

FaceReader

Reference Manual

Version 2.0

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1

Introduction

Thank you for purchasing FaceReader, the unique professional system for detecting emotional expressions in the face. This manual contains all the information you need to make the most of this powerful tool. By way of introduction, this chapter describes how to use the manual, and how to get additional support if required. This chapter also contains an introduction to FaceReader, an overview of what is new in FaceReader 2.0 and a description of the limitations of the current version.

1.1 About this manual

The manual is written so that it is understandable without the program in front of you, but it is probably more rewarding to try out the procedures as they are described. You can use this manual in one of two ways:

Read through the chapters relating to particular functions, to get background information before using the program.

Consult the manual as a reference document, to find out particular information. You can find a topic either by consulting the table of contents (at the front of the manual) or the index (at the end).

If you prefer, this manual is also provided as a PDF (portable document format) file. This file can be read and printed using Adobe Acrobat® Reader, which you can download free of charge from www.adobe.com. You can either copy the PDF file from the installation CD to your hard disk, or open it directly from the FaceReader installation CD.

All the information in this manual can also be found in the Online Help. To access the Online Help from within FaceReader, press **F1** or choose **Help** from the **Help** menu. Use the Contents, Index or Search options to find specific help topics.

1.2 Typographical conventions

Software elements (such as menus or commands) are shown in **bold**.

Keys such as **F1** are also shown in bold.

Functions that have task bar icons are indicated by the icon in the margin.

- Check box options are indicated with a square.
- Radio buttons (only one item in a group can be selected at once) are shown by a circle.



Warnings are indicated by a warning icon. Ignoring warnings can lead to data loss or damage.



Important information is shown by an information button.



Tips and tricks are shown by a light-bulb and text in italics.



A reference to other documentation (than the FaceReader manual) is indicated by this icon.



Details about hardware are shown using this icon.

1.3 How to get additional support

Online help

You can start the online help by pressing **F1** or by selecting **Help** in the **Help** menu. You can find help topics by selecting Contents, or using the Index or Search function.

Help menu

FaceReader's Help menu contains the following options:

Help topics – Starts the Online Help. On the start page you will find an overview of FaceReader. You can then select other topics using the table of contents, index or search function.

Quick Setup Guide – The Quick Setup Guide helps you to set up your camera and lighting correctly. By default, the Quick Setup Guide is shown every time you start FaceReader.

FaceReader Online – This is a link to the FaceReader section on the Noldus website.

FaceReader Support – This is a link to the Help desk section on the Noldus website.

Upgrade – If you click this option, the **Upgrade Key** dialog box opens. The dialog box contains your license number. It opens automatically when you start FaceReader 2.0 for the first time after installation and the system detects the old hardware key.

About – Choose this option to see details of exactly which version of FaceReader you are using and the serial number of your software.

Noldus Help Desk

If you have any problems, questions, remarks or comments, please let us know. You can contact us via our website (www.noldus.com/support) and fill out a Support Request Form (preferred) or phone during working hours in two time zones. See Appendix B to get details on how to contact our support department.



Please check the online help or this manual before contacting our support department.

Please refer to the **About Noldus - Contact us** section on our website (www.noldus.com) for other contact information.

1.4 An introduction to FaceReader

This section gives a general overview of what the FaceReader program does. For a more detailed description of all its functionality, please see chapter 3 - 7 in this manual.

What is FaceReader?

FaceReader is a program for facial analysis. It can detect emotional expressions in the face. It can identify six basic emotions: happy, sad, angry, surprised, scared, disgusted and a neutral state. Additionally, it can indicate the person's gender, age, ethnicity, the amount of facial hair (beard and/or moustache) and whether the person is wearing glasses or not. The software can also identify the subject.

FaceReader data can be imported into The Observer, the leading software package for the collection, analysis and presentation of observational data. This enables you to integrate FaceReader data with other data, such as manually logged events, physiological data and eye tracker data and to analyze the full context. For instance, what user interface is the test participant looking at and what part triggers an emotion.

FaceReader can be used in a wide range of research areas:

Psychology – How do people respond to particular stimuli, e.g. in cognitive research.

Education – Observing students' facial expressions can support the development of educational tools.

Human-computer interaction – Facial expressions can provide valuable information about user experience.

Usability testing – Emotional expressions can indicate the ease of use and efficiency of user interfaces.

Market research – How do people respond to a new commercial's design?

Consumer behavior – How do participants in a sensory panel react to a presentation?

How does FaceReader work?

The main problem in the analysis of facial expressions is how to deal with variance in pose/orientation and lighting of the face. The solution that FaceReader uses, is to classify faces in three consecutive steps. Please see reference [1] - [3] on page 11 for more information.

1 Face finding – The position of the face in an image is found using a method called the Active Template Method (ATM). The Active Template Method (which is similar to the implementation described in [4]), places a template over an image and calculates what the most likely position of the face is. In FaceReader 2.0 a second algorithm for face finding has been added, the Viola Jones cascaded classifier algorithm. This algorithm takes over when the Active Template Method has problems finding the face.

- 2 Face modelling** – In this step, a model-based method is used, called the Active Appearance Model (AAM) [5], to synthesize an artificial face model, which describes the location of 55 key points in the face and the facial texture of the area entangled by these points. The model uses a database of annotated images and calculates the main sources of variation found in the images. Principal Component Analysis compression is used to reduce the model dimensionality. New faces can then be described as deviations from the mean face, using a vector.
- 3 Face classification** – The actual classification of the facial expressions is done by training an artificial neural network [6], which takes the above vector as input. As training material nearly 2000 manually annotated images were used. The network was trained to classify the six basic or universal emotions described by Ekman [7]: happy, sad, angry, surprised, scared, disgusted and a neutral state.

FaceReader can recognize facial expressions with an accuracy of 89%. For some emotions the accuracy is higher, for others lower (Table 1).

	happy	angry	Sad	surprised	scared	disgust	neutral	recall
happy	138	0	1	0	0	0	1	0.99
angry	1	116	2	1	3	11	0	0.87
sad	3	4	109	19	2	1	1	0.78
surprised	0	1	6	128	0	0	0	0.95
scared	0	8	5	2	115	5	3	0.83
disgust	1	5	3	0	3	125	0	0.91
neutral	0	11	2	1	1	0	125	0.89
precision	0.97	0.80	0.85	0.85	0.93	0.88	0.96	0.89

Table 1 Horizontally: emotional expressions scored manually by the annotators of the Karolinska data set [8]. Vertically: expressions scored by FaceReader [1,2].

References:

- 1** H. van Kuilenburg, M. Wiering and M.J. den Uyl. A Model Based Method for Automatic Facial Expression Recognition. Proceedings of the 16th European Conference on Machine Learning, Porto, Portugal, 2005, pp. 194-205, Springer-Verlag GmbH.
- 2** M.J. den Uyl and H. van Kuilenburg. The FaceReader: Online Facial Expression Recognition. Proceedings of Measuring Behavior 2005, Wageningen, The Netherlands, August 30 - September 2, 2008, pp. 589-590.
- 3** H. van Kuilenburg, M.J. den Uyl, M.L. Israël and P. Ivan. Advances in face and gesture analysis. Proceeding of Measuring Behavior 2008, Maastricht, The Netherlands, August 26-29, 2008, pp. 371-372.
- 4** K.K. Sung and T. Poggio. Example-based learning for view-based human face detection. IEEE Transactions on Pattern Analysis and Machine Intelligence, 20(1): 39-51, 1998.
- 5** T. Cootes and C. Taylor. Statistical models of appearance for computer vision. Technical report, University of Manchester, Wolfson Image Analysis Unit, Imaging Science and Biomedical Engineering, 2000.
- 6** C.M. Bishop. Neural Networks for Pattern Recognition. Clarendon Press, Oxford, 1995.
- 7** P. Ekman. Universal facial expressions of emotion. California Mental Health Research Digest, 8: 151-158, 1970.
- 8** D. Lundqvist, A. Flykt, A. Öhman. The Karolinska Directed Emotional Faces - KDEF. CD ROM from Department of Clinical Neuroscience, Psychology section, Karolinska Institute, 1998.

1.5 What's new in FaceReader 2.0

This section gives users of FaceReader 1.0 an idea of the improvements in FaceReader 2.0. The changes include a revision of the user interface and adding important new functionality. Please see below for an overview of the new functionality.

New face models

New face models have been added to the software. It is now possible to analyze Asian faces and face of children older than 3 years. Please note that the current FaceReader version is not well-trained for analysis of East-Asian children.

Improved face finding and face modeling

The Active Template Method for finding the face is not the only face finding method anymore. A second algorithm has been added, the Viola Jones cascaded classifier algorithm. If the Active Template Method has problems finding the face, the Viola Jones algorithm takes over. That means that more faces are found.

Face modeling has also improved. FaceReader 2.0 tracks better and can, therefore, cope better with (slowly) moving faces. Fast movements are still a problem.

Select which part of the video (stream) will be analyzed

You can now select and analyze only the interesting parts in your video. You can browse to the parts of interest in your video file or wait till an interesting episode starts in your live video stream and start the analysis at that point in time. In this way, you can analyze several interesting episodes in your video file or live video stream.

New graphs which you can use in your reports

New graphs are available in FaceReader 2.0. You can now view **Expression Graphs** for each emotion. In an **Expression Graph** you can view one facial expression over time. FaceReader also provides a **Pie chart** with the distribution of emotions in your

data. You can save the **Expression Graphs** and **Pie chart** and use them in your presentations and reports.

Log files in XML format

You can now save your analysis results in XML format. This is especially useful if you want to import your FaceReader data into The Observer, our software package for collecting and analyzing observational data. If you want to import FaceReader data as external data, you can still use the Detailed logs in text format.

New codec pack

FaceReader 2.0 now has its own codec pack. There is no interference with The Observer XT MainConcept Decoder Pack anymore.

1.6 Limitations of the current version

The current FaceReader version has a number of limitations. It is good to keep these in mind when you start working with FaceReader.

FaceReader is currently not trained to work with very young children, below the age of 3.

FaceReader 2.0 is not (yet) trained for analysis of children from East Asia and South-East Asia. In contrast to the previous version, FaceReader 2.0 works well with other children and East Asian and South-east Asian adults.

Glasses may hinder classification. Especially thick and dark frames can reduce performance significantly. A polarisation filter on the camera can help to avoid reflections in the glasses.

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Pose, movement and rotation of the test person are limited. The test person should stand or sit and look frontally into the camera (angle $< 30^\circ$).

FaceReader requires strict light conditions. Please see page 27 for more information.

The face should not be partially hidden, for instance by a hat or very heavy facial hair. It is also very difficult to classify a person's facial expressions when he/she is eating, because the person's hand covers part of the face when he/she puts food in the mouth.

FaceReader can analyze one face at once. If there are more faces in an image, these can be analyzed in different runs, provided that the positions do not change significantly.

Please contact us if any of the limitations above impede your research.

2

Installation

This chapter describes how to install FaceReader on your computer. It also provides information how to set up your hardware.

Prior to installation, please check the packaging list to make sure all the components are presents. If any of the components listed is missing or damaged, please report this to us immediately.

The contents of your package differ for new and existing users:

If you are a new user of FaceReader – You received the FaceReader installation CD, this Reference Manual and a hardware key.

If you are upgrading from FaceReader 1.0 – You received the FaceReader installation CD and this Reference Manual. You also received a number to upgrade your current hardware key. Hence, no hardware key is enclosed, because the one you have is upgraded automatically when you start FaceReader for the first time and enter the upgrade number.



FaceReader 2.0 will be installed next to FaceReader 1.0. If you do not want two FaceReader versions on your computer, you must de-install FaceReader 1.0 before installing the new version.

2.1 System requirements

Prior to installation, please check whether your computer meets the system requirements for running FaceReader.

Operating system

Microsoft Windows XP or Windows Vista.

FaceReader has been thoroughly tested using a US English version of Windows XP Professional (with Service Pack 3) and Windows Vista Business edition (with Service Pack 1). Like any software package, it is possible that minor differences in the operating systems of certain local language versions may affect how well FaceReader runs. If you encounter a problem of this sort, please contact Noldus Technical Support.

Computer

System requirements when using FaceReader stand-alone

— **on a computer with Windows XP:**

Processor: minimum Pentium 3, 600 MHz, Pentium Dual Core/
Dual Processor recommended

Internal memory: minimum 512 MB RAM, 2 GB recommended

— **on a computer with Windows Vista:**

Processor: minimum 1 GHz

Internal memory: minimum 1 GB RAM, 2 GB recommended

When using FaceReader in combination with The Observer:

Minimum Pentium Dual Core, 2 GHz

Internal memory: minimum 1GB RAM, 3 GB recommended

Camera

USB camera with a resolution of at least 640 x 480 pixels or an analog camera in combination with a framegrabber. When you use a webcam, we strongly recommend that you use a high-quality webcam. Simple webcams are not suitable.

You can also use a Firewire camera, but you need a program like DVdriver to make it work. Please see page 54 for more information about DVdriver.

2.2 Installing the FaceReader software



First install the FaceReader software and then connect the hardware key to your computer, not the other way around.

Follow the steps below to install the FaceReader software:

- 1 Insert the FaceReader installation CD in the CD-ROM drive of your computer. The setup program should start automatically.



If the program does not start automatically, select **Run** from the **Start** menu on the Windows taskbar. Click **Browse** and select the file **Setup.exe** from the CD drive. Click **OK** to run this file and start the installation.

- 2 On the **Welcome** screen (Figure 2.1) click **Next**.

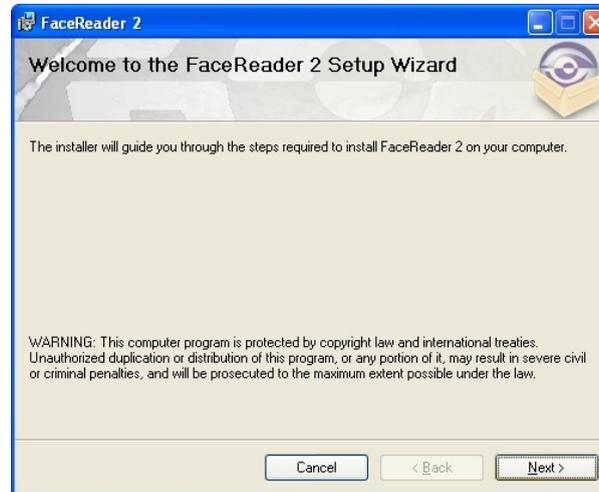


Figure 2.1 FaceReader's **Welcome** screen.

- 3 Read the **License Agreement** (Figure 2.2) carefully and click **I Agree** to confirm that you accept its terms. Then click **Next**.

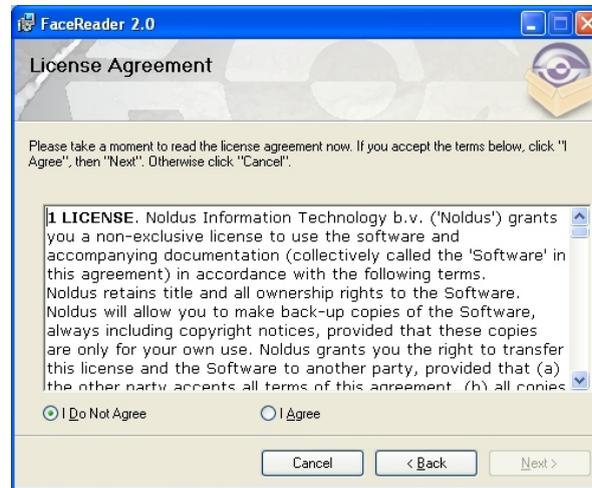


Figure 2.2 FaceReader's License Agreement.

- 4 On the **Select Installation Folder** screen (Figure 2.3), you can select the location in which you want to install FaceReader. We recommend that you install the program in the default folder (C:\Program Files\Noldus\FaceReader 2).



To be able to install FaceReader in this folder, you must have administrator rights, i.e. you are the system administrator or you are a member of the Windows group Administrators and have been assigned administrator rights. Window Power Users cannot install FaceReader.

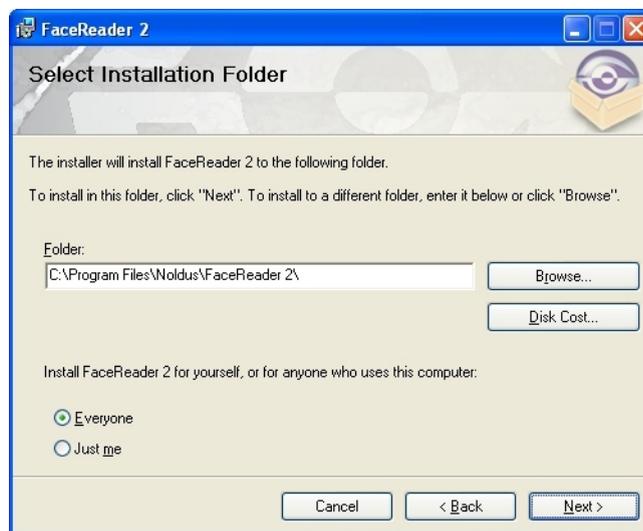


Figure 2.3 The **Select Installation Folder** screen.

- 5 On the **Select Installation Folder** screen (Figure 2.3), you can also select whether you want to install FaceReader for yourself or for anyone who uses the computer. Make your choice and click **Next**.
- 6 In the next screen, you are asked to confirm the installation. Click **Next**.

The installation of FaceReader starts. First, the drivers for the hardware key (HASP Device drivers) are installed. When the installation of the drivers is complete, you get a message. The installation of FaceReader continues.

- 7 When the installation of FaceReader is complete, a message will appear informing you that FaceReader has been successfully installed. Click **Close** to exit.



In addition to the FaceReader software, a number of sample images and video files is installed (in C:\Program Files\Noldus\FaceReader 2\Examples).

2.3 Connecting and upgrading the hardware key



First install the FaceReader software and then connect the hardware key to your computer, not the other way around.

Each FaceReader license comes with a hardware key. This is an important piece of equipment: you can only use FaceReader when the hardware key is connected to your computer. Please keep this in mind and make sure that you do not lose the key!

Connecting the hardware key

Plug the key into an available USB port on your computer. If the hardware key is correctly connected, a red light is visible inside the key.



Please be careful with the hardware key. It is sensitive and can be easily damaged.

Upgrading the hardware key

If you are upgrading from FaceReader 1.0, and start FaceReader 2.0 for the first time after installation, the system automatically detects the old hardware key and asks you to type the new **Upgrade Key** number in the **Upgrade Key** dialog box. This number is normally sent to you by e-mail or in your welcome letter.

2.4 Setting up your hardware

FaceReader can only classify facial expressions correctly if it gets a good video image. Both the placement of the camera and the lighting of the subject's face are of crucial importance in obtaining reliable classification results.



By watching FaceReader's image quality bar, you can see whether your setup produces high-quality video. Please see page 31 for more information about the image quality bar.

Choosing your camera

FaceReader has been thoroughly tested with a Philips SPC 900NC PC webcam and a Logitech Quickcam 4000 Pro. You can purchase both camera types from us or use another webcam with a resolution of 640 x 480 pixels (or higher). Simple webcams are not suitable. You can also use an analog camera in combination with a framegrabber.

You can also use a Firewire camera, but then you need a program like DVdriver to make it work. See page 54 for more information about DVdriver.

Camera setup

It is important to place the camera at a location that will give the most steady frontal view of the subject's face throughout the

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experiment. The ideal position for the camera is directly in front of the test participant. If the subject faces a computer screen, the camera can be placed either directly above or directly below the screen. When placing the camera on top of the monitor, try to position it slightly below eye level, either by raising the chair and/or by lowering the monitor. When placing the camera below the monitor, lower the chair to position the camera slightly below eye level. The classification output may have a small bias towards 'angry' when the camera is placed on top of the monitor and a small bias towards 'surprised' when the camera is placed below the monitor. This is due to the fact that people tend to tilt their head when showing these emotions. Alternatively, a camera like the Logitech QuickCam® Sphere™ (in Europe)/Orbit™ (in the US) can be used for placement of the camera in the middle of the screen.

Adjusting your camera

It is important to adjust your camera to provide images with a good contrast and brightness. You can adjust the contrast and brightness by adjusting the hardware settings using the software provided by the manufacturer of your camera. When adjusting your hardware settings, do not pay attention to the lighting of the background. Focus only on the face area of the image and ignore a very light or very dark background.



Figure 2.4 Image with a good contrast and brightness.

In Figure 2.4 you can see an example of a face image showing a good contrast and lighting. Dark areas of the face (such as the eyebrows and the pupils) are near-black and the lightest part of the face (the eye whites) are nearly white. The intensity histogram (made of the face area only) (Figure 2.5) shows how the intensity values fill the whole spectrum.

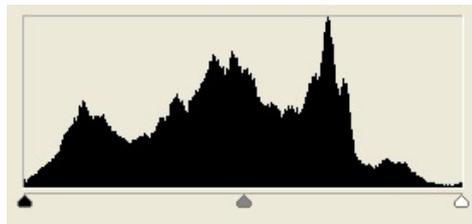


Figure 2.5 Intensity histogram of the image in Figure 2.4.



Please note that it is not possible to view a histogram like the one above in FaceReader. If you want to view such a plot, you can use graphics software like PaintShop Pro or Photoshop. To analyze video images, first make a screenshot of the image of interest.



Figure 2.6 Overexposed image.

The face area of the image in Figure 2.6 is overexposed. The forehead and cheekbones are nearly white and show very little texture. The histogram (Figure 2.7) shows how only the high intensity part of the spectrum is filled. Decrease the brightness by adjusting the hardware settings of your digital camera or decrease the aperture size of your analog camera to correct this problem.

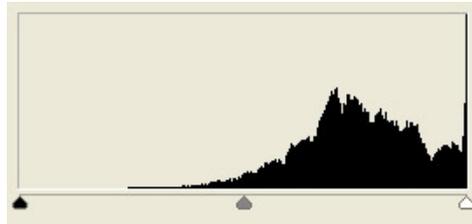


Figure 2.7 Intensity histogram of the image in Figure 2.6.



Figure 2.8 Image with too little contrast.

A very common problem is that the image has too little contrast (Figure 2.8). Especially when the background is very dark or very light and the camera is set to 'automatic', the face area of the image will have a very low variability in intensity (a low contrast). The contrast is too low when the face area of the image contains no bright white and no deep black pixels. The intensity histogram

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(Figure 2.9) shows that only the middle section of the spectrum is filled. Correct this problem by adjusting your camera (increase the contrast).

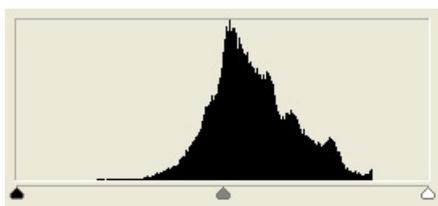


Figure 2.9 Intensity histogram of the image in Figure 2.8.

When working with a subject with a dark or very pale skin color, you may need to make some extra adjustments. The default settings will often yield an image as shown below (Figure 2.10). Although there are both dark areas and white areas (the eyes) in the face, the skin itself shows too little variations in intensity. By increasing the brightness (to make the face lighter) and increasing the contrast (to increase the variation in skin tones) you can correct this problem. For people with a very pale skin, decrease the brightness and contrast.

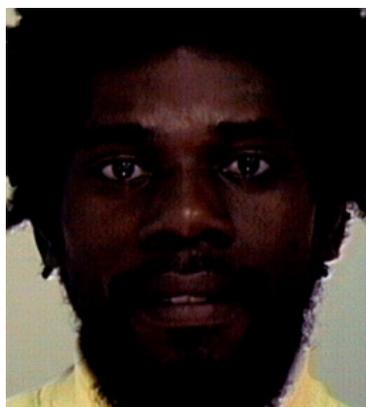


Figure 2.10 Image that is too dark.

The corrected image should look similar to the image below (Figure 2.11). Pay special attention to the skin tones. The eye whites may have less variation in intensity, but this is of lesser importance. Similarly, for individuals with a pale skin, darker areas like the eyebrows may lose some detail.



Figure 2.11 Image with a good contrast and brightness.

Lighting setup

A good lighting setup is vital to get a good image. Diffuse frontal lighting is desirable. The light intensity or color is less relevant. Strong shadows or reflections should be avoided. If possible, place the FaceReader setup in front of a window. Make sure that any windows to the sides of the subject are blinded. Lights from the ceiling, common in most buildings, will produce shadows below the eyebrows and nose. If the subject faces a computer screen, two lights to either side of the monitor will give good performance under most circumstances (please see Figure 2.12). You can purchase such lights from us. In situations where interior lighting cannot be controlled, stronger lights (e.g., four 25W fluorescent (TL) tubes) can be used to negate the effect of other, undesirable, light sources.

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To assess the quality of your (video) image, you can view FaceReader's image quality bar. Please see page 31 for more information.



Figure 2.12 FaceReader setup with lights to either side of the monitor.

3

Analyzing facial expressions

FaceReader can classify facial expressions either live or offline. In a live setup a camera is connected to the computer with FaceReader running, in an offline setup you open a video file or image in FaceReader.

3.1 Selecting a face model

Before you can start analyzing facial expressions, you must select the face model that best fits the faces that you are going to analyze. You can choose from a list of six models:

General 1 – This model has been trained on a very diverse selection of images. This model works well under most circumstances for most people.

General 2 – Like the **General 1** model, this model has also been trained on a very diverse selection of images. Under some variations of pose and lighting the **General 2** model can give better results than the **General 1** model.

Below Screen Optimized – This model has been optimized for a camera position below the monitor. It does not work well with East Asian faces and children.

EastAsian 1 – Select this model to analyze East Asian faces, for instance, Chinese or Japanese faces.

EastAsian 2 – Like the **EastAsian 1** model, this model has also been trained with East Asian faces. Under some variations of pose and lighting the **EastAsian 2** model can give better results than the **EastAsian 1** model.

Children – Select this model if your test participants are children between the age of 3 and 10. The current FaceReader version is not well-trained for analysis of East-Asian children.

From the **Options** menu, select **Settings**. Click **Face Models** in the list on the left and select the appropriate model from the drop-down list. Then click **OK**.

3.2 Analyzing facial expressions

FaceReader can classify facial expressions either live using:

A video signal from a camera (digital or analog) – See page 30.

or offline using:

A digital video file – See page 33.

An image – See page 35.

Analyzing faces using a camera

You can either use a digital camera or an analog camera (in combination with a framegrabber) to analyze faces in FaceReader.



If you use a digital camera, make sure that you have installed the software that comes with your camera, and connect the camera to an available USB or FireWire port on your computer (depending on the device). Please note that you need a program like DVdriver when you use a FireWire camera. See page 54 for more information about DVdriver.

- 1 From the **File** menu select **New Analysis** and then **Camera Analysis**. A window opens that allows you to select your camera from a drop-down list (see Figure 3.1). Select your camera and click **OK**.

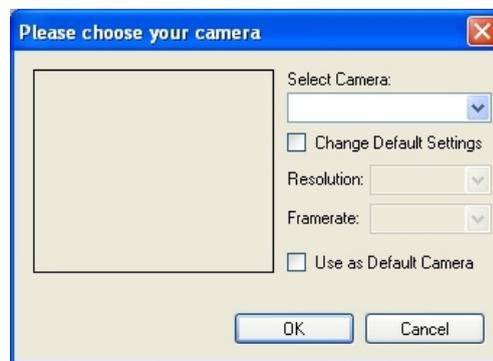


Figure 3.1 Window to select your camera.

- Change Default Settings** – By default, FaceReader selects the highest possible resolution and framerate. Select the **Change Default Settings** check box if you want to use a lower resolution or framerate.
- Use as Default Camera** – Select this check box if you always use the same camera. FaceReader automatically selects the camera.

The camera view will appear in the **Current Analysis** window.



- 2 Click the **Start Analysis** button to start the analysis of the facial expressions. A block is added to the **Analysis Overview** with the start time of the analysis interval (see Figure 3.2 for an example of an **Analysis Overview**).

Block	Begin time	End time
1	15:58:36.06	16:06:00.26

Clear Logs

Figure 3.2 Example of an **Analysis Overview**.



The name of the **Start Analysis** button changes into **Stop Analysis**.

- 3 Make sure that the quality of the camera view is good. The **Image quality** bar can help you to assess the quality of the camera image. The image quality bar must look like the one in Figure 3.3, that is, the colored bar must cross both dashed lines.



Figure 3.3 The Image quality bar.



If the quality of your camera image is not good enough, the text 'Framing failed' (FaceReader cannot find the face) or 'Modeling failed' (FaceReader cannot model the face) will appear in the **Analysis**

Visualization window. Probably either the lighting of the test person's face or the position of the camera is not optimal. See Section 2.4 for information how to improve your setup.

- 4 Click the **Stop Analysis** button to stop the analysis. The **End time** of the analysis interval is added to the **Analysis Overview**.
- 5 Repeat steps 2-4 to analyze more episodes.
- 6 From the **File** menu select **Save Analysis Results** to save the analysis results. For more information about (saving) FaceReader log files, see page 43.



The data of all the blocks are saved in one log file. If you log with a fixed interval, the text **Not Analyzed** will appear in the log file for the time points that were not analyzed. See the **File Logging** settings on page 76 for more information on the option **Log with a fixed interval**.



Click the **Clear Logs** button to delete the analysis results. The analyzed intervals in the **Analysis Overview** will be deleted.

Analyzing faces in a video file



Please see Appendix A for an overview of the video formats which FaceReader supports.

- 1 From the **File** menu, select **New Analysis** and then **Video Analysis**.
- 2 Browse to the location on your computer where you stored your video file. Select the video file name and click **Open**. The first frame will appear in the **Current Analysis** window.
- 3 Use the slider and the video control buttons to position the video file at the point where you want to start the analysis.



Play – Play the video file.



Pause playback – When you click the **Play** button it changes into the **Pause Playback** button. Click this button to pause the video.



Stop Playback/Rewind to beginning – Stops the video and jumps to the start of the video.



Step backward – Moves the video file one frame back with each click of the button.



Step forward – Moves the video file one frame forward with each click of the button.



- 4 Click the **Start Analysis** button to start the analysis of the facial expressions. A block is added to the **Analysis Overview** with the start time of the analysis interval (see Figure 3.3 for an example of an **Analysis Overview**).



The name of the **Start Analysis** button changes into **Stop Analysis**.



FaceReader can only classify facial expressions if the quality of the video is good. The **Image quality** bar can help you to assess the quality of the video image. The image quality bar must look like the one in Figure 3.2, that is, the colored bar must cross both dashed lines. If the quality of the video is not good enough, the text 'Framing failed' (FaceReader cannot find the face) or 'Modeling failed' (FaceReader cannot model the face) will appear in the **Analysis Visualization** window.

- 5 Click the **Stop Analysis** button to stop the analysis. The **End time** of the analysis interval is added to the **Analysis Overview**.
- 6 Repeat steps 3-5 to analyze more episodes in the video.

- 7 From the **File** menu, select **Save Analysis Results** to save the analysis results. For more information about (saving) FaceReader log files, see page 43.



The data of all the blocks are saved in one log file. For the time points that are not analyzed, the text **Not Analyzed** appears in the log file.



Click the **Clear Logs** button to delete the analysis results. The analyzed intervals in the **Analysis Overview** will be deleted.



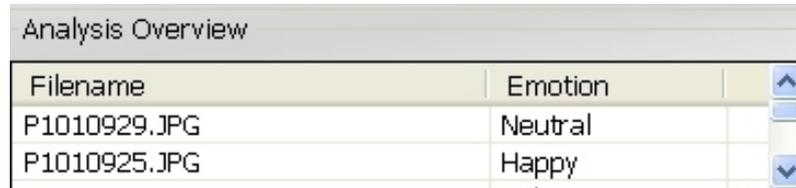
By default, the video is processed frame-by-frame. If you like to speed up the analysis, you can change the **Video Process Speed**. See page 73 for more information.

Analyzing faces in images



Please see Appendix A for an overview of the image formats which FaceReader supports.

- 1 From the **File** menu, select **New Analysis** and then **Image Analysis**.
- 2 Browse to the location on your computer where you stored your images. Select the images and click **Open**. The last-selected image will appear in the **Current Analysis** window.
- 3 Select the **Analyse all images** check box if you want to analyze all selected images.
- 4 Click the **Start Analysis** button to analyze the images. The analysis results will appear in the **Analysis Overview** (see Figure 3.4 for an example). For each image, the dominant emotion is logged.



Filename	Emotion
P1010929.JPG	Neutral
P1010925.JPG	Happy

Figure 3.4 Example of an **Analysis Overview** after analyzing a series of images.



FaceReader can only classify facial expressions if the quality of the images is good. The **Image quality** bar can help you to assess the quality of the images. The **Image quality** bar must look like the one in Figure 3.2, that is, the colored bar must cross both dashed lines. If FaceReader cannot analyze the face, the text 'Framing failed' (FaceReader cannot find the face) or 'Modeling failed' (FaceReader cannot model the face) will appear in the **Analysis Visualization** window and **Unknown** will appear in the **Analysis Overview**.

- 5 From the **File** menu, select **Save Analysis Results** to save the analysis results. For more information about saving FaceReader log files, see page 43.



If you analyzed a series of images, the data of all the images are saved in one log file.



Click the **Clear Logs** button to delete the analysis results. The analysis results in the **Analysis Overview** will be deleted.

4.3 Visualization options

Visualization

The **Analysis Visualization** window gives you some insight in how FaceReader analyzes your video images. Click the **Visualization** button to select one of the options:

Show Framing – Draws a box around the face at the location where the face was found (see Figure 3.5).

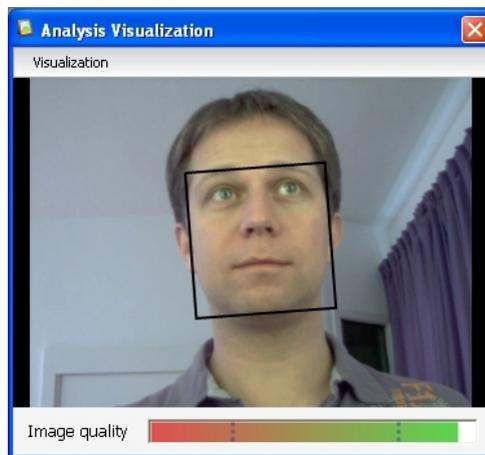


Figure 3.5 The **Analysis Visualization** window when the option **Show Framing** is selected.

Show Model – Shows the model that has been constructed by the face modeling algorithm (see Figure 3.6).

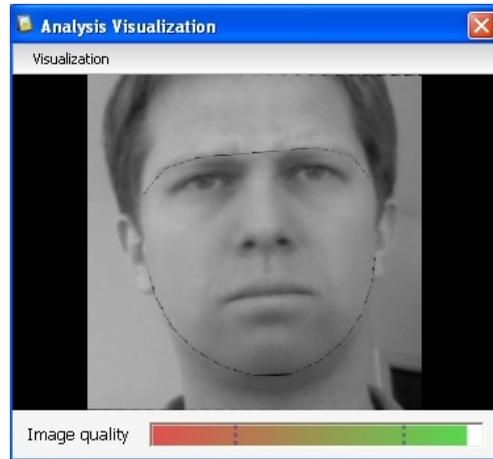


Figure 3.6 The **Analysis Visualization** window when the option **Show Model** is selected.

Show Mesh – Shows the positions of the 55 key points used by the face modeling algorithm (see Figure 3.7).

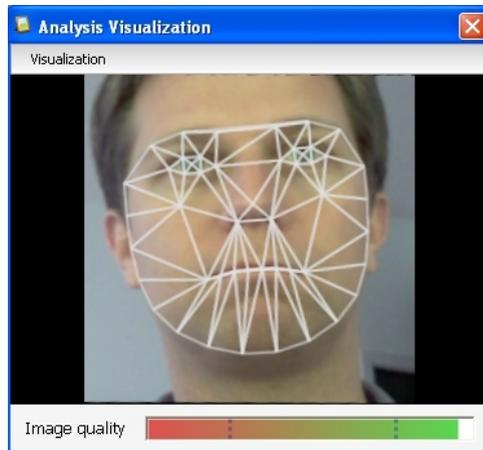


Figure 3.7 The **Analysis Visualization** window when the option **Show Mesh** is selected.

4

FaceReader's output

4.1 FaceReader's graphical output

Emotional Expressions bar chart – See below.

Expression Graphs – See page 40.

Personal Characteristics – See page 41.

Pie chart – See page 42.

Emotional Expressions bar chart

In the **Emotional Expressions** bar chart (see Figure 4.1 for an example) you can see which of the six basic emotions (and the neutral state) show up on the face. When your input is a live video stream or a video file, you will see the bars change over time, reflecting the changes in emotions on the face. Each emotion is expressed as a value between 0 and 1. Each time the dominant emotion changes, a record with the emotion is added to the State log (see below for more information about the log files).



Figure 4.1 **Emotional Expressions** bar chart showing the emotions that are visible on the face.

Expression graphs

In an **Expression Graph** you can view one facial expression over time. From the **Window** menu, select **Expression Graphs** and choose the emotions you want to view. Each emotion is plotted in a separate window.

By default, only the **Valence Expression Graph** is visible (see Figure 4.2 for an example). The valence indicates whether the emotional status of the subject is positive or negative. 'Happy' is the only positive emotion, 'Sad', 'Angry', 'Scared' and 'Disgusted' are considered to be negative emotions.



Click the **Save as image** button to save the **Expression graphs** as *.PNG, *.JPG, *.BMP, *.GIF or *.TIF images and use them in your presentations and reports.



Click the **Copy** button to copy the **Expression graphs** to the Windows clipboard.



From the **Window** menu, select **Reset Window Layout** to close the **Expression Graphs** that you opened extra and to reset the position of your windows.

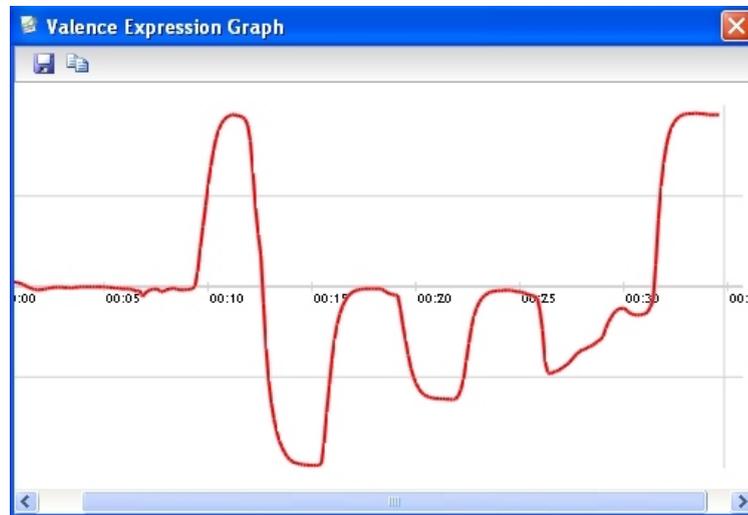


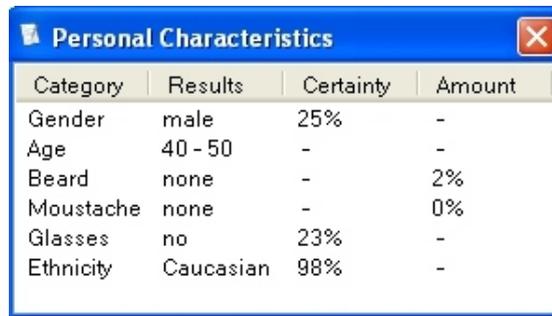
Figure 4.2 Example of a **Valence Expression Graph**.

Personal Characteristics

In addition to emotions, FaceReader can "read" other information from the face: the subject's gender, age and ethnicity and whether the person has a beard, moustache or glasses (see Figure 4.3 for an example of the output given by FaceReader). For the age a range is given, for gender, ethnicity and the presence of glasses a certainty value (ranging between 0 and 100%). The amount of facial hair (beard and moustache) is indicated by a value between 0 and 100%.



The additional facial features also give you an indication of the quality of the image. If the quality of your image is poor, the information will not be correct. For instance, if FaceReader reports that a female test person is male, then the modeling is not correct, most probably because the image is of poor quality.



Category	Results	Certainty	Amount
Gender	male	25%	-
Age	40 - 50	-	-
Beard	none	-	2%
Moustache	none	-	0%
Glasses	no	23%	-
Ethnicity	Caucasian	98%	-

Figure 4.3 **Personal Characteristics** of the test person.

Pie chart

Select one of the analysis intervals in the **Analysis Overview** to view a pie chart with the distribution of emotions in your data. See Figure 4.4 for an example.



Use the **Ctrl** and **Shift** keys to select multiple intervals and view a pie chart that is based on all these data.

Right-click on the chart and click

Copy – To copy the chart to the Windows clipboard

Save Image As – To save the chart in one of the following formats: *.png, *.jpg, *.bmp, *.gif, *.tif, *.emf.

Page Setup – To change the print properties. You can select, for instance, whether you want to print the chart in landscape or portrait view and set the margins.

Print – To print the chart.

Show Point Values – To view the subdivision of emotions in percentages. Move with your mouse over the pie to view the percentages.

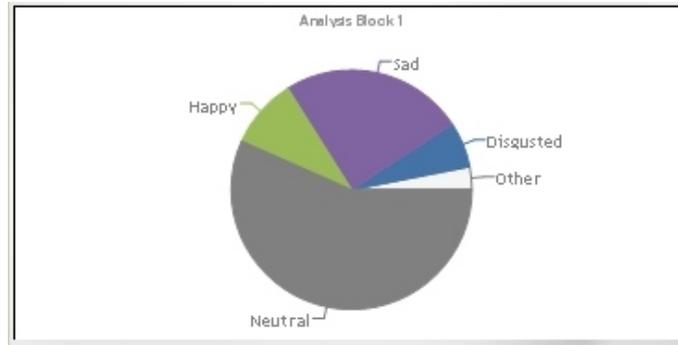


Figure 4.4 An example of a pie chart.

4.2 FaceReader's numerical output - log files

You can save your classification results in one or more log files, and open these files in other programs, either to view the data or to analyze them.

Saving your analysis results

- 1 From the **File** menu, select **Save Analysis Results**.
- 2 Browse to the location on your computer where you want to store your log files and click **OK**. The default location is:

Windows XP: C:\Documents and Settings\All Users\(\Shared) Documents\Noldus\FaceReader\Logs

Windows Vista: C:\Users\Public\Documents\Noldus\FaceReader\Logs

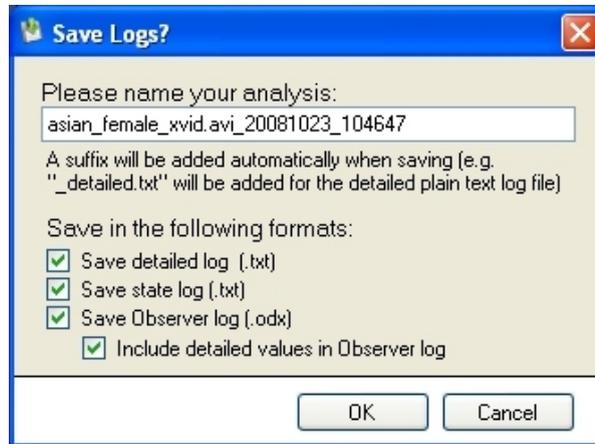


Figure 4.5 **Save Logs** window.

- 3 Enter a name for your log files in the **Save Logs** window (Figure 4.5). The default name for the log files is:

SOURCE_YYYYMMDD_hhmmss_detailed.txt for the Detailed log

SOURCE_YYYYMMDD_hhmmss_state.txt for the State log in text format and

SOURCE_YYYYMMDD_hhmmss.odx for the Observer log.

where SOURCE specifies the name of the camera, video file or image that has been analyzed and YYYYMMDD_hhmmss is the date/time code.

YYYY = year including the century

MM = month with leading zero

DD = day with leading zero

hh = hours, 12-hour format with leading zero

mm = minutes with leading zero

ss = seconds with leading zero

4 In the **Save Logs** window, select one or more of the following formats and click **OK**:

- Save detailed log (.txt)** – See below for more information about the Detailed log in text format.
- Save state log (.txt)** – See page 46 for more information about the State log in text format.
- Save Observer log (.odx)** – By default, Observer log contains information from the State log as well as the Detailed log. If you are only interested in the State log data, you can de-select the **Include detailed values in Observer log** check box. See page 47 for more information about the Observer log.

Detailed log

The **Detailed log** (see Figure 4.6 for an example) contains all the emotional classifier outputs. When no face is found or the face cannot be modeled (e.g. because the quality of the video is poor), a record with **FIND_FAILED** or **FIT_FAILED** is added. If you analyze a video file and skip frames (that is, you set the **Video Process Speed** to >1), the logging frequency changes accordingly. If you work live (using a camera) and your computer cannot process the incoming images fast enough, frames will be skipped and a record with **MISSING** will be added to the Detailed log.

The **Detailed logs** are text files with the data separated by tabs. You can view the data in most spreadsheet programs and text editors, for instance, Excel or Notepad. You can also import Detailed logs into The Observer XT, our software package for collecting observational data. Please see page 58 for more information about importing Detailed logs into The Observer XT.

Chapter 4

Video analysis detailed log							
Start time: 19/10/2008 11:34:16							
Filename: C:\Program Files\Woldus\FaceReader 2.0\Examples\Video\asian_female_xvid.avi							
Frame rate: 8							
Video Time	Neutral	Happy	Sad	Angry	Surprised	Scared	Disgusted
00:00.0	0.1313477	0.7650781	0.1710718	2.123E-06	0.002373053	0.1460252	0.016251
00:00.1	0.1314764	0.7564444	0.1877222	2.317E-06	0.002062535	0.1362553	0.018481
00:00.3	0.1339615	0.7317685	0.2333096	2.455E-06	0.001689581	0.1222761	0.023227
00:00.4	FIT_FAILED	FIT_FAILED	FIT_FAILED	FIT_FAILED	FIT_FAILED	FIT_FAILED	FIT_FAILED
00:00.5	0.138569	0.7545908	0.1907348	2.494E-06	0.001875711	0.1249512	0.017833
00:00.6	0.1417947	0.7564254	0.1868566	2.592E-06	0.001773018	0.1181344	0.017784
00:00.8	0.1493387	0.7559493	0.1845512	2.605E-06	0.001692068	0.1107239	0.017935
00:00.9	0.1645878	0.7473007	0.1873246	2.802E-06	0.00154845	0.1001133	0.018305
00:01.0	0.1992622	0.7437561	0.1817564	2.941E-06	0.001403463	0.08740279	0.017041
00:01.1	0.2664039	0.7542067	0.1559238	2.927E-06	0.00124605	0.06454232	0.01182
00:01.3	0.342395	0.750963	0.1396845	3.267E-06	0.001117764	0.05465202	0.009746
00:01.4	0.3899825	0.7380883	0.1360645	3.566E-06	0.001030006	0.04635561	0.008315
00:01.5	0.4442757	0.7176858	0.1507298	3.419E-06	0.000936526	0.03454099	0.007383
00:01.6	0.5073184	0.6597363	0.1820733	3.576E-06	0.000995575	0.02653803	0.006385
00:01.8	0.579511	0.5673918	0.1935866	0.00000494	0.001142418	0.02126473	0.005782
00:01.9	0.64867	0.4714736	0.2006602	7.475E-06	0.001399912	0.01584039	0.005754
00:02.0	0.7306536	0.3777321	0.189371	1.4062E-05	0.001774858	0.01072675	0.006356
00:02.1	0.8230961	0.2662672	0.1740562	3.1979E-05	0.003158899	0.007892585	0.005505
00:02.3	0.88334	0.187108	0.1542673	6.6705E-05	0.006537302	0.005760696	0.004936
00:02.4	0.919778	0.1295031	0.1209467	0.00013842	0.01385708	0.004094547	0.004849
00:02.5	0.9448349	0.09233368	0.07724492	0.00027376	0.02688065	0.002783396	0.004757
00:02.6	0.9620654	0.06460573	0.06474003	0.00038477	0.02920898	0.001942036	0.004338
00:02.8	0.973914	0.04574647	0.07025409	0.00040606	0.02291788	0.001357584	0.00391
00:02.9	0.9820618	0.03281729	0.07874762	0.00047925	0.02246847	0.000996533	0.003513
00:03.0	0.9876647	0.02381446	0.09438161	0.0004993	0.02264472	0.000773525	0.003265
00:03.1	0.9915175	0.01766993	0.1143215	0.00049084	0.02136248	0.000636122	0.003129

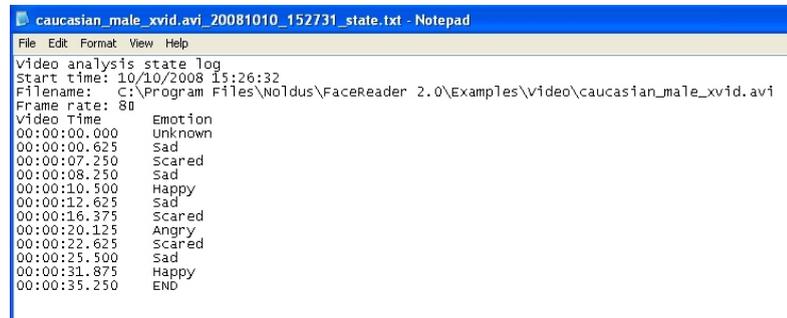
Figure 4.6 An example of a Detailed log.

State log

The State log shows the emotional state the test person is in (see Figure 4.7 for an example). A record is added to the log each time the dominant emotion changes. If no face is found or the face cannot be modeled (for instance, because the quality of the video is poor), a record with **UNKNOWN** is added to the State log.

State logs are text files which you can open in most text editors.

FaceReader's output



```
caucasian_male_xvid.avi_20081010_152731_state.txt - Notepad
File Edit Format View Help
video analysis state log
Start time: 10/10/2008 15:26:32
Filename: C:\Program Files\NoIdus\FaceReader 2.0\Examples\Video\caucasian_male_xvid.avi
Frame rate: 80
Video Time      Emotion
00:00:00.000   Unknown
00:00:00.625   Sad
00:00:07.250   Scared
00:00:08.250   Sad
00:00:10.500   Happy
00:00:12.625   sad
00:00:16.375   Scared
00:00:20.125   Angry
00:00:22.625   scared
00:00:25.500   Sad
00:00:31.875   Happy
00:00:35.250   END
```

Figure 4.7 An example of a State log.

Observer log

The Observer log contains information from the State log as well as the Detailed log, in XML format. Select this output format if you want to import your data in The Observer, our software package for collecting observational data. Please see page 55 for more information about importing Observer logs into The Observer.

5

Using FaceReader in combination with The Observer XT

Integrating FaceReader data with other data may give you a more complete picture of the phenomena that you are studying. For instance, when testing your newly developed web site, it may be interesting to know what emotions it evokes, but it may be even more intriguing to see at what part of the web site your test person is looking when his facial expressions are classified as 'happy' or 'surprised'. Manually logging the test person's verbal reactions or measuring his physiological responses makes the picture complete. For the integration of all these data, you can use The Observer XT.

The most convenient way to do this, is to make a video recording of the test person's face, and analyze the video both in FaceReader and The Observer. See Section 5.1 for the advantages of this method.

Alternatively, you can use FaceReader live. You can start and stop FaceReader from within The Observer: start classification when you start an observation and stop classification when you stop the observation (see Section 5.2 for the steps to follow). In this way, you can synchronize your FaceReader data with your manually logged events.

If you want to use the video signal from your camera both in FaceReader and The Observer, you need to split it. See Section 5.3 for the procedure to use DVdriver® for this purpose.

When the observation is ready, you can import FaceReader's log files into The Observer and visualize the test person's facial expressions together with your observational data. See Section 5.4 for the procedure to follow.

5.1 Recording a video and analyzing it both in FaceReader and The Observer

You can make a video recording using the software provided by the manufacturer of your digital camera. Alternatively, you can use an analog camera and encode the video to make a digital video file.

Working with video instead of live has a number of advantages:

You can analyze the video frame by frame. When you work with a live video signal and log with a fixed interval of 5 frames/sec, FaceReader may skip frames if it cannot keep up with the incoming information.

You do not need to score live in The Observer with the risk that you miss important events. When you make a video, you can play it multiple times and score in as much detail as you need.

If you like, you can make more than one video recording. For instance, a close-up recording of the test person's face (for analysis in FaceReader) and a screen capture of the test person's computer screen. You can open both videos in The Observer.



For more information about screen capture, please see Section A.4 in The Observer XT 8.0 Reference Manual.

5.2 Starting and stopping FaceReader from within The Observer

The functionality to control FaceReader from within The Observer enables you to:

- Start classification when you start an observation
- Stop classification when you stop an observation

Starting classification precisely when you start the observation, has the obvious advantage that you synchronize your FaceReader data with your manually logged events.

For this functionality to work you must make settings in both FaceReader and in The Observer.

Settings in FaceReader

- 1 From the **Options** menu, choose **Settings** and then click **File Logging** from the list on the left. Select the options **Log with a fixed interval** and **Allow external application commands**.
- 2 Restart FaceReader.

Settings in The Observer XT 8.0

There is a template project on the FaceReader installation CD (in the **Documentation** folder) in which the appropriate settings have already been made. You can either use this project or create a new project and make the settings yourself following the procedure below.

- 1 Create a new project.

- 2 Click **Observation Sources**, select **Live** and then click **Add external program**. The **Add External Program** window opens (see Figure 5.1).

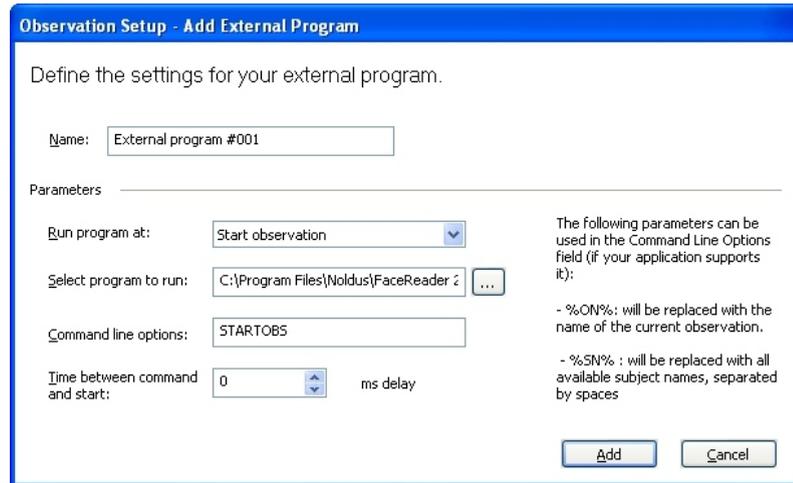


Figure 5.1 The **Add External Program** window in The Observer XT 8.0.

- 3 Make sure that **Start Observation** is selected in the **Run program at** field.



- 4 Click the button next to the **Select program to run** field (see the icon in the margin) and browse to the location where the FaceReader program file (FaceReader.exe) is stored, by default in

C:\Program Files\Noldus\FaceReader 2

- 5 Select the file and click **Open**.
- 6 In the **Command line options** field enter **STARTOBS**. This instructs FaceReader to start analyzing when you start an observation.
- 7 Click **Add** to add the setting to the **Observation Sources** list.

- 8 Repeat Steps 3-7 for **Stop Observation**. Enter **STOPOBS** in the **Command line options** field. This instructs FaceReader to stop analyzing when you stop your observation.

You are now ready to set up your project in The Observer. For more information, refer to The Observer XT Reference Manual.

- 1 When your project is ready, check that your camera is connected to the PC and that it is turned on.
- 2 Start a new observation. Classification in FaceReader is automatically started.
- 3 Score data in The Observer.
- 4 Stop the observation. Classification in FaceReader is automatically stopped.

You can now save your classification results and import FaceReader's log files into The Observer XT. Please see Section 5.4 for the steps to follow.

5.3 Splitting the video signal and analyzing it both in FaceReader and The Observer XT

If you want to use a single video stream both in FaceReader and The Observer XT, you need to split it. You can do this with DVdriver®. Please contact us at info@noldus.nl for your personal copy of this software.



You can also use DVdriver if you want to use a FireWire camera in combination with FaceReader. Without a program like DVdriver, FireWire cameras do not work.

- 1 Install the DVdriver software on your computer.



If you work on a computer with Windows Vista, a Windows Security window will pop up during installation with the message that Windows cannot verify the publisher of the driver software. Click **Install this driver software anyway**.

2 Make sure that your camera is connected to the computer.



3 Right-click the **DVdriver** icon on your taskbar and select **Load Video Device** and check whether your video camera is selected. If necessary, select it from the drop-down list and click **OK**.

Open the video in FaceReader:

1 From the **File** menu, select **New Analysis** and then **Camera Analysis**. A window opens that allows you to select your camera from a drop-down list.

2 Select **DVdriver** as your camera and click **OK**. The camera view will appear in the **Current Analysis** window.

Open the video in The Observer XT 8.0:

1 Start The Observer XT and create a new project.

2 Click **Observation Sources**, select **Live** and then select **DVdriver** in the list of devices.

3 Select **Add external program** to start and stop classification in FaceReader from within The Observer XT. See page 51 for more information about this option and for the steps to follow.



You are now ready to set up your project in The Observer XT. For more information, please refer to The Observer XT Reference Manual.

1 When your project is ready, create a new observation. The camera view will appear in the **Videostreams** window.

2 Start the observation. The time in The Observer XT starts running and classification in FaceReader is automatically started.

- 3 Score data in The Observer XT.
- 4 Stop the observation. Classification in FaceReader is automatically stopped.
- 5 You can now save your classification results and import FaceReader's log files into The Observer XT. Please see Section 5.4 for the steps to follow.

5.4 Importing FaceReader log files into The Observer XT 8.0

When you are ready classifying your test person's facial expressions, you can import the log files into The Observer XT to combine the data with your manually scored events and any other data that you imported (physiological data, eye tracker data etc.). You can import both the Observer log and the Detailed log in The Observer XT 8.0.



Please contact Noldus Technical Support if you want to import FaceReader log files into The Observer XT 6 or 7.

Importing Observer logs

When you save the FaceReader log files, you can choose whether you save only the State log information or both the State log and the Detailed log information. If you choose the latter, the Detailed log data will be saved as numerical modifiers. That means that you can calculate statistics like, e.g., the mean and maximum classification value for each of the emotions when you import the log files into The Observer XT. Follow the steps below to import FaceReader Observer logs:

- 1 Start The Observer XT, open the appropriate project or create a new one. From the **File** menu, choose **Import** and then

Observational Data. The **Select Observational Data Files** window opens (see Figure 5.2).

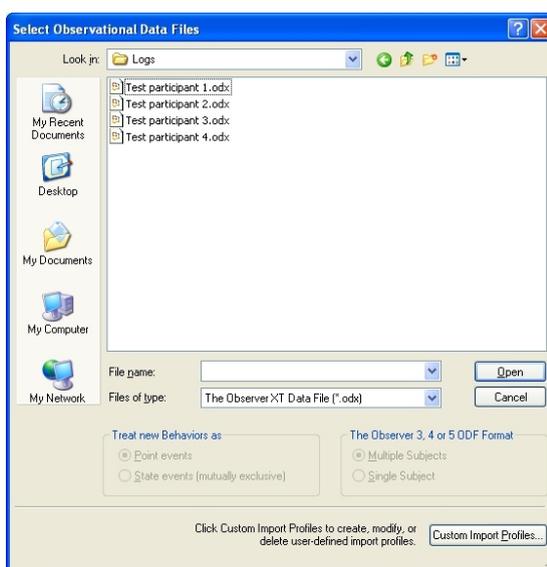


Figure 5.2 The **Select Observational Data Files** window when importing an Observer log.

- 2 In the **Files of type** field, select **The Observer XT Data File (*.odx)** from the drop-down list.
- 3 Browse to the location on your computer where you stored your log file, by default in:
 - C:\Documents and Settings\All Users\(\Shared) Documents\Noldus\FaceReader\Logs (Windows XP) or
 - C:\Users\Public\Documents\Noldus\FaceReader\Logs (Windows Vista).
- 4 Select the appropriate log file and click **Open**. The data are imported into The Observer XT as a new observation named 'FaceReader data'.



If you imported your log file into a project with an existing coding scheme, it may be that the key codes of the emotions conflict with the key codes of the behaviors that you defined previously. If this is the case, you must redefine your key codes and make them unique.

– If you imported State log information only

If you only saved State log information in your Observer log, the new observation contains one Event File 'State log values'. When you open the coding scheme, you will see that a behavioral group 'Emotions' has been added with the six basic emotions, the neutral state plus 'Unknown' as behaviors. 'Unknown' is the emotion that is logged when FaceReader cannot find or model the face.



You can now select your data, visualize them (see Figure 5.3 for an example) and calculate statistics. Please see The Observer XT 8 Reference Manual for more information.

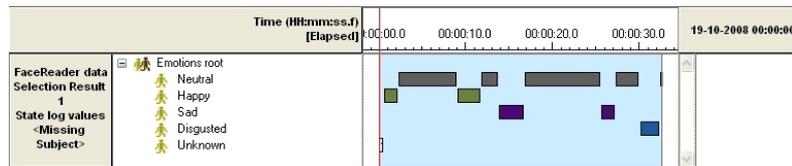


Figure 5.3 An Observer log plotted in The Observer XT 8.

– If you imported both State log and Detailed log information

If you saved both State log and Detailed log information in your Observer log, the new observation contains two Event Files: 'State log values' and 'Detailed log values'. Two behavioral groups have been added to the coding scheme:

Emotions – This behavioral group includes the six basic emotions plus the neutral state and 'Unknown' (the emotion that is logged when FaceReader cannot find or model the face).

Behavior root – This behavioral group contains the behavior 'Detailed expression values' to which 7 numerical modifier groups are attached: one for each emotion.

You can now select your data and calculate statistics. For instance, select only that part of your observation when the test participant looked at the home page of your newly developed web site and calculate the mean classification values for each of the emotions during this period.

Importing Detailed logs as external data



To be able to import FaceReader data as external data, you need the 'External Data Module' of The Observer XT.



When you import a Detailed log as external data, you can view the data together with your manually scored events in The Observer XT, but you cannot calculate any statistics. To be able to calculate statistics, you need to save your data as an Observer log and select the option **Include detailed values in Observer log**. See page 55 for information about importing Observer logs.

On the FaceReader installation CD you will find an import profile to import Detailed log files and a folder with the log file on which the import profile is based. Follow the steps below to copy both the import profile and the log file to your computer:

- 1** Browse to the **Import profiles** subfolder in the **Documentation** folder on the FaceReader installation CD.
- 2** Copy the import profile ('FaceReader 2.0 Detailed log as external data.eip') to the default directory for import profiles:
 - In Windows XP: C:\Documents and Settings\All Users\Application Data\Noldus\Common\Profiles.
 - In Windows Vista: C:\ProgramData\Noldus\Common\Profiles.

Using FaceReader in combination with The Observer

as an Observer log and select the option **Include detailed values in Observer log**. See page 55 for information about importing Observer logs.

On the FaceReader installation CD you will find an import profile to import Detailed log files and a folder with the log file on which the import profile is based. Follow the steps below to copy both the import profile and the log file to your computer:

- 1 Browse to the **Import profiles** subfolder in the **Documentation** folder on the FaceReader installation CD.
- 2 Copy the import profile ('FaceReader 2.0 Detailed log as external data.eip') to the default directory for import profiles:
 - In Windows XP: C:\Documents and Settings\All Users\Application Data\Noldus\Common\Profiles.
 - In Windows Vista: C:\ProgramData\Noldus\Common\Profiles.



The **Application Data** folder and **ProgramData** folder are hidden folders. To view these folders, click **Start** on the Windows task bar, select **(Settings** and then) **Control Panel** and double-click **Folder Options**. Click the **View** tab and select the option **Show hidden files and folders**.

- 3 Create a new subfolder in the **Application Data/ ProgramData** folder: 'FaceReader 2.0 Detailed log as external data'.
- 4 Copy the log file ('FaceReader 2.0 log_detailed.txt') from the installation CD to the corresponding subfolder in the **Application Data/ProgramData** folder.

You are now ready to import your log files into The Observer XT.

- 1 From the **File** menu, choose **Import** and then **External Data**. The **Import External Data** window opens (see Figure 5.4).

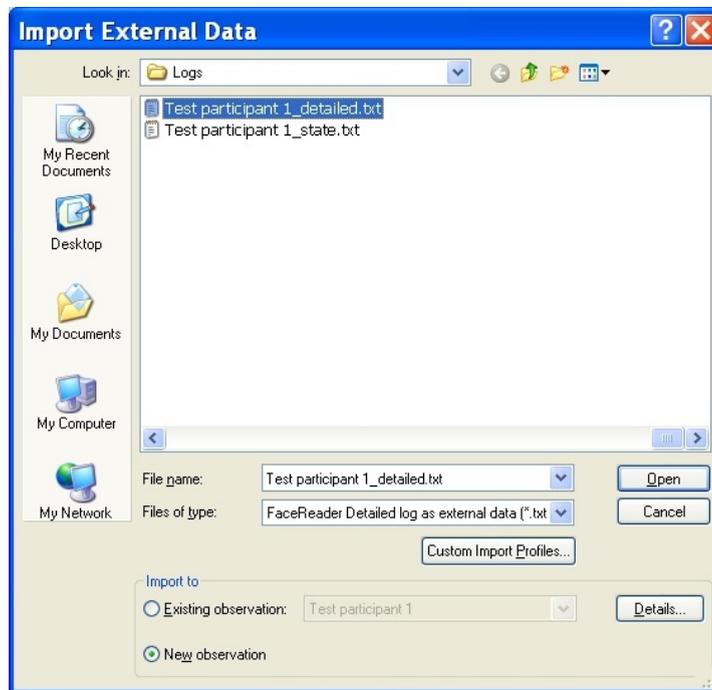


Figure 5.4 The **Import External Data** window.

- 2 In the **Files of type** field, select **FaceReader 2.0 Detailed log as external data (*.txt)** from the drop-down list.
- 3 Browse to the location on your computer where you stored your log file, by default in:
 - C:\Documents and Settings\All Users\(\Shared) Documents\Noldus\FaceReader\Logs (Windows XP) or
 - C:\Users\Public\Documents\Noldus\FaceReader\Logs (Windows Vista).
- 4 Select whether you want to import the log file into an
 - Existing observation** or a

○ **New observation**

5 Select the appropriate log file and click **Open**. The data are imported into The Observer XT.

You can now visualize your data and view your FaceReader data in the same plot as your manually logged events. See Figure 5.5 for an example.

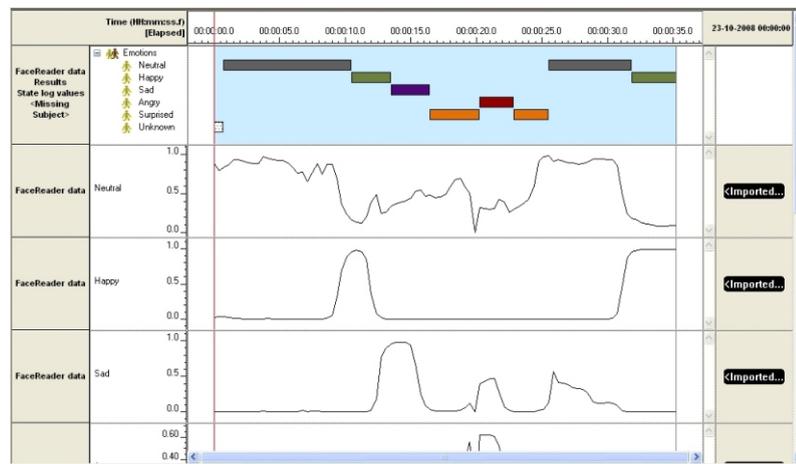


Figure 5.5 A FaceReader Detailed log (and Observer log) plotted in The Observer XT. In the uppermost plot you see the Observer log data and in the plots below each of the emotions of the Detailed log.

6

Identification

In addition to classifying facial expressions and "reading" other information from the face (like age, gender, etc.), FaceReader can recognize persons that have previously been added to a database. The identification functionality enables you to make a database of all the test persons that participate in your tests. You can customize FaceReader's settings in such a way that the next time a person is tested, his/her name will automatically be added to the Detailed log files.

You can use the identification functionality with images from a digital video file (Section 6.1) or a camera (Section 6.2).

6.1 Adding a person to the database

When using a video file

- 1 From the **File** menu, select **New Analysis** and then **Video Analysis**.

- 2 Browse to the location of the video file on your computer, select the appropriate file and click **Open**.
- 3 From the **Window** menu, select **Monitor identity**. The **Monitor Identity** window opens (see Figure 6.1).

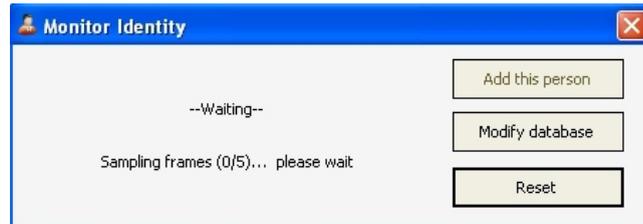


Figure 6.1 The **Monitor Identity** window when waiting for the video to start.



- 4 Click the **Start Analysis** button in the **Current Analysis** window. The video will start to play and FaceReader starts its analysis. As soon as 5 frames have been analyzed, the **Add this person** button in the **Monitor Identity** window will become available and 'unknown person' will appear in the **Monitor Identity** window (see Figure 6.2).

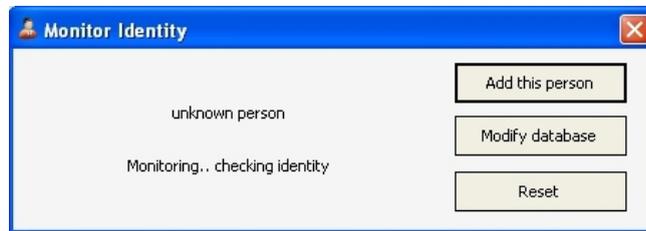
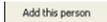


Figure 6.2 The **Monitor Identity** window reporting that the test person is not (yet) in the database.



- 5 Click the **Add this person** button. The **Add person to database** window opens (see Figure 6.3).



Figure 6.3 The **Add person to database** window.

- 6 Enter the name of the person in the video and click **OK**. The name will appear in the **Monitor Identity** window and is added to the database, together with the first 5 images that have been analyzed.



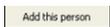
Click the **Reset** button to restart the person identification routines. The **Monitor Identity** window will change into the one in Figure 6.1 and identification starts anew.

When using a camera

- 1 From the **File** menu, select **New Analysis** and then **Camera Analysis**.
- 2 A window opens that allows you to select your camera from a drop-down list. Select your camera and click **OK**.
- 3 From the **Window** menu, select **Monitor identity**. The **Monitor Identity** window opens (Figure 6.1).



- 4 Click the **Start Analysis** button in the **Current Analysis** window. FaceReader will start its analysis. As soon as 5 frames have been analyzed, the **Add this person** button becomes available and 'unknown person' appears in the **Monitor Identity** window (see Figure 6.2).



- 5 Click the **Add this person** button. The **Add person to database** window opens (Figure 6.3).
- 6 Enter the name of the person in front of the camera and click **OK**. The name will appear in the **Monitor Identity** window and

is added to the database, together with the first 5 images that have been modeled.



Use the **Reset** button to re-start the person identification routines. The **Monitor Identity** window will change into the one in Figure 6.1 and identification starts anew.

6.2 Monitoring the identity of a person

When you have added your test persons to the database, FaceReader will recognize them the next time they appear in a (live) (video) image (provided that they did not change too much!). To monitor the identity of your test persons, follow steps 1-4 in Section 6.1 or Section 6.2. As soon as 5 frames have been analyzed, a prediction of the current person's identity will be made and the name will appear in the **Monitor Identity** window. The frames will continuously be refreshed and guesses at the person's identity will keep being made.



Select the option **Write identity label to the log** in the **File Logging** settings to add a column with the test person's name to your Detailed log files.

6.3 Renaming persons in the database

If you accidentally entered the wrong name for a test participant, you can rename it.

- 1 From the **Window** menu, select **Monitor identity**. The **Monitor Identity** window opens (Figure 6.1).

- 2 Click the **Modify database** button. The **Modify identity database** window opens.
- 3 Right-click the appropriate name in the list and click **Rename Person**. The **Rename person** window opens.
- 4 Enter the correct name and click **OK**.

6.4 Removing persons from the database

To remove a person from the database:

- 1 From the **Window** menu, select **Monitor identity**. The **Monitor Identity** window opens (Figure 6.1).
- 2 Click the **Modify database** button. The **Modify identity database** window opens.
- 3 Right-click the appropriate name in the list and click **Remove Person**. The person and all his/her images will be removed from the database.

6.5 Removing images from the database

There may be several reasons why you would like to remove images from the database. If you stored, e.g., images showing the test participant with his/her eyes closed, it is better to remove them because they will negatively affect identification.

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It may also be that you linked images to the wrong name. When adding a person to the database, FaceReader does not give a warning if the name you enter is already in the database. If you accidentally add, for instance, two times "Donna Smith" to the database for two different persons, FaceReader will link the images of the two persons to the name "Donna Smith". You can use the steps below to delete the images that have been linked to the wrong name:

- 1** From the **Window** menu, select **Monitor identity**. The **Monitor Identity** window opens (Figure 6.1).
- 2** Click the **Modify database** button. The **Modify identity database** window opens.
- 3** Right-click the appropriate name in the list. The images that are linked to the name will appear.
- 4** Right-click the appropriate image and click **Remove Image**. The image will be removed from the database.

7

Settings

This chapter gives an overview of all the settings that you can make in FaceReader. There are seven categories of settings:

General settings – View your license info and hide the Quick setup guide. See page 70.

Face Model settings – Choose which model will be used for finding, modeling and classifying faces. See page 71.

Analysis settings – Specify the speed of video processing. See page 72.

Identification settings – Enable person identification, specify to match only with persons in the database, whether or not to ignore recently added persons and how to deal with images of poor quality. See page 74.

File Logging settings – Set FaceReader to log with a fixed interval or accept external application commands. Specify which additional parameters you want to add to the Detailed logs (personal characteristics, identity label, image quality value or valence value). See page 76.

Visualization setting – Set FaceReader to play your video continuously. See page 79.

Advanced settings – Use the **Advanced** settings only at the advice of Noldus or if you have experience with face recognition algorithms. See page 80.

From the **Options** menu, select **Settings** to view the settings.

By resting with your mouse on an item in the settings, additional information will appear as shown in Figure 7.1.

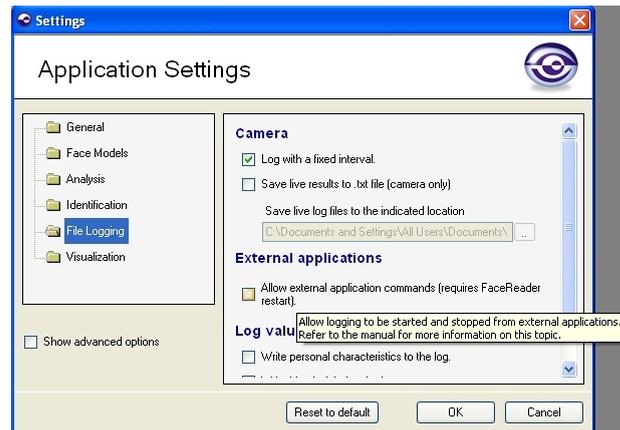


Figure 7.1 Additional information about the settings.



Click the **Reset to default** button to undo the changes you made in the settings and go back to the default settings.

7.1 General settings

In the **General** settings you can view your license info.

- Show Quick setup guide when FaceReader starts.** The Quick Setup guide helps you to set up your camera and lighting correctly. By default, the Quick setup guide is shown every time you start FaceReader. Clear the check box to start FaceReader without the Quick setup guide.

Default setting – Option selected.

7.2 Face Model settings

Active Model

In the **Face Model** settings you can choose the model that will be used by FaceReader for finding, modeling and classifying faces. You can choose between six models:

General 1 – This model has been trained on a very diverse selection of images. The model works well under most circumstances for most people.

General 2 – Like the **General 1** model, this model has also been trained on a very diverse selection of images. Under some variations of pose and lighting the **General 2** model can give better results than the **General 1** model.

Below Screen Optimized – This model has been optimized for a camera position below the monitor. It does not work well with East-Asian faces and children.

EastAsian 1 – Select this model to analyze East Asian faces, for instance, Chinese or Japanese faces.

EastAsian 2 – Like the **EastAsian 1** model, this model has also been trained with East Asian faces. Under some variations of pose and lighting the **East Asian 2** model can give better results than the **EastAsian 1** model.

Children – Select this model if your test participants are children between the age of 3 and 10. The current FaceReader version is not well-trained for analysis of East-Asian children.

Default setting – **General 1** is selected.

Model behaviour

- Dynamic updating (increased speed)** – With this option selected, FaceReader does not search for the face in the whole video image, it only looks in that part of the image which contained the face in the previous image plus 30%. In addition, in the face modeling step, the program does not start

modeling with the average face as a base, instead it uses the face in the previous image. With the option **Dynamic updating** selected FaceReader can analyze faces at a much higher frame rate (up till 5 times faster).

Default setting – Option selected.

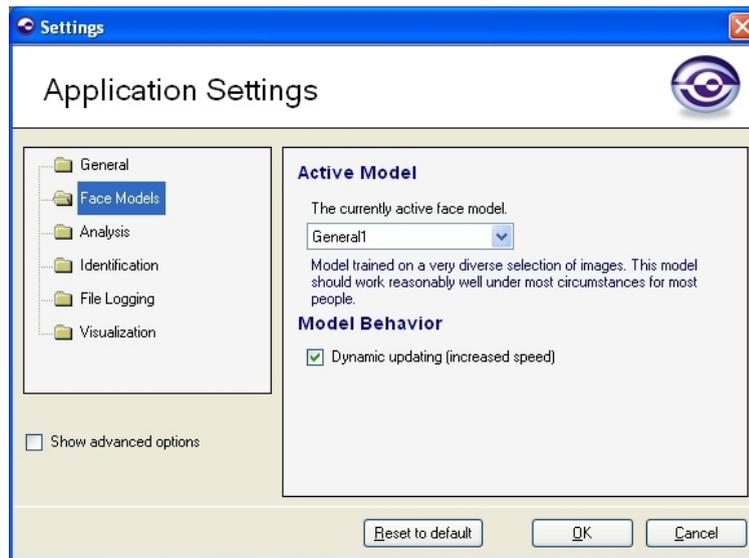


Figure 7.2 The **Face Model** settings.

7.3 Analysis settings

Classification

- Smoothen classification values** – With this option enabled, classification values are transformed to obtain a smooth output signal. Disabling this option will give you the raw output data.



If you are analyzing a set of images where each image shows a different person or facial expression, this option has no effect.

Default setting – Option selected.

Video

Video Process Speed – By default, the video is processed frame-by-frame, that is, the **Video Process Speed** is 1. If you like to speed up the analysis and change the **Video Process Speed** to 2 or 3. If the **Video Process Speed** is 2 every second frame in the video is processed. If the **Video Process Speed** is 3, every third frame.

Default setting – Speed 1 is selected.

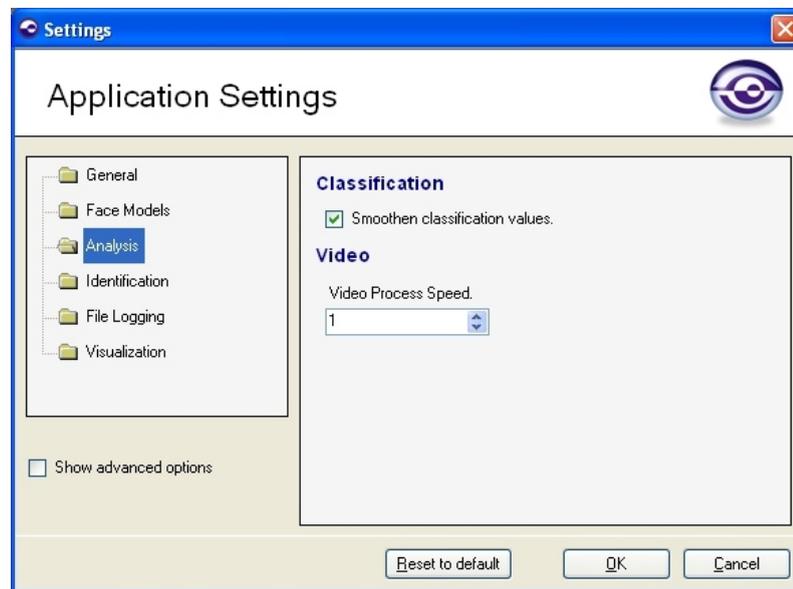


Figure 7.3 The **Analysis** settings.

7.4 Identification settings

Basic settings

- Enable person identification** – Select this option to enable the identification functionality.

Default setting – Option selected.

- Always find the best match** – If this option is selected, FaceReader identifies people by choosing from the list of persons that have been added to the system. With the option disabled, FaceReader also considers the possibility that the person in the (video) image is a new, unknown person.

Default setting – Option selected.

Data storage location



Click the button in the margin to browse to the location where you want to store the identity profiles.



When you add a new face to the database, FaceReader stores 5 video images on your computer. These images make up the identity profile.

The default location for the identity profiles is

C:\Documents and Settings\\Local Settings\Application Data\Noldus\FaceReader\identityprofiles (Windows XP)

C:\Users\\AppData\Local\Noldus\FaceReader\Identityprofiles (Windows Vista)

Finetune settings

Avoid matches to recently added persons – People tend to change in appearance only gradually. Someone who has been added to the database several years ago will have changed more than someone who has been added to the system an

hour ago. This option allows you to change the extent to which this fact is being considered:

- 0 - not important
- 1 - little important
- 2 - medium important
- 3 - important
- 4 - very important
- 5 - extremely important

Default setting – 0 - not important

Acceptable False Positive Rate – FaceReader can make two types of identification errors. Firstly, an unknown person can be incorrectly identified as someone already in the data set (false positive). Secondly, a known person may not be recognized as such and may be considered as an unknown person (false negative). This option allows you to specify the false positive rate that you find acceptable. You can enter a value between 0.01 and 0.5.

Default setting – 0.08

Force matches when model quality is poor – This option allows you to specify how important it is that FaceReader makes matches if the quality of the appearance model is poor:

- 0 - not important
- 1 - little important
- 2 - medium important
- 3 - important
- 4 - very important
- 5 - extremely important

Default setting – 3 - important

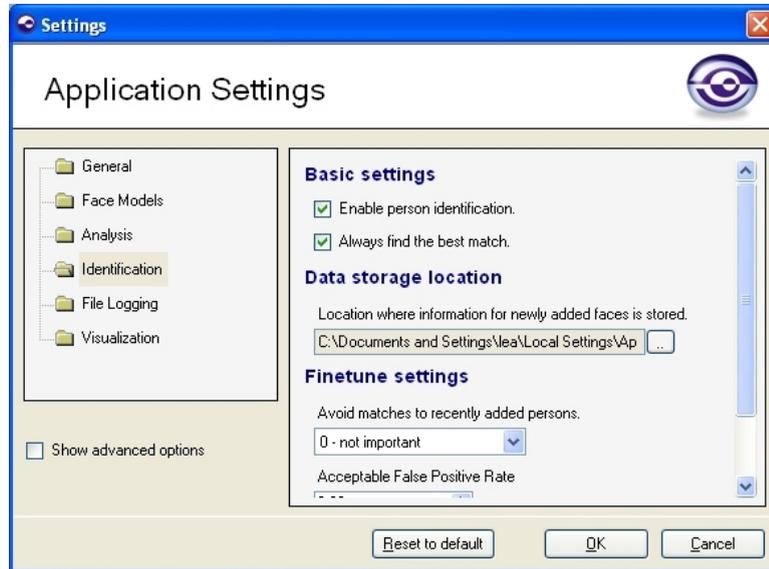


Figure 7.4 The **Identification** settings.

7.5 File Logging settings

Camera

- Log with a fixed interval** – If this option is selected, an update to the Detailed log will be made every 200 milliseconds. If your computer cannot process the incoming images fast enough, frames will be skipped and a record with **MISSING** will be added to the Detailed log.



When you analyze faces in a video file, FaceReader always logs with a fixed interval. Depending on your **Video Process Speed**, FaceReader analyzes the video images frame-by-frame or every second frame or third frame.



To be able to import the Detailed log into The Observer, you must log with a fixed interval.

Default setting – Option selected.

- Save live results to .txt file (camera only)** – With this option selected, FaceReader logs the data as soon as they become available. It does not wait till the session has ended.



The (Detailed) log can be accessed real-time by other applications. This makes that FaceReader can be used for research into affective computing and the design of adaptive interfaces. In other words, FaceReader allows other programs to respond instantaneously to the emotional state of the test participant.



Click the button in the margin to browse to the location where you want to store the live results. The default directory is

C:\Documents and Settings\All Users\(\Shared) Documents\ Noldus\FaceReