller numbers (<100) will increase it the range.

Default: zero (use default eye detector range)

7.4. LeftDetector

The name of an eye detector to be used for the (camera) left eye.

Default: empty (use default)

7.5. LeftInterface

Internal control. Leave at the default (zero) unless directed by an EIRC representative.

7.6. MinConsistency

The minimum consistency on a scale from 1 to 999 that will generate a template for searching or enrollment.

Default: zero

7.7. OutputDir

Specifies a directory to receive diagnostic face detection images. See Specifying Directories.

Default: empty (no output)

7.8. RightDetector

The name of an eye detector to be used for the (camera) right eye.

Default: empty (use default)

7.9. RightInterface

Internal control. Leave at the default (zero) unless directed by an EIRC representative.

7.10. RoiScale

Can be used to adjust the size of the region of the detected face where the eyes are expected in percent. Larger numbers (> 100) will decrease the size of the region; smaller numbers (<100) will increase it. Typically this can be set to 150 in cases where large amounts of head roll are expected. It could be decreased slightly below 100 in cases where the faces are from "passport quality" images.

Default: zero (no adjustment)

8. Height Controls

For fixed camera positions, a grid can be calibrated to provide an estimate of the height of a person standing a target distance away from the camera as scaled by the detected distance between the eyes.



For this example, `GridCols=3`, `GridRows=7`, and `GridFile` points to a file (`GridFile.cdf`) that contains the following, and `TargetEyePixels=62`.

```
0 0 0
0 74 0
0 68 0
0 62 0
0 56 0
0 50 0
```

8.1. Enable

Set true to enable height estimation processing. You must set `GridCols` and `GridRows` then specify a `GridFile` before the results will be calculated.

Default: false (no height estimation)

8.2. GridCols

Specifies the number of columns expected in the `GridFile`.

Default: zero (not used)

8.3. GridFile

Provides the location of a file containing the height values (in inches or centimeters) for each grid row and column. The file must have numeric entries for each (rows * cols) cell. Specify `GridCols` and `GridRows` before changing this value.

Default: none (not used)

8.4. GridRows

Specifies the number of rows expected in the `GridFile`.

8.5. HeightScale

Adjusts the estimation of the top of the head. If the camera is significantly above the subjects heads, you may want to decrease the value to allow for image foreshortening. Specify in per cent.

Default: zero (1.0)

8.6. HeightUnits

Sets the units that are specified in the grid file and in `TargetHeight`. This parameter allows the height confidence to be independent of the units units used. It is basically the number of millimeters in the unit specified. For example: 10 for centimeters, 25 for inches, or 305 for feet.

Added: v1.71A

Default: 25 (inches)

8.7. MinConfidence

The minimum confidence level that will be considered a height match for output to the `Output/HeightDir`.

Default: zero (anything matches)

8.8. MinConsistency

The minimum template generation consistency that will be submitted for height estimation.

Default: zero (try anything that passed `Generate/MinConsistency`)

8.9. TargetEyePixels

The expected number of pixels between the eyes at the target distance from the camera.

Default: zero (not used)

8.10. TargetHeight

The target height of the subject (in inches or centimeters as defined in the `GridFile`).

Default: zero (not used)

9. Input Controls

9.1. BeginDateTime

Specify the earliest files of interest (by last modified time) in an input hot directory using ISO 8601 extended format: YYYY-MM-DDTHH:MM:SS

Special value: blank (or anything invalid) disables

Default: blank

9.2. DeleteAfter

If true, files are deleted from the "hot directory" input as they are ingested into the SDK.

Default: false

Warning

Use this very, very carefully. If you pause while an image is in the input cache, these images will be lost forever.

9.3. EndDateTime

Specify the latest files (by last modified time) of interest in an input hot directory using ISO 8601 extended format:
YYYY-MM-DDTHH:MM:SS

Special value: blank (or anything invalid) disables

Default: blank

9.4. Format

Specifies the image encoding format that the data from an IP camera. This is useful if the URL suffix doesn't match the data format. For example, `http://root:wireless@192.168.1.228/axis-cgi/jpg/image.cgi` returns JPG format data.

Note

This value is semi-volatile. It is only read at the time a new HTTP-scheme Input/URL.

Special value: blank reverts to the suffix of the URL.

Default: blank

Added: Version 1.68

9.5. Loop

If true, causes the input directory to be restarted from the beginning when all images in the directory have been processed. This is useful for demonstration or testing purposes.

Default: false

9.6. MaxCache

The SDK caches a few images from either the IP camera or the hot directory so that it doesn't have to wait for an image to be acquired when it is ready to process the next image. This value controls the maximum number of frames that are cached. Smaller values will reduce perceived latency.

Special value: Zero translates to five.

Default: Zero

9.7. MoveAfter

Specifies where image files will be moved after the frame has been ingested into the SDK.

Special value: Blank, no action

Default: Blank

9.8. NewestOnly

If true only the most recently arrived file is retrieved from the input directory when the SDK is ready to cache another frame.

Default: false

9.9. NewOnly

If true only images that arrive in the hot directory after the Input/URL is changed are used.

Default: false

9.10. NumFiles

Output only value. Upon a change of Input/URL that results in a hot directory, this value specifies the number of files in the hot directory at the time of the change.

9.11. Pause

Specifies whether acquisition of frames from the input URL is paused or not. Be sure to heed the warning above. Also note that when pause occurs (transition from false to true), all input frames in the cache are dropped. The frame and faces currently being processed will continue to be output.

Default: false (not paused)

9.12. RestartSecs

Number of seconds to wait without receiving HTTP frames before restarting HTTP connection.

Special value: 0 (no restart)

Default: 3

Warning

Removed: v1.69

9.13. SampleMsec

Specifies the number of milliseconds that the SDK will wait between taking samples from the IP camera or the hot directory.

Special value: Zero for one second

Default: Zero

9.14. Skip

Specifies the number of files to be skipped for each file processed from an input hot directory.

Default: 0 (no skipping)

9.15. Sourceld

Specified an identifier for an IP camera. It is prepended to a time stamp for the ImageId.

Default: blank (none)

9.16. URL

/Image/URL controls the input to the IfSearch console for "hot directory" input or live retrieval from an IP camera. See the Image Input section above for details.

Default: none (will not function)

10. Mark Controls

10.1. BodyColor

Marks the body below a detected face that meets `Generate/MinConsistency`.

Default: magenta

11. Match Controls

11.1. AppendPersonId

If true, if a face in the source image meets "red box" conditions, then =M999-PersonId is appended to the SearchId when writing to `FaceDir` or `FaceCacheDir`, where 999 is the match confidence.

Note

Was briefly (between v1.68C and v1.68E) =C999-PersonId.

Default: false

Added: v1.68C

11.2. DuplicateThreshold

RESERVED for future use.

Default: 6

11.3. Enable

If true, casual matching is enabled allowing Image, Match, and XML output, and "red box" mode for the Marked image.

Default: false (disabled)

11.4. MarkConfidence

Overrides `MinConfidence` for `Output/MarkMatchColor`.

Default: zero (use `MinConfidence`)

11.5. MarkMaxPersons

Used for `Output/MarkMatchColor`; not considered a match if specified number of people are over `MarkConfidence`.

Default: zero (no check)

11.6. MaxDistance

Override MinConfidence with the Euclidean distance between vectors to be considered a match.

Default: 0 (no override)

11.7. MaxFaces

If PersonMode=true, the maximum number of total faces to be returned from the matcher before PersonMode combining.

Default: 0 (no limit)

11.8. MaxPersonFaces

If PersonMode=true, the maximum number of faces for an enrolled person that will be combined in the final results.

Default: 5

11.9. MaxResults

The maximum number of results to return from the matching process.

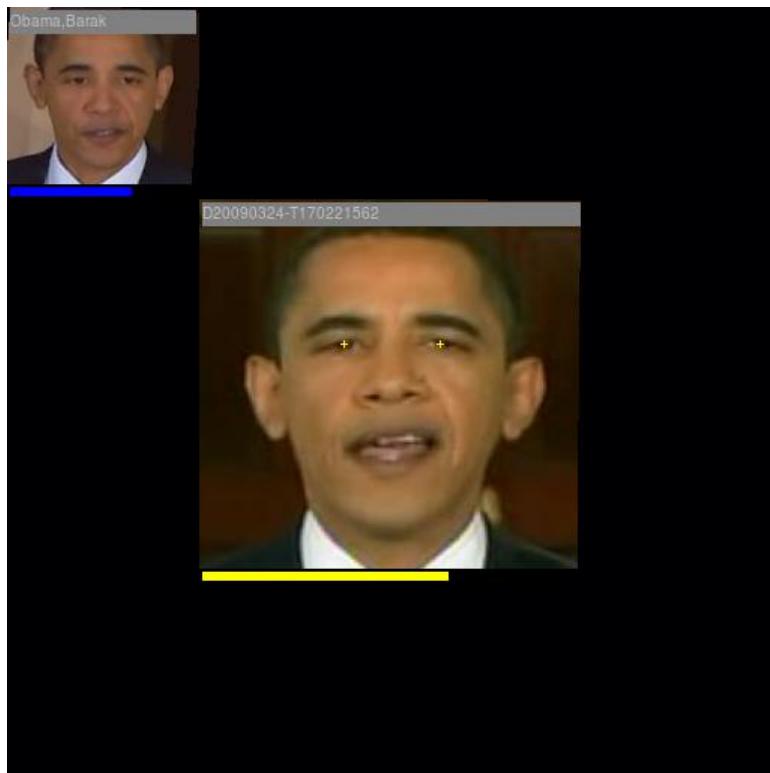
Default: 0

11.10. MinConfidence

The minimum "confidence" value, in the range from 1 to 999, that will be returned as a possible match.

Figure 4.12. Without MinConfidence



Figure 4.13. With MinConfidence=650

Default: 0

11.11. MinDistance

The minimum Euclidean distance allow from the matching process.

Default: 0 (no limit)

11.12. PersonMethod

RESERVED for future use.

Default: 0

11.13. PersonMode

If true, up to `MaxPersonFaces` results will be combined in the match results. Otherwise, each enrolled face is considered independent.

Default: true

12. Options Controls

12.1. Message

Receives warning, error, and fatal messages from the SDK. They are formatted with a "W", "E", or "F" followed by an 8 character hexadecimal error code (or zeros) then the time of the message and the message text itself. The OEM application can clear this message to receive the next message. The next message is set after one minute if the previous message is not cleared. Fatal messages are moved to the front of the queue.

12.2. NoPrompt

If true, IfSearch does NOT prompt for a key to continue before closing itself.

Default: true (NO prompt)

Warning

NOT volatile; must be specified on the command line or set in the registry before starting IfSearch.exe.

12.3. PollCount

Output only: Zero during initialization, one at application startup, incremented each time options are scanned.

12.4. Shutdown

Set to true to command IfSearch.exe to close itself. This is the preferred way to shutdown the console application. In order to prevent multiple instances of IfSearch to be running against the same base registry key, IfSearch sets this true during initialization then false while running. A calling application should set this to true before it closes itself. See Multiple Instances below.

12.5. UpdateMsec

Default: zero (no check for volatile updates)

13. Output Controls for Directories

Output data consists of capture images, frame images, detection images, cropped face images, normalized face images, and XML data files. The following table describes the various output categories. The output files are distributed to a set of directories specified in the configuration.

Table 4.1. Output Files

Name	Data	Markings	Description
Capture	Capture	none	Raw captured image
Capture2	Frame	none	Preprocessed image
Marked	Frame	head, eyes, body	Marked input frame
NoFace	Capture	none	No faces detected
NoEyes	Crop	none	Potential face detected, but no eyes
BadFace	Norm	none	Eyes detected, but low template consistency
Face	Norm	none	Face and eyes detected. If casual match enabled, also meets match criteria
NoMatch	Norm	none	Good face, but doesn't meet match criteria
XML	XML	n/a	Data of frame, faces, analytics, matches
FaceCache	Norm	none	Faces with directory contents managed by SDK
Height	Detect	head	Meets height estimate criteria

Name	Data	Markings	Description
Clothes	Detect	head	Meets clothes color criteria
NoClothes	Detect	head	Does not meet clothes color criteria
SkinColor	Norm	none	Meets that skin tone criteria
Resolved	Detect	head	Meets resolver criteria
ResolvedFace	Norm	none	Meets resolver criteria
Match	Norm	none	Matching faces from INDIbase enrollment
Body	other	none	Body below the detected face

Normalized face image files written to the Face, FaceCache, and MarkedFace directories have INDIface templates embedded into them. They are suitable to be transferred to Search or Enroll command mode input directories. Search and Retrieve command mode output directories receive normalized face image files from the INDIbase.

Table 4.2. Diagnostic Files

Name	Data	Markings	Description
MarkedFace	Norm	eyes, skin	Face with eyes and skin tone detection markings
Recon	other	eyes	A reconstruction image from a generated template
Vector	other	n/a	A graph representing a generated template
Detect	Frame	heads, detectors	Image used to detect faces
Generate	Crop	eyes, detectors	Image used to generate template
Skin	Frame	none	Input image with non-skin areas masked
Charcol	Frame	none	Input image converted to characteristic colors for clothes color matching

Frame images and XML data files are identified by an Image ID. For frames captured from IP cameras, the image ID consists of a date stamp to the thousands of the second optionally prepended with a specified Camera ID. For images read from a directory, the image ID is the complete base name of the file. Cropped and normalized face image files are identified by a Face ID. The face ID consists of the image ID appended with the x,y coordinates of the position of the face in the original image and the quality and consistency values for the detected face.

Nomenclature for SDK Output File Names:

X1234Y0567 The center of the face was detected at pixel x,y coordinates (1234,0567)

Note

Pixel coordinates are grow to the left and down.

W194 The detected face was 194 pixels wide.

Q789 The face was detected at 78.9% "quality"

C543 A face template with 54.3% "consistency" was generated

- E092 Eyes located 92 pixels apart were used to generate the template
R03 This person or face was ranked 3rd in a search or casual match.
M890 This person or face has a 89.0% "match confidence"

Capture image file format is controlled by `Input/Format`. Face, FaceCache, MarkedFace, Generate, and ResolveFace images are controlled by `Output/FaceFormat` and `Output/FaceQuality`. All other image files are controlled by `Output/Format` and `Output/Quality`.

Except for BaseDir all the controls below default to empty (i.e. no output for that class of file). See Specifying Directories above for details relating to these output directories as well as input or output directories in other sections.

13.1. BadFaceDir

Faces where eyes were detected, but didn't meet `Generate/MinConsistency`.

13.2. BaseDir

This can be used as a base directory for the other input and output directories if they are relative. See Specifying Directories above for details.

Default: `./Output`

13.3. BodyDir

Outputs an image containing the detected head and a rectangle below the head where a body would be expected.

13.4. Capture2Dir

The input image for face detection after preprocessing.

Note

Files written to this directory are in `Output/Format`.

Warning

This will change to Output/InputDir in the future.

13.5. CaptureDir

A copy of the raw original (before preprocessing) image from camera or file.

Note

Files written to this directory are in `Input/Format`.

13.6. ClothesDir

A frame image with the face marked that met the criteria for a clothes color match. See the Clothes Color Controls section.

13.7. FaceCacheDir

Faces that have been detected and templates generated (if `Generate/Enable=true`) and are matched to the IN-Dibase (if `Match/Enable=true`) are placed here in addition to FaceDir. The SDK manages this directory and

periodically scans this directory and deletes the oldest files to bring the number of files in the cache directory down to `Output/MaxCache`.

Change: v1.69E - Faces written to the `NoMatchDir` are also cached here.

13.8. FaceDir

Faces that have been detected and templates generated (if `Generate/Enable=true`) and are matched to the IN-Dibase (if `Match/Enable=true`) are placed here.

13.9. HeightDir

A frame image with the face marked that met the criteria for height estimation match. See the Height Controls section above.

13.10. ImageDir

When casual matching is in effect (`Match/Enable=true`) a composite image with the detected face at the center surrounded by up to twelve closest matching enrolled faces is written here.

13.11. MatchDir

The enrolled face image files are written to this directory for matches that meet the criteria set in the Match Controls section. The file name is the format `{ImageId}-X0123Y0456C678E099-R01.ext` where (123,456) are the x,y coordinates of the center of the detected face, 678 is the template consistency, 99 is the number of pixels between the eyes, and the rank of the match is 1.

13.12. MarkedDir

The input frame with various items detected marked. See Output Controls for Marking Images below for what can be marked.

13.13. MarkedFaceDir

Faces that have been detected and templates generated (if `Generate/Enable=true`) and are matched to the IN-Dibase (if `Match/Enable=true`) are placed here with the eye locations marked and, if Face Color detection is enabled, the sampled skin areas are marked.

13.14. NoClothesDir

Destination of face-marked images in which clothes matching *didn't* detect a match.

Added: v1.68

13.15. NoEyesDir

Faces where we were unable to detect eyes are placed here.

13.16. NoFaceDir

Frames where no faces were detected are placed here.

13.17. NoMatchDir

When casual matching is enabled, faces where good templates were generated, but did not meet the criteria set in the Match Controls section are written here.

Change: v1.69E - Faces that written to this directory are also cached in `FaceCacheDir`.

13.18. ReconDir

Diagnostic reconstruction images of generated face templates are written to this directory. See Reconstruction figure.

13.19. VectorDir

Diagnostic vector graph images of generated face templates are written to this directory. See Vector figure.

13.20. XMLDir

An XML file is written to this directory describing the frame, faces found, and matches is written to this directory.

Warning

The XML format is likely to change. Please contact EIRC before using these files.

14. Output Controls for Marking Images

Most of these controls are for setting colors for `Output/MarkedDir` images. See Setting Colors. If a control is missing it's default is used; if a control is present, but blank, that mark is disabled.

14.1. MarkAllColor

Marks all detectors in the Detect image.

Default: none

14.2. MarkBackgroundColor

Sets the background color for the Marked image.

Default: none

14.3. MarkBackgroundFile

Sets a file to be used instead of the input frame for the Marked image.

Default: empty

14.4. MarkBackgroundTransparency

Sets the transparency of the background color.

Default: 100

14.5. MarkBadFaceColor

Marks faces where eyes were detected but were less than Generate/MinConsistency.

Default: green

14.6. MarkClothes

If true, characteristic colors are shown where clothes color detection is taking place.

Default: false

14.7. **MarkEyeColor**

Marks the eye location for generated templates.

Default: yellow

14.8. **MarkEyeRoiColor**

Marks the eye region of interest and indicators of the eye detector sizes in the Generate image.

Default: none

14.9. **MarkFaceColor**

Marks the location of a detected face when Generate/MinConsistency is met.

Default: yellow

14.10. **MarkMatchColor**

Marks the location of a detected face when it has found a match in the INDIbase. See also the `MarkMinConfidence` and `MarkMaxPersons` in Match Controls.

Default: red (hence the name "Red Box" mode)

Figure 4.14. Marking MarkMatchColor



14.11. **MarkNoEyesColor**

Marks detected potential faces where no eyes were detected.

Default: blue

14.12. **MarkOverCrop**

The amount outside of the detected face that is written over the background of the Marked image.

Default: 133

15. Output Controls for Other Purposes

15.1. **FaceFormat**

Sets the image file format for Face, FaceCache, MarkedFace, Generate, and ResolveFace images.

Default: PNG

15.2. **FaceQuality**

Sets the compression quality level for Face, FaceCache, MarkedFace, Generate, and ResolveFace image files. Ranges from 0 for highly compressed files to 100 for uncompressed files.

Special value: -1, let the compressor decide.

Default: -1

15.3. **FacesProcessed**

Output only. Shows the number of faces processed.

15.4. **Format**

Sets the image file format for non-face images.

Default: JPG

15.5. **ForceMarked**

Forces a marked image to be output even if there are no markings. This is used to make sure a marked image is written for every input frame even if no faces are found.

Default: false

15.6. **FramesProcessed**

Output only. Shows the number of frames processed.

15.7. **LogDetail**

Specifies the minimum level of detail written to the log file. Levels are Leave (log everything), Enter (log function entry), Detail (detailed data), Debug (debugging information), Info (informational messages), Progress (progress messages), Warning (only warnings or worse), Error (only severe errors or worse), Fatal (only error that shutdown the console).

Default: Info

15.8. LogFile

Special value: "none" for no log file

Default: ./log/IfSearch-@.log relative to Output/BaseDir

15.9. LogStdout

If true also logs to stdout of the console at Info level.

Default: true

15.10. MaxCache

The target number of files to maintain in the Output/FileCacheDir.

Default: 64

15.11. Quality

Sets the compression quality level for non-face image files. Ranges from 0 for highly compressed files to 100 for uncompressed files.

Special value: -1, let the compressor decide.

Default: -1

15.12. WriteFaceInfo

If true, generated templates are embedded in face image files. Requires Output/FaceFormat=PNG.

Default: true

16. PreProcess Controls

As more preprocessing controls are exposed (skin tone detection, low variance detection, luminance stretching, etc) they will complete this section.

16.1. Aspect

Specify the adjustment of the ratio of the vertical scale to the horizontal scale.

Special value: 0.0 converts to 1.0 (no change)

Default: 0.0 (no change)

16.2. Rotate

Specify the number of degrees the input image is to be rotated counter-clockwise.

Special value: 0.0 converts to 1.0 (no change)

Default: 0.0 (no change).

16.3. Scale

Specify a scale factor for the input image.

Special value: 0.0 converts to 1.0 (no change).

Default: 1.0 (no change).

17. Resolve Controls

The "Resolver" takes confidence levels from all steps of the facial analytics and combines the results to get an overall confidence level. If this overall level falls between the specified `MinConfidence` and `MaxConfidence`, then that frame marking the detected face and/or the face image will be written to output directories. Each factor (`Quality`, `Consistency`, `FaceColor`, `Height`, `LowerClothes`, and `UpperClothes`) can be weighted (even negatively) in the overall value.

17.1. Consistency

The weight given to generated template consistency.

Default: zero (not included)

17.2. Enable

Must be true for operation of the Resolver.

Default: false

17.3. FaceColor

The weight given to the confidence of the closest matching face color key.

Default: zero (not included)

17.4. FaceDir

The output directory for resolved faces.

Default: blank (no face output)

17.5. Height

The weight given to height estimation confidence.

Default: zero (not included)

17.6. LowerClothes

The weight given to lower clothes color match.

Default: zero (not included)

17.7. MarkedDir

The output directory for frames with the resolved face marked.

Default: blank (no frame output)

17.8. MaxConfidence

The maximum overall confidence level to be consider resolved.

Default: zero (no maximum)

17.9. MinConfidence

The minimum overall confidence level to be considered resolved.

Default: zero (no minimum)

17.10. Quality

The weight given to face detection quality.

Default: zero (not included)

17.11. UpperClothes

The weight given to upper clothes color match.

Default: zero (not included)

Chapter 5. Command Mode Reference

IfSearch can be commanded to perform other actions in Search, Enroll, and Retrieve modes.

Search Mode	Search, VerifyList (future), Verify
Enroll Mode	Enroll, Delete, Remove, RemoveAll, Rename
Retrieve	Retrieve, Status, PersonReport, Enumerate (future)

1. General Command Process

As you can see in the Enrolling subsection of Getting Started above, using INDIface command modes follows a predictable sequence.

1. First you set any parameters that might be needed for the command you plan to use.
2. Second you set the name of the command in the `Command` variable. When the command is recognized, the `Results` and `Reason` variables are cleared and the command begins to execute. You can monitor the progress of the command via the `Status` variable.
3. Finally, when execution of the command is complete, the `Status` variable is set to "Done" or "Error" (or "NotFound" for Retrieve Mode) and the `Command` variable is cleared. You can inspect the `Reason` variable for the cause of an Error status or the `Results` variable for a Done status. Note that "Done" is not written to the `Status` variable until all files have been written to an `OutputDir`.

Note

While it is not required, if possible it is suggested to pause (`Input/Pause=true`) mainline processing during while Command Mode commands are executing achieve more predictable timings of command execution. Command Mode processes are at a slightly lower priority than mainline processes.

Warning

The registry must be volatile for Command Mode to work. Set `Options/UpdateMsec` to reflect how responsive you want the mainline SDK process to be to command triggers.

1.1. Common Variables

These variables are common to all three modes.

1.1.1. Command

The OEM application sets `Command` to one of the specified commands to trigger its execution. The SDK clears it after the command has finished. Invalid commands are ignored.

Warning

Any necessary command parameters should be changed before setting `Command`.

1.1.2. Status

The SDK updates this variable as execution proceeds. The final status will always be "Done" "Error" or "NotFound"

1.1.3. Results

When `Status=Done`, this variable contains the result of command execution.

1.1.4. Reason

When `Status=Error`, this variable contains an explanation of the error condition.

2. Search Mode

Search Mode is used to search the INDIbase enrolled faces against one or more gathered faces. The faces for searching are faces that had been detected and templates generated (basically the output of the `FaceDir`, `FaceCacheDir`, `NoMatchDir`, or `MarkedFaceDir` with `Output/WriteFaceInfo=true`). They can be searched against a single person (Verify command), all of the active faces enrolled in the INDIbase (Search command), or, in the future, a short list of persons of interest (VerifyList command).

Note

See the Formal Search subsection of Getting Started above for an example.

Results: The Results variable will be set in the following format with `Output/Delimiter` between each line:

```
D20090119-T200050562-X0169Y0244C583E087.PNG search image Active
D20090119-T200109578-X0234Y0192C573E044.PNG search image Active
D20090119-T200114562-X0269Y0189C623E034.PNG search image Active
D20090119-T200115609-X0386Y0184C680E046.PNG search image Active
D20090119-T200441593-X0284Y0258C506E126.PNG search image Active
10 results
1. 793    316057 Hume,Brit
2. 793    970578 Biden,Joe
3. 789    98797 Obama,Barak
4. 773    707299 Baer,Brett
5. 728    126628 Williams,Juan
6. 710    59290 Obama,Michelle
7. 682    305166 Smith,Sheppard
8. 642    657519 Reid,Harry
9. 593    837859 Giuliani,Rudy
10. 548   170123 GeicoGuy
```

First, each face image files will be listed with "Active" listed if it contains a valid embedded template. Second, a line will show the number of results to follow. Third, the rank, match confidence level (on a scale of 1 to 999), `PersonKey`, and `PersonId` of the best matches will be listed. In non-PersonMode searches, the results line contains face, not person, identifiers. For the Verify command, the files are listed followed by "Confidence=876".

If `Search/OutputDir` is specified, the enrolled faces for the best matches are written. In non-PersonMode, one face image file is written for each of the best matching faces. The file name is formatted as `R01M987-FK654321` to indicate match rank #1, match confidence 987 (scale of 1 to 999), and FaceKey 654321. In PersonMode, a directory named `R01M987-{PersonId}` is created for each person in order and the face images that contributed to the match are written to those directories with the same file name format as non-PersonMode.

Note

This file/directory name nomenclature was changed in v1.68F.

2.1. Commands

Currently the Search and Verify commands are recognized.

2.1.1. Search

Searching the entire INDIbase

This command sorts the best matches of the templates in the `Search/InputDir` versus all of the faces enrolled in the INDIbase. In PersonMode, the `MaxPersonFaces` highest ranking results from the same person are combined to increase that person's confidence rating. The results can be limited by the `MaxResults` and `MinConfidence` parameters.

2.1.2. Verify

Verifying the identity of a single person

This command compares the templates embedded in the face image files in Search/InputDir versus the faces enrolled for the specified PersonKey or PersonId. The MaxPersonFaces highest ranking results are combined and the confidence level is returned. No files are written for the Verify command.

2.1.3. VerifyList (future)

Searching for a few persons of interest

2.2. Parameters

In addition to the common variables above, the following combinations of parameters can be used to identify the person and faces to be enrolled. Search Mode also has parallel parameters from the Match section above: MaxFaces, MaxPersonFaces, MaxResults, PersonMethod, PersonMode.

2.2.1. InputDir

Specifies where face template image files will be read for searching. See Specifying Directories above for additional information.

2.2.2. OutputDir

Specifies where search results face image files will be written. See Specifying Directories above for additional information. If blank, the Results variable will be populated, but no image files are written.

3. Enroll Mode

Enroll Mode allows you to add face templates to the INDIbase and to manage persons and faces in the INDIbase.

3.1. Commands

You can use the Enroll, Delete, Remove, RemoveAll, and Rename commands in Enroll Mode.

3.1.1. Enroll

Add faces to the INDIbase

This command allows you to add faces that had been detected and templates generated (basically the output of the FaceDir, FaceCacheDir, NoMatchDir, or MarkedFaceDir with Output/WriteFaceInfo=true) to the INDIbase face template repository attached to the SDK instance. The complete base name of each file becomes the FaceId of the template.

Note

See in the Enrolling subsection of Getting Started above for an example.

Results: The Results variable will start with either "Unidentified Enrollment" for non-person mode or "PersonId=N7969000@CA5 PersonKey=123456" for person mode. It will be followed by either "{FaceId} already enrolled." or "{FaceId} enrolled as {PersonKey}:{FaceKey} Active" for each image in the specified InputDir.

3.1.1.1. Non-Person Mode

If the PersonMode is false, then face templates are added to the INDIbase without identifying them as a particular person. The PersonKey and PersonId parameters are ignored.

3.1.1.2. Person Mode

You can add face templates to an existing person in the INDIbase by specifying either their numeric `PersonKey` (assigned by INDIbase when the person record was created) or their `PersonId`. If the specified `PersonId` is not already in the INDIbase, then a new person record is created.

3.1.1.3. Anonymous Enrollment (future)

With Anonymous Enrollment, the INDIbase will assign a `PersonKey` to new sets of faces that belong to an unknown person. Their `PersonId` can be assigned later via the `Rename` command.

3.1.2. Delete

Delete one face from the INDIbase

This command allows you to delete a single face template from being included in searches. The face is still enrolled and can be retrieved for future reinstatement (method TBD). Specify either the numeric `FaceKey` assigned to the face when it was enrolled or the `FaceId` (typically the complete base file name of the image template file at the time of enrollment). For `FaceId` lookups, a `PersonKey` must be specified also. If the face was enrolled in non-person mode, then specify `PersonKey=0`. For person mode enrollments either specify an existing `PersonKey` or `PersonId`.

3.1.3. Remove

Remove all of a Person's faces from the INDIbase

Specify an existing `PersonKey` or `PersonId`.

3.1.4. RemoveAll

Remove all faces from the INDIbase to start over fresh

Set `PersonId=Confirm` to confirm that you want to remove all faces from the INDIbase.

3.1.5. Rename

Assign a new `PersonId` to an existing person

Specify an existing `PersonKey` or `PersonId` to be renamed and a `NewPersonId` with the new name.

3.2. Parameters

In addition to the common variables above, the following combinations of parameters can be used to identify the person and faces to be enrolled.

3.2.1. PersonKey

A unique number identifying an existing person in the INDIbase. INDIbase assigns this number to new person records. An unidentified (non-person mode) enrollment has `PersonKey=0`.

3.2.2. PersonId

A unique string supplied by the OEM application as its identifier for a person.

3.2.3. FaceKey

A unique number identifying an existing face enrolled in the INDIbase. INDIbase assigns this number at enrollment.

3.2.4. FaceId

A string that identifies a face enrolled in the INDIbase. The strings must be unique within the person record. The unidentified enrollments must also have unique `FaceIds`.

3.2.5. InputDir

Specifies where face template image files will be read for enrollment. See Specifying Directories above for additional information.

3.2.6. SetDescription

If non-empty during an Enroll command, the person's description in the INDIbase is set to this string.

3.2.7. Description

Returns either a newly set or existing description for the person from the INDIbase, if any.

3.2.8. NewPersonId

A string identifying the person to replace their existing PersonId. The NewPersonId can not already exist in the INDIbase.

4. Retrieve Mode

Retrieve Mode can be used to retrieve a single face enrollment or all the faces enrolled for a person from the INDIbase.

4.1. Commands

4.1.1. Retrieve

The Retrieve command will retrieve all of the faces enrolled for a person or will retrieve a single face. For a single face, you can specify FaceKey or person record identification (PersonKey or PersonId) and FaceId. To retrieve all enrolled faces for a person, specify either a PersonKey or PersonId with FaceKey blank, non-existent, or zero.

Results: For person retrieval, the Results variable will start with "Person {PersonKey}={PersonId}". For each face enrolled a "Face: {FaceKey}={FaceId} {{status}}" entry is appended to the results. Values for status are "Inconsistent" (not suitable for matching), "Active" (used for matching), "Deleted" (has been deleted), or "Error" (likely the face's XML file has been damaged).

4.1.2. Status

The Status command will return information about the enrollment to the INDIbase.

Results: Four comma delimited numbers.

1. Number of identified people enrolled
2. Number of unidentified faces enrolled
3. Total number of faces enrolled
4. Total number of faces enrolled that are included in searches

Added: v1.69H

4.1.3. PersonReport

The PersonReport command will write a comma delimited file with one line for each person enrolled in the INDIface. The name of the report file must be specified in ReportFile variable before setting Command=PersonReport. Each line will contain four values.

1. PersonKey (numeric identifier issued by INDIface when a new person was enrolled)

2. PersonId surrounded by double quotes (string specified when a new person was enrolled)
3. Number of faces enrolled for that person
4. One if the person is active for searching or zero otherwise

Results: "# bytes written to {ReportFile} for # persons".

Note

XML format reports are anticipated in the future.

4.1.4. Enumerate (future)

We will have the ability to enumerate the unidentified (non-person mode) enrollments and the list of person records once someone identifies a preferred interface.

4.2. Parameters

In addition to the common variables above, the following combinations of parameters can be used for Retrieve Mode.

4.2.1. OutputDir

Specifies where face template image files will be written. See Specifying Directories above for additional information. If blank, the keys and ids are enumerated in the Results variable, but no image files are written.

4.2.2. ActiveOnly

If true, only faces that are currently used for matching are retrieved. Otherwise all enrolled faces, active or not, are retrieved.

Default: true

Added: v1.68D

4.2.3. ReportFile

Name of file where PersonReport is to be written.

Default: none (error if missing)

Added: v1.69H

5. Error Reasons

The following messages could be returned in the Reason variable for Command Mode commands.

No FaceBase	No INDIbase face template repository was opened
Enroll/InputDir is blank	No input directory was specified from which to retrieve face template files.
PersonKey 123456 does not exist	The specified person key is not enrolled in the INDIbase.
PersonId ... does not exist	The specified person id is not enrolled in the INDIbase.
PersonId must be specified for new person	Currently each person must have a PersonId. This restriction will go away with Anonymous Enrollment.
Cannot create new person	Internal error

Can't cd to {InputDir}	The specified InputDir likely doesn't exist.
{InputDir} is empty	The specified InputDir does not contain any supported image files.
Null image in {filename}	The image file is likely corrupt.
INDI EigenFace Null Status	No template data in the image file. Images for enrollment must come from the output of FaceDir, FaceCacheDir, or MarkedFaceDir with both Detect/Enable=true and Generate/Enable=true.
Error parsing XML ...	The template data embedded in the image file was somehow damaged or is incompatible with the SDK.
Missing INDI-EigenFace-Template	The template data embedded in the image file was somehow damaged or is incompatible with the SDK.
FaceKey 654321 does not exist	The specified face id is not enrolled in the INDIBase.
FaceId ... does not exist for {PersonId}	The specified face id is not enrolled in the INDIBase for the specified person.
FaceId ... does not exist unidentified	The specified face id is not enrolled in the INDIBase without person identification.
FaceId or FaceKey must be specified	For the Delete command.
Must specify person key or id to ...	No person key or id was specified.
No Consistent Faces to search	None of the image files in Search/InputDir contained embedded templates.
No ReportFile name specified	ReportFile name must be specified before setting Retrieve/Command=PersonReport
XML format not yet supported	Support for XML reports has not yet been completed.
Error opening {ReportFile} for truncated write: {Error}	File system error

Chapter 6. Changes

This chapter will show plans for future changes to the SDK, the history of changes to the SDK, and a change log for this document itself.

1. SDK Plans

Anticipated changes to the SDK will be listed here in approximate soonest-first order.

1.1. Short Term

Scheduled second quarter 2011

- Support for AVS Video Converter's JPE image export output
- Handle empty FaceBase/BaseDir
- Combine Verify results up to MaxPersonFaces
- Anonymous enrollment
- Implement PreProcess/MaxPixelRows and MaxPixelCols
- Implement Input/Crop
- Specify eye locations on Enroll

1.2. Medium Term

Scheduled third quarter 2011

These capabilities may be implemented in SDK1 or wait for second generation.

- Enroll batch capability for person or non-person enrollment
- AutoEnroll mode?
- Volatile LogFile and LogDetail
- Retrieve/Command=Enumerate once someone defines what they need.
- Expose color correction to SDK
- Implement ImageIdFormat, FaceIdFormat and PersonIdFormat as controls
- Implement binary facial recognition data files and/or embed data in DLL plugins
- Binary INDIbase templates

1.3. Long Term

If this becomes necessary in SDK1 it will be implemented. Otherwise we will use a SQL-based INDIbase in the second generation.

- Volatile FaceBase

2. SDK Change History

This section will document changes to the SDK since January 2010 (v1.65) release in most recent first order.

2.1. Version 1.71

Scheduled for release at end of June

- v1.71A - Added Height/HeightUnits parameter

2.2. Version 1.70

Released May 28, 2011

- Changed wording on Enroll=Delete error messages
- Object detection exceptions are fatal.
- Cosmetic changes to detect and composite images

2.3. Version 1.69

Released April 25, 2011

- Added Interface controls for object detection
- Completely remove ResetAfter; we'll leave RestartSecs to cover emergencies
- Improved HTTP communication
- NoMatchDir faces are also written to FaceCacheDir
- No longer reports file written after file write error
- Fixed Input/Format to Output/Format on NoFaceDir files.
- Added Status and PersonReport commands to Retrieve Mode

2.4. Version 1.68

Released March 26, 2011

- Added Output/NoClothes for non-matching clothes
- Added Input/Format for IP camera URLs suffix that don't match the image data returned.
- Improved Clothes Matching discrimination
- Added Mark/AppendPersonId
- Added Retrieve/ActiveOnly
- Changed nomenclature of Search/OuputDir file/directory names.

2.5. Version 1.67

Released February 20, 2011

- Builds now for 32-bit Windows and 64-bit Linux (Ubuntu).
- Upgraded to v2.2.0 Intel object detection library.
- Separated use of MaxDistance from MinConfidence. MinDistance, MaxDistance, and DuplicateThreshold are used to qualify vectors initially and MinConfidence is used to limit final results.
- Enroll/OutputDir did nothing so it was removed.

2.6. Version 1.66

Released February 5, 2011

- Restructured for build without DDT and IJM libraries
- Removed duplicate results of same unidentified face in non-person search
- Restructured initialization for running in Linux

3. SDK Document Change Log

This document was first released with SDK version 1.60 and the first "official" release of this document with v1.68. Changes since v1.68 will be listed below latest first.

3.1. Version 1.70

- Added missing and future controls to Detect section: (ForceFind, GroupMethod, GroupThreshold, NeighborThreshold, and OverlapThreshold)
- Moved "Getting Started" to a chapter on its own.

3.2. Version 1.69

- Restored short term changes.
- Added note to Input/Format.
- Added legal notices and moved Notes to an Appendix.
- Added Tech Note: How a Frame Becomes a Match
- Added two new commands to Retrieve Mode
- Added clothes color confidence figures
- Added multiple output directory note
- Added AVS4YOU to recommended tools

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Appendix B. Tech Notes

1. Tools

These are some of the tools we have found helpful in implementing the INDIface SDK.

1.1. Process Monitor

ProcMon by Sysinternals (a subsidiary of Microsoft) has proven valuable to monitoring the reading/writing of files and registry entries as an application interacts with IfSearch. Start at <http://technet.microsoft.com/en-us/sysinternals/bb896645.aspx> to download it.

1.2. Network Monitor

WireShark has proven useful when connecting new IP cameras. Get it at <http://www.wireshark.org>.

1.3. Image Viewing and Manipulation

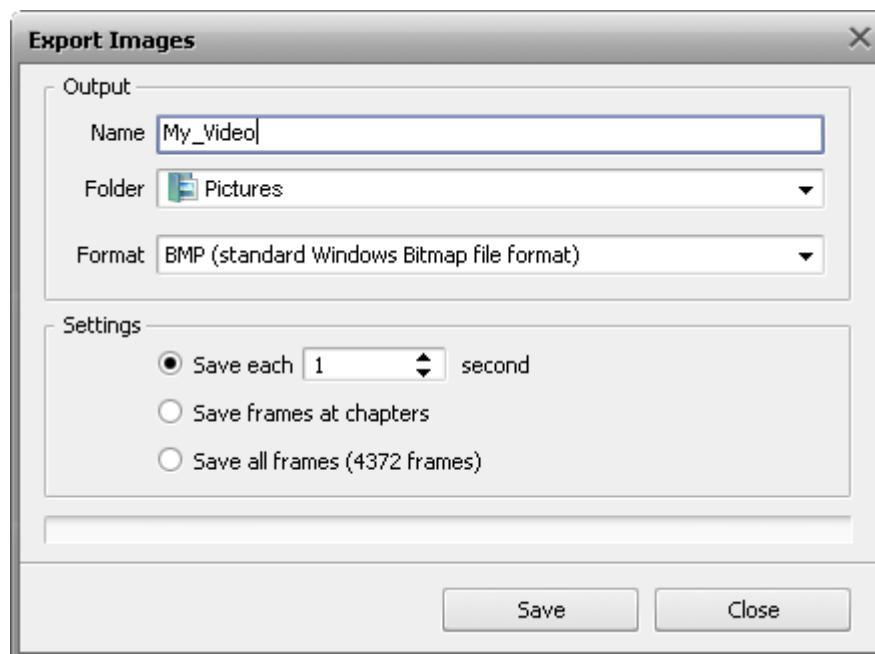
IrfanView is a very helpful utility for viewing, manipulating, and converting still images and directories of images. Visit <http://www.irfanview.com/> if you are interested. Unfortunately it is only available on Windows at the moment.

1.4. Screen Capture

If you don't already have a favorite Print Screen utility, check out Gadwin PrintScreen. We have found the free version very capable, but the Professional version has more power. Visit them at <http://www.gadwin.com/download/> to see their products.

1.5. Video File Manipulation

AVS4YOU (r) has an excellent suite of multimedia and other applications. Start by downloading their Video Converter at <http://www.avs4you.com/> and see the note on exporting to a directory of PNGs at <http://onlinehelp.avs4you.com/AVS-Video-Converter/Features/Editing/exportimage.aspx>.

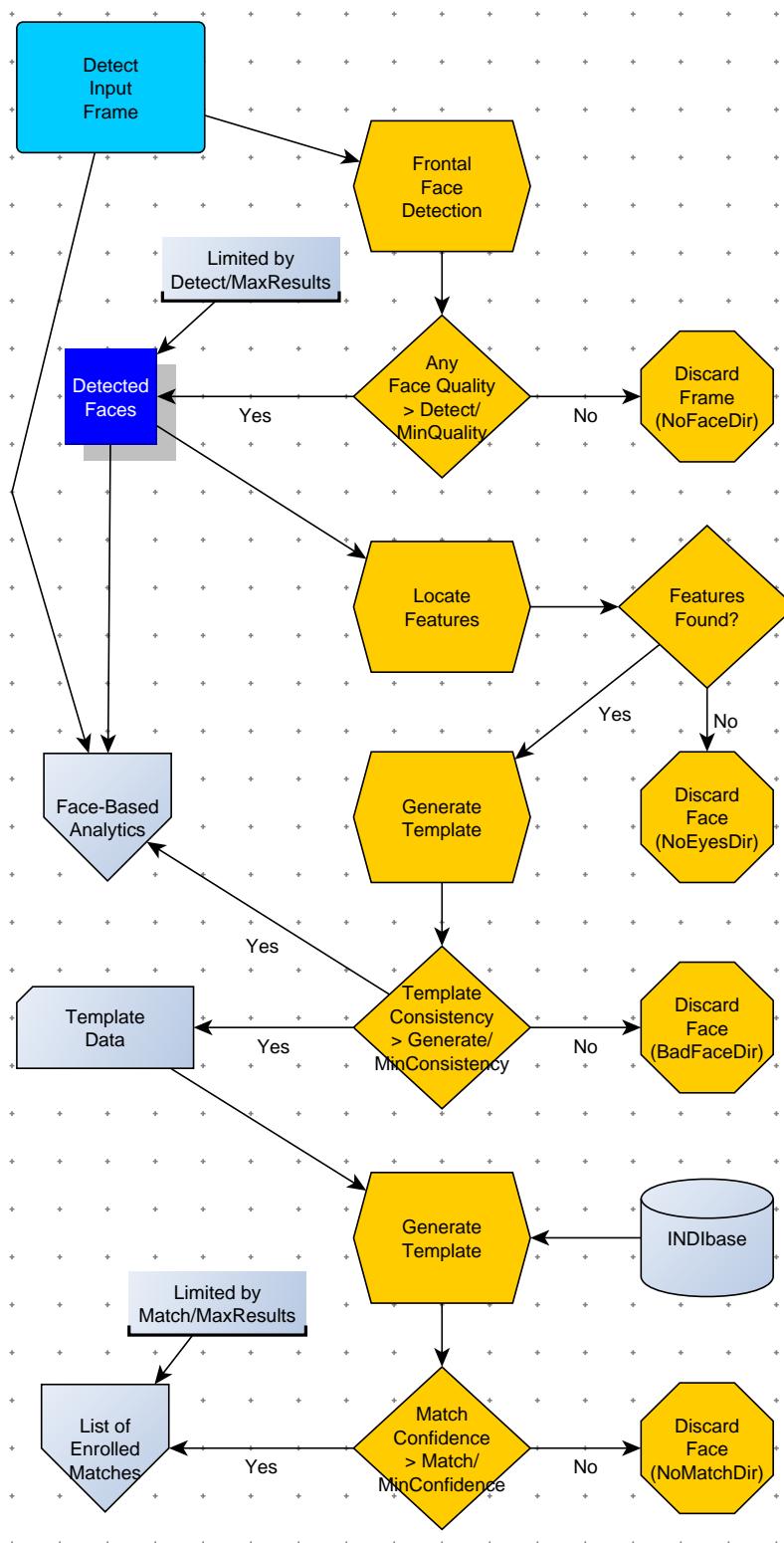


2. How a Frame Becomes a Match

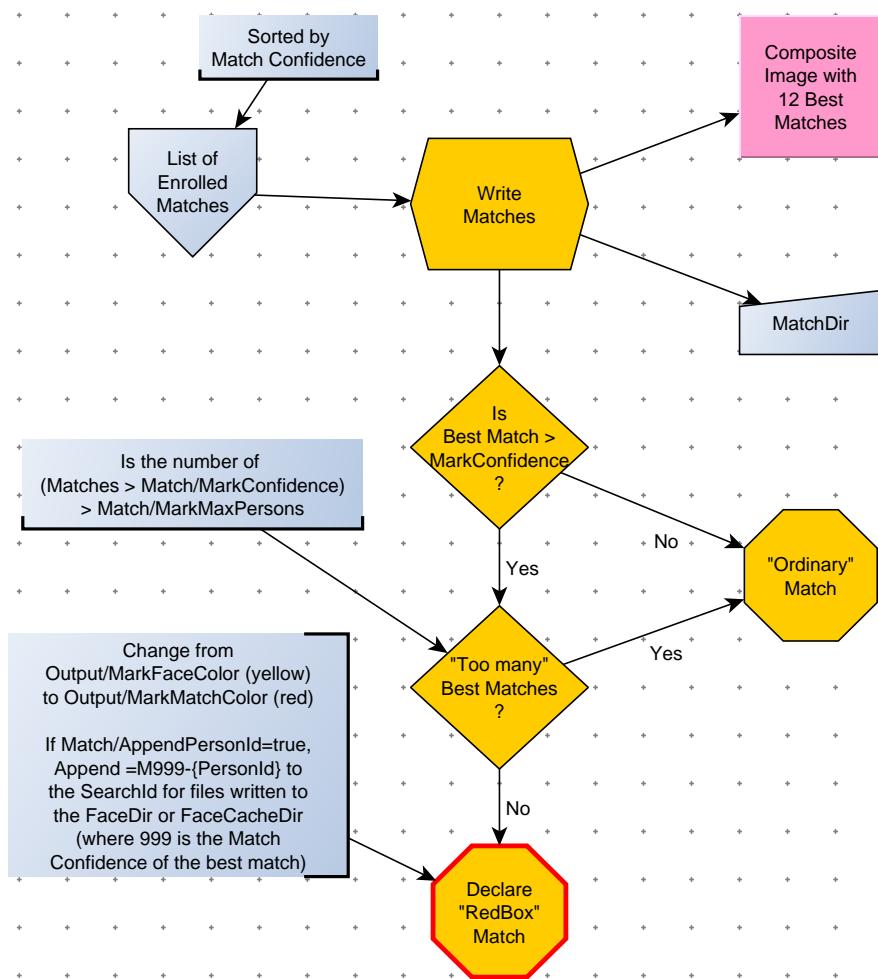
Sung to the tune of "How a Bill Becomes a Law"

This note describes in sequence how the INDIface SDK1 control parameters are applied at each step.

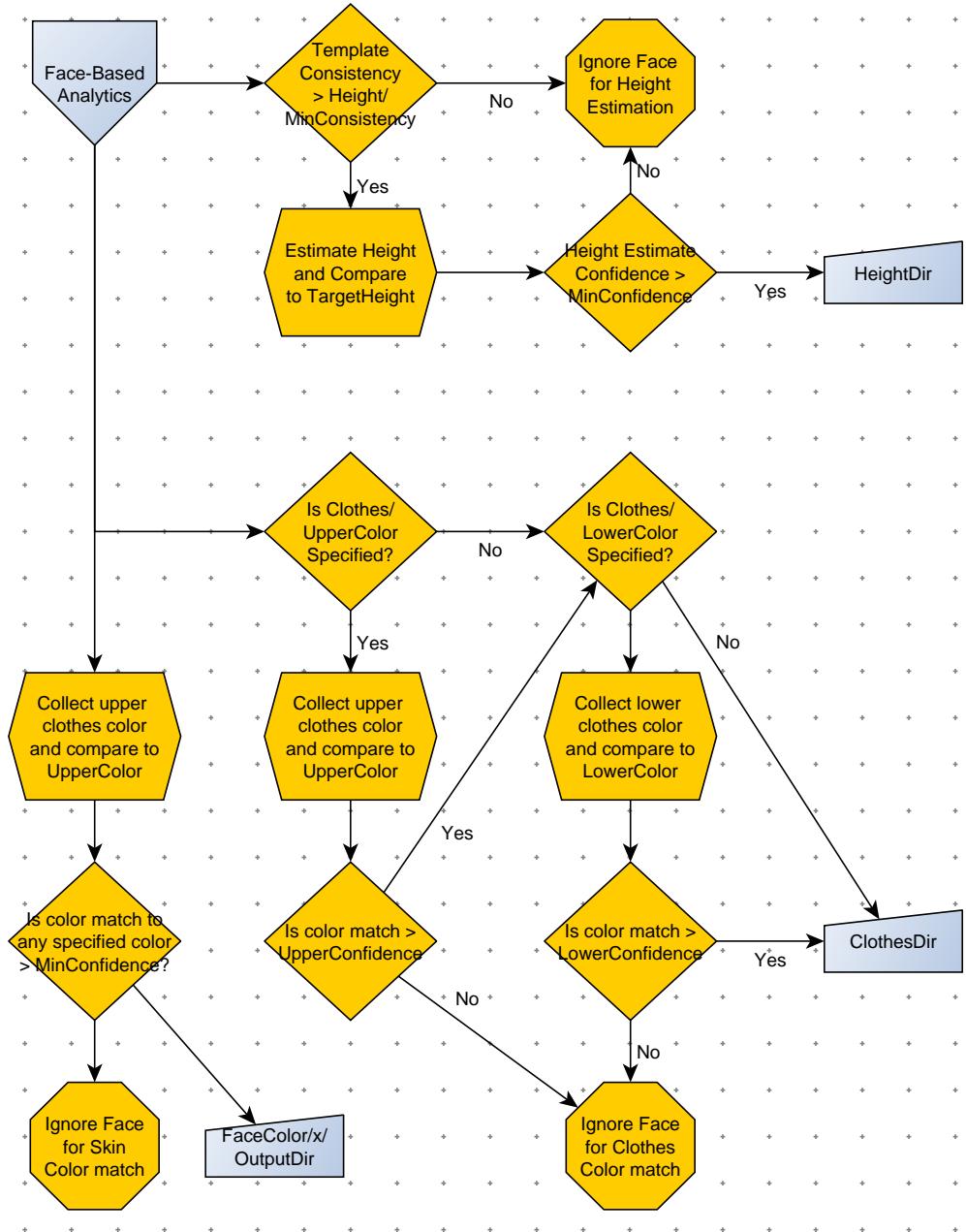
The first figure shows how faces are detected from input frames and what criteria are used to qualify them for casual matching against INDIbase enrollments.

Figure B.1. Match Flow

The second figure shows how a face earns "RedBox" distinction.

Figure B.2. "RedBox" Match

The third figure shows how a face can succeed at the Height Estimation, Skin Color, and Clothes Color analytics.

Figure B.3. Face-based Analytics

3. Multiple Instances

Since the v1.60 release of the SDK, you have the ability to have multiple instances of the SDK running.

Keep the following guidelines in mind:

1. You can now specify the base registry key on the command line as `%[orgName]/appName`. The default is `HKCU\Software\EclipseIR\IfSearch`. Only one instance of `IfSearch.exe` should be running on a given registry base key at a time. If an instance of `IfSearch` is started while another is running, the running instance will terminate itself. There is a possibility that two instances could be started almost simultaneously and not know the other exists, so you should guard against this.
2. Multiple instances can use different or share enrollment FaceBases. If multiple instances are sharing a FaceBase,

- If multiple instances will be enrolling, they should have non-overlapping ranges of PersonKey and FaceKey. [External specification of key ranges isn't supported yet, but can be if needed.]
 - Enrollment from one instance will not be visible in other instances until they are restarted. [This restriction can be eliminated if it becomes a problem before we switch to SQL-based enrollment.]
3. The data files and paths are now relative to the application's directory, so W:\hatever\INDIface\bin can be added to the system PATH and IfSearch.exe can be executed from any current directory now.