VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo

User's guide

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1 Introduction

VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo application is designed with aim to demonstrate the capabilities of Neurotechnology faces recognition engine. The program is a Windows 7/8/10 compatible GUI application.

Evaluation software supports image acquisition from the external video source (such as Web or IP cameras (see page 11)). It can also read face images from still images (.bmp, .tif, .png, .jpg, .gif files).

The application has 2 operation modes:

1. **Enrollment**. Software processes the face image, extracts features and writes them to the database.
2. **Identification**. This mode performs new face image identification against face templates stored in the database.

1.1 System Requirements

The exact system requirements highly depends on the use scenario, some approximate minimal requirements are listed below.

Hardware requirements:

- x86 (32-bit) or x86-64 (64-bit) compatible processors.
  - AVX2 support is highly recommended. Processors that do not support AVX2 will still run the Neurotechnology algorithms, but in a mode, which will not provide the specified performance. Most modern processors support this instruction set, but please check if a particular processor model supports it.
  - The CPU plugin supports inference on Intel® Xeon® with Intel® AVX2 and AVX512, Intel® Core™ Processors with Intel® AVX2, Intel Atom® Processors with Intel® SSE.
- 2 GB of free RAM is recommended for general usage scenarios. It is possible to reduce RAM usage for particular scenarios.
- (Optionally) A webcam or IP camera or any other camera (recommended frame size: 640 x 480 pixels) for face images capturing. Neurotechnology SDK includes support modules for a list of cameras. An IP camera should support RTSP and stream video in H.264 or M-JPEG. Cameras, which can operate in near-infrared spectrum, can be also used for image capture. Any other webcam or camera should provide DirectShow, Windows Media or Media Foundation interfaces for Windows platform, GStreamer interface for Linux and Mac platforms.
- (Optionally) Fingerprint scanner. Neurotechnology SDKs includes support modules for more than 150 models of fingerprint scanners under Microsoft Windows, Linux and Mac OS X platforms. See the list of supported fingerprint scanners.
- (Optionally) Iris scanner (recommended image size: 640 x 480 pixels) for iris image capture. Neurotechnology SDKs includes support modules for several iris cameras. See the list of supported iris scanners.
- (Optionally) Microphone. Any microphone that is supported by the operating system can be used.

Microsoft Windows specific requirements:

- Microsoft Windows 7 / 8 / 10, 32-bit or 64-bit. Note that some fingerprint scanners are supported only on 32-bit OS or only from 32-bit applications.
- Microsoft .NET framework 4.5 or later (for .NET components usage)
- Microsoft Visual Studio 2012 or newer (for application development with C++ / C# / VB .NET)
- Sun Java 1.7 SDK or later (for application development with Java)

Linux specific requirements:

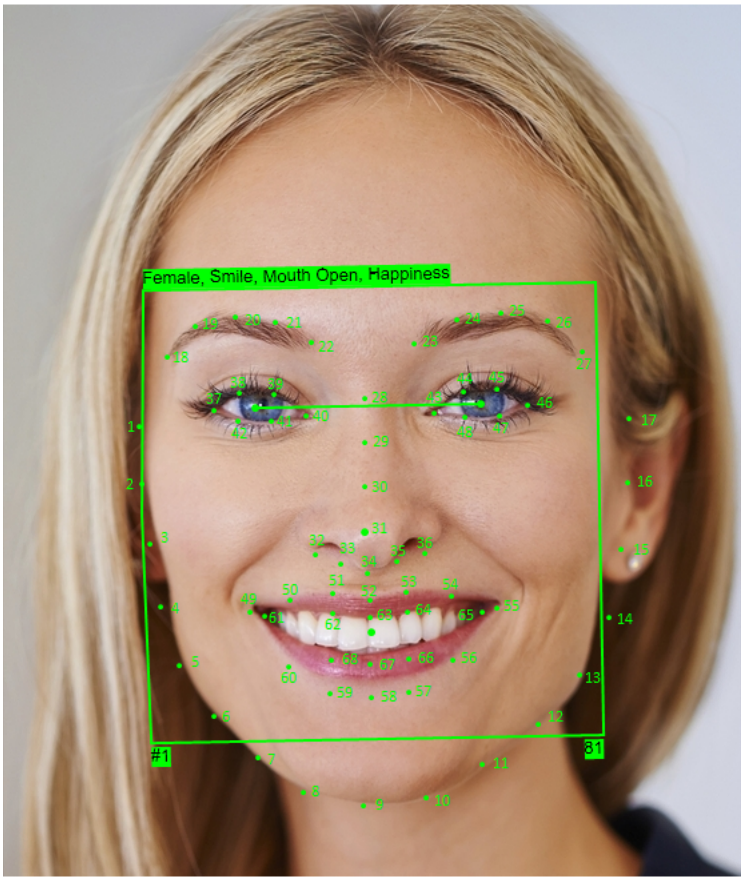
- Linux 3.10 or newer kernel (32-bit or 64-bit) is required. If a fingerprint scanner is required, note that some scanners have only 32-bit support modules and will work only from 32-bit applications.
- glibc 2.17 or newer
- GStreamer 1.10.x or newer with gst-plugin-base and gst-plugin-good is required for face capture using camera/webcam or rtsp video. GStreamer 1.4.x or newer is recommended.

- libgudev-1.0 219 or newer (for camera and/or microphone usage)
- alsa-lib 1.1.6 or newer (for voice capture)
- gcc 4.8 or newer (for application development)
- GNU Make 3.81 or newer (for application development)
- Sun Java 1.8 SDK or newer (for application development with Java)

2 Face Feature Points

Feature points

The image below shows the face bounding rectangle and detected 68 face features:



This option can be enabled in faces sample applications by selecting *Detect all feature points*.

These API functions are for working with feature points:

- To retrieve feature points: `NLAttributesGetFeaturePoints` function for C; `NLAttributes.FeaturePoints` property for .NET; `getFeaturePoints` method for Java. These return the collection of all feature points.
- `NLFeaturePoint` structure contains information about feature point - coordinates, code and confidence.
- `NLAttributes` class provides not only functionality for feature points, but also for face expressions, gender and liveness.

Notes

It is not recommended to use age attribute for live video streams.

3 Application

VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo incorporates Neurotechnology face recognition algorithm. Using this demo application face images can be enrolled from still images (from image files) or video streams (from cameras) and identification task performed.

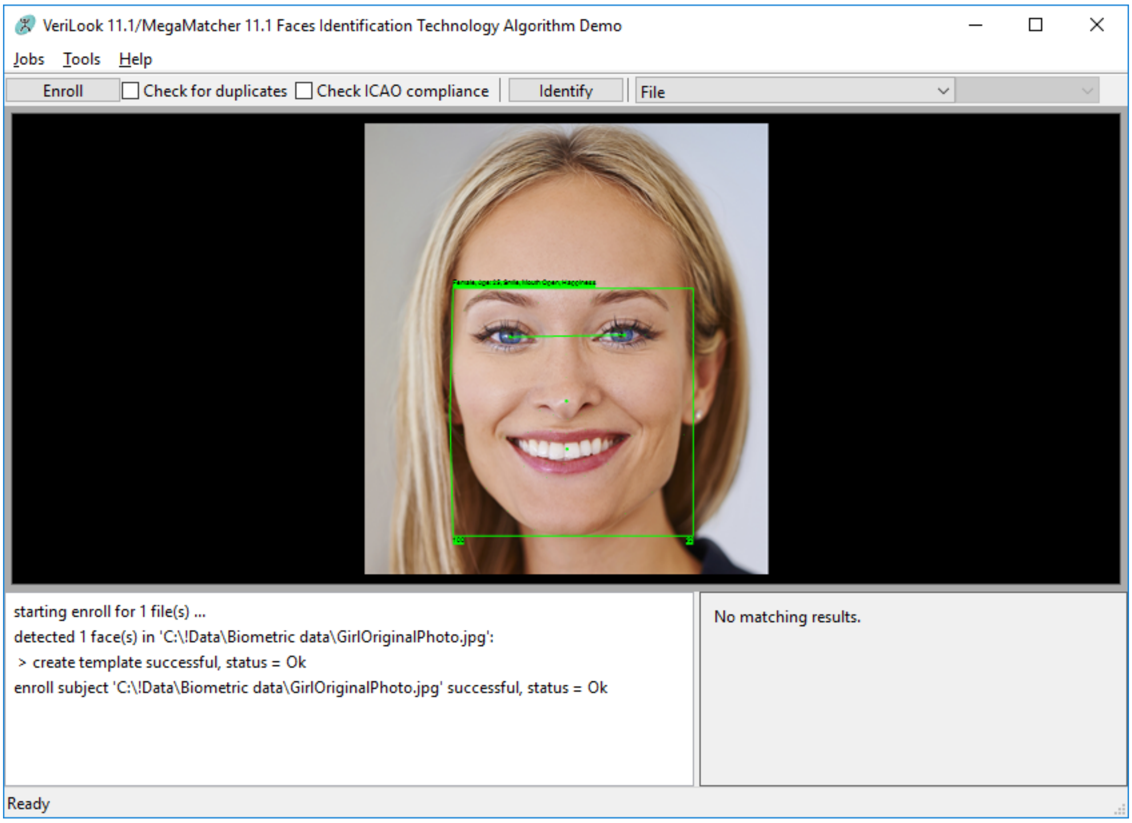
3.1 Windows

VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo application in Windows OS can be started from `FacesAlgorithmDemo.exe`.

3.1.1 Main Window

Main application window has three-pane layout, where top pane is used for displaying image or video stream and two bottom panes are used for messages logging. Menu commands and two toolbar buttons, used as shortcuts for most accessed commands, control application.

Person can be enrolled using "Enroll" command. After enrolling a person's image from file the main window looks like this:


VeriLook 11.1/MegaMatcher 11.1 Faces Identification Technology Algorithm Demo
Jobs
Tools
Help
Enroll
□ Check for duplicates
□ Check ICAO compliance
Identify
File
Female, Age: 33, Smile, Mouth Open, Happiness

```
starting enroll for 1 file(s) ...
detected 1 face(s) in 'C:\!Data\Biometric data\GirlOriginalPhoto.jpg':
 > create template successful, status = Ok
enroll subject 'C:\!Data\Biometric data\GirlOriginalPhoto.jpg' successful, status = Ok
```

No matching results.

Ready

The main window panes are these:

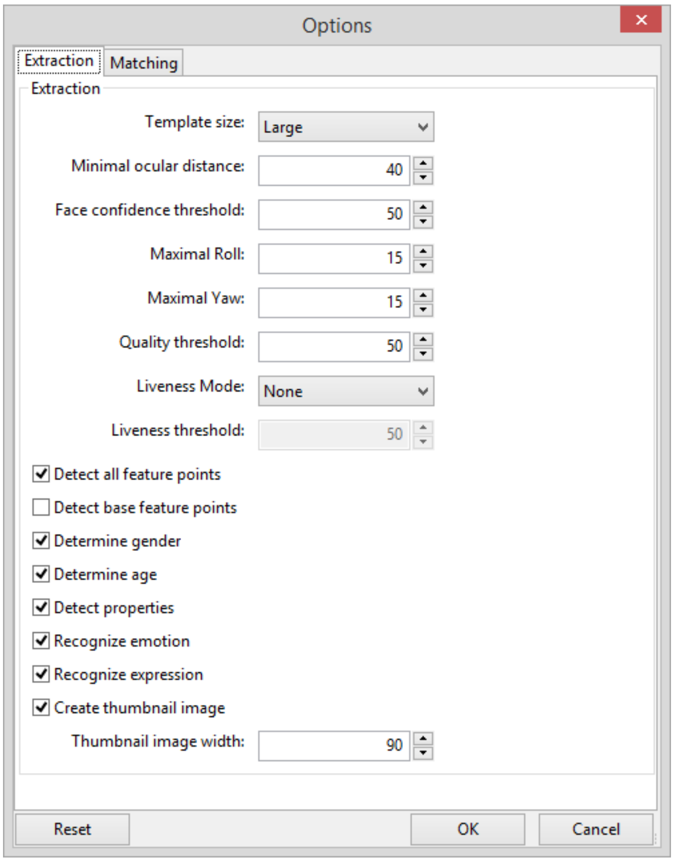
1. Top face detection pane, used to display video or still images and result of face detection algorithm overlaid on image.
2. Left pane is application log, used for system information and application progress messages.

3. Right pane is matching results pane for listing id of the subject in the database, most similar to matched image. Subjects are considered “similar” if their score value exceeds matching FAR (False acceptance rate) set via Options (*Tools->Matching*) dialog. Also in this pane matching score is displayed.

3.1.2 Options Dialog

Options dialog window can be accessed through menu command *Tools->Options...* Options dialog window is used to configure faces extraction and matching parameters.

Extraction



Template size: Large

Minimal ocular distance: 40

Face confidence threshold: 50

Maximal Roll: 15

Maximal Yaw: 15

Quality threshold: 50

Liveness Mode: None

Liveness threshold: 50

☑ Detect all feature points

□ Detect base feature points

☑ Determine gender

☑ Determine age

☑ Detect properties

☑ Recognize emotion

☑ Recognize expression

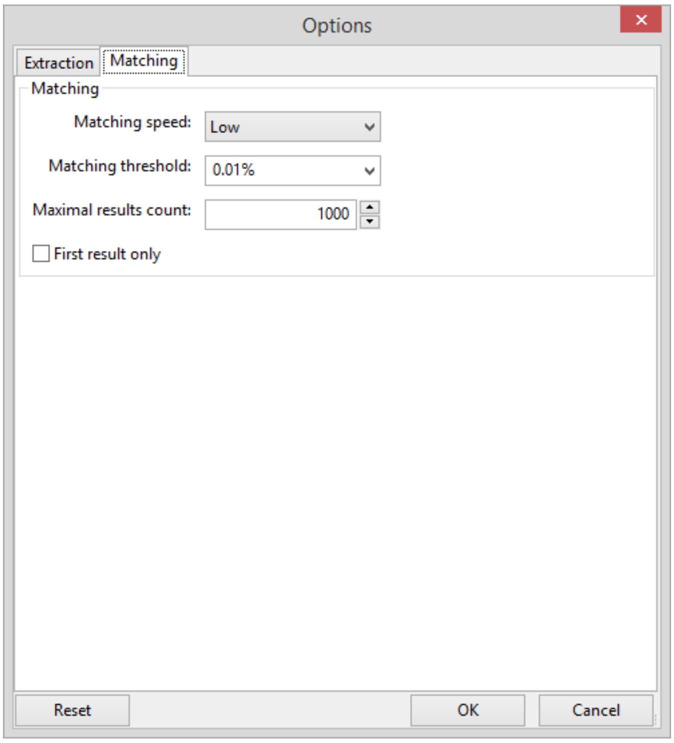
☑ Create thumbnail image

Thumbnail image width: 90

- *Template size* - size of face image templates when enrolling from image. Can be used Large, Medium or Small template. It is recommended to use large template size.
- *Minimal ocular distance* – minimum distance between eyes.
- *Face confidence threshold* – value which controls the requirements for face detection. The greater this value is the more strict rules are applied when looking for faces in an image.
- *Maximal Roll* - this value is used to define the maximum value in degrees of rolled face image which can be enrolled or identified.
- *Maximal Yaw* - this value is used to define the maximum value in degrees of yawed face image which can be enrolled or identified.
- *Quality threshold* – controls how strict rules are applied when determining the quality of a found face for extraction.
- *Liveness mode* - can choose 3 liveness detection modes: passive, active or none (liveness detection is not used). For more information see section Face Liveness Detection (↗ see page 9).
- *Liveness threshold* – value which controls the requirements for face liveness. The greater this value is the more strict rules are applied when deciding if the face is live.
- *Detect all feature points* – if checked, eyes, nose, lips and face feature points will be detected. Otherwise, only eyes will be detected.

- *Detect base feature points* – if checked, eyes' centers and nose tip will be detected.
- *Detect gender* – if checked, gender will be detected.
- *Detect properties* – if checked, face properties will be detected.
- *Recognize expression* – if checked, facial expression will be detected.
- *Recognize emotion* – if checked, emotions will be detected.
- *Create thumbnail image* – if checked, a thumbnail image will be created during extraction.
- *Width* – width of the thumbnail image.

Matching



Matching

Matching speed: Low

Matching threshold: 0.01%

Maximal results count: 1000

□ First result only

- *Matching speed* – defines matching speed. When the most accurate matching results are required it is recommended to use *Low* speed. But in this case matching task is performed slower. If the maximum matching speed is required it is recommended to use *High* matching speed. **Note**: Template size also affects matching speed. The highest possible matching speed is achieved when *Small* template and *High* speed is used.
- *Matching threshold* - threshold that separates identical from different face templates. Matching threshold is linked to false acceptance rate (FAR, different templates erroneously accepted as of the same) of matching algorithm. The higher is threshold, the lower is FAR and higher FRR (false rejection rate, same templates erroneously accepted as different) and vice a versa.
- *Maximal results count* – maximum number of matching results returned.
- *First result only* – if checked, only the first positive result will be returned during matching.

3.1.3 Menu Commands

The following table explains menu commands of the Faces Algorithm Demo application.

Menu command	Description
Jobs » Enroll	Enrolls image to face database.
Jobs » Identify	Search for matching image in face database.
Tools » Clear Log	Clear application log windows.

Tools » Clear Database	Empty faces database.
Tools » Options…	Display options dialog.
Help » About	Display information about Faces algorithm demo application.

3.1.4 Simple Usage Examples

In this section simple basic scenarios of using VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo application are described in a step by step fashion.

Enrolling from the camera

1. First, camera which will be used as the capture device must be selected from "Source" menu in the toolbar. After that camera video input should be visible in the upper pane of the sample application.
2. Faces found in the video stream are outlined in the capture image by green rectangle (the green rectangle outlines the face that best fits the matching requirements of the Neurotechnology Faces algorithm in addition this face has its eyes marked by the application).
3. To enroll a face from a video stream, "Enroll" button in the toolbar can be used or option "Enroll" from a system menu "Jobs" can be selected. This operation succeeds when at least one face in the image is present. Sample application processes several frames and enrolls the face into the internal database.

Identifying from the camera

1. Select the camera which will be used as the capture device from the "Source" menu in the toolbar. Camera's video input should be visible in the upper pane of the sample application.
2. Faces found in the video stream are outlined in the capture image by colorful rectangles (the green rectangle outlines the face that best fits the matching requirements of the Neurotechnology Faces algorithm in addition this face has its eyes marked by the program, and yellow rectangles show other faces found in the image).
3. To identify a face "Identify" button must be clicked or option "Identify" must be selected from a system menu "Jobs". After this the face, that best suits the matching requirements of the Neurotechnology Faces algorithm (it should be outlined by a green rectangle in the video input pane) will be matched against the database of the demo program and most probable candidate will be displayed in the bottom right pane of the program window.

Enrolling from the file

1. Select file input as the capture device from "Source" menu in the toolbar.
2. To enroll a face from a file "Enroll" button must be pressed or "Enroll" option selected from the system menu "Jobs". After that a file open dialog should displayed in which a file must be selected. The image in the file will be displayed in the upper pane of the window, with the found face outlined by a green rectangle (if such rectangle is absent it means that no face suitable for enrollment was found in the image) and a dialog asking for the person to be enrolled id will be shown. The outlined face will be enrolled to the demo program database.

Identifying from the file

1. Select file input as the capture device from "Source" menu in the toolbar.
2. To identify a face from a file "Identify" button must be pressed or "Identify" option selected from the system menu "Jobs". After that a file open dialog should be displayed in which a file must be selected. The image in the file will be displayed in the upper pane, with the found face outlined by a green rectangle (if such rectangle is absent, it means that no face, suitable for matching was found in the image). The outlined image will be matched against the demo program database and most probable candidate will be displayed in the bottom right pane of the window.

3.2 Linux

VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo application on Linux can be started from `FacesAlgorithmDemo` file. There are separate distribution for 32 bits and 64 bits operating system. See Windows (see page 4) part to find out how to use this application.

3.3 Mac OS X

VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo application on Mac OS can be started from `FacesAlgorithmDemo.app` file. See Windows (see page 4) part to find out how to use this application.

4 Face Liveness Detection

Neurotechnology faces recognition algorithm is capable to differentiate live faces from non live faces (e.g. photos).

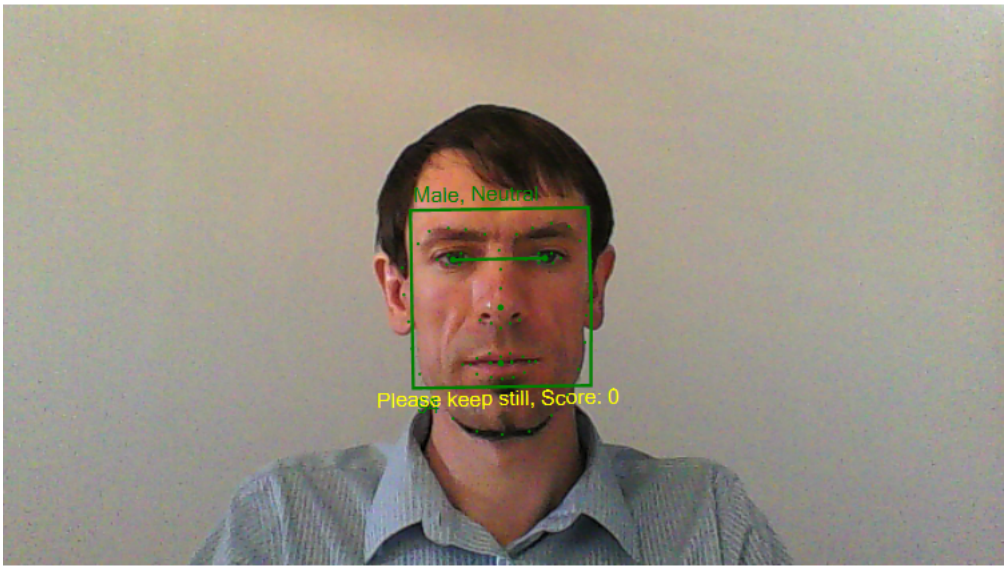
Liveness modes

Faces recognition algorithm has 6 modes for liveness check:

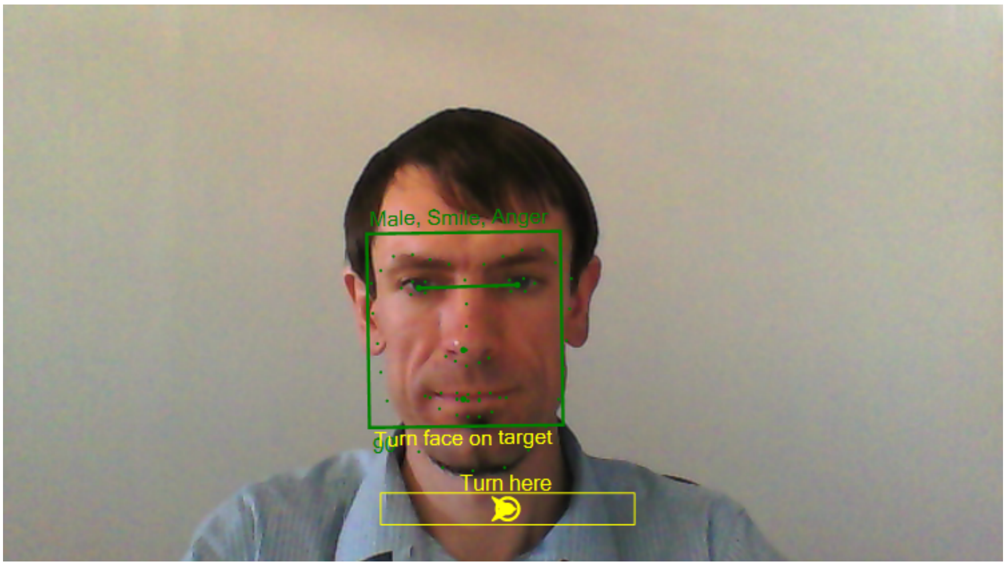
- **Passive**. In this mode user should hold his head still for a few seconds and blink eyes. Face recognition algorithm calculates the score and checks if the face is live.
- **Active**. In this mode user should follow the commands on the screen by moving his head or blinking eyes. Face recognition algorithm checks if the face is live.
- **Passive and Active**. This mode is a mix of passive and active liveness checks.
- **Simple**. In this mode user should follow commands on the screen and turn face from side to side. It is simplified version of active liveness recognition.
- **Custom**. In this mode it is required to turn head to four directions (up, down, left, right) in a random order (follow-up points are same as Active mode).
- **None**. In this mode face liveness check is not performed.

Passive and active modes can be combined for a better liveness check. The images below show how faces liveness check is performed when passive and active modes are combined.

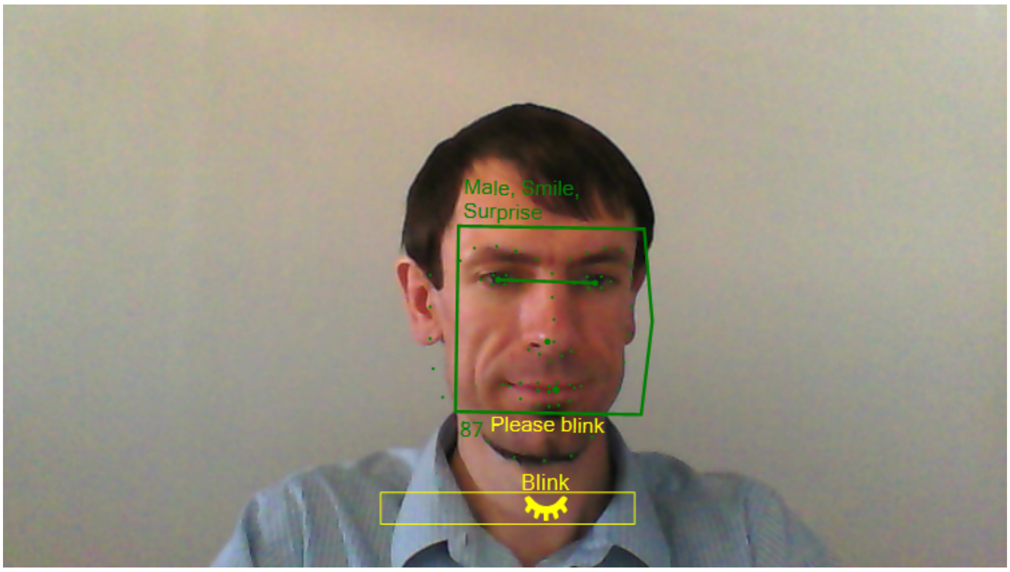
1. Passive liveness check is performed and user is asked to keep still:



2. When passive liveness check was performed, active liveness check starts. User is asked to turn his face (head) on the target. The arrow shows turn direction:



Active liveness check also has eyes blink step when user asks to blinks his eyes several times:



3. Also, simple liveness check can be used. In this mode user should keep rotating yaw and follow on screen commands.

Combining both passive and active liveness check modes higher accuracy can be achieved. Please check Faces samples in the SDK for more information how to use liveness check.

4. When custom liveness mode is used, user is required to turn his head in 4 randomly selected directions (up, down, left and right).

5. When no liveness check is needed, select *None* liveness check mode.

5 IP Cameras Configuration

VeriLook 12.3/MegaMatcher 12.3 Algorithm Demo can be used with most IP cameras. Some of recommended IP cameras need configuration:

Cisco Video Surveillance IP 4500

Cisco Video Surveillance IP 4500 camera is supported through NdmCisco plugin. The camera should be configured by editing the `NdmCisco.conf` file in `\Cameras\NdmCisco` directory of the Algorithm Demo. Multiple cameras can be specified, by using the following template (for each camera):

```
[Camera]
Ip=192.168.2.150
Username=admin
Password=Admin123
ChannelId=1
ChannelName=Channel1
Id=MyId
DisplayName=MyDisplayName
```

1. *IP* - defines IP address of camera channel
2. *Username* - camera's username. To set camera's username use Cisco software.
3. *Password* - camera's user password.
4. *ChannelId* - Camera's channel ID.
5. *ChannelName* - Name of camera's channel.
6. *Id* - NDeviceManger ID for the camera.
7. *DisplayName* - display name for the camera.

Mobotix DualNight M12

Mobotix DualNight M12 IP camera is supported through NdmMobotix plugin. The camera should be configured by editing the `NdmMobotix.conf` file in `\Cameras\NdmMobotix` directory of the Algorithm Demo. Multiple cameras can be specified, by using the following template (for each camera):

```
[Camera]
Ip=192.168.2.136
Id=MobotixId
DisplayName=MobotixDisplayName
Channel=right
```

1. *IP* - defines IP address of camera channel
2. *Id* - NDeviceManger ID for the camera.
3. *DisplayName* - display name for the camera.
4. *Channel* - camera's channel.

Prosilica GigE Vision

Prosilica GigE Vision camera is supported through NdmProsilica plugin. The plugin is saved as `VimbaC.dll` file in `\Cameras\NdmProsilica` directory of the Algorithm Demo.

Note: This camera does not require any additional configuration.

Canon EOS DSLR

Canon EOS DSLR cameras with video mode are supported through NdmCanonEds plugin. The plugin is saved as `EDSDK.dll` file in `\Cameras\NdmCanonEds` directory of the Algorithm Demo

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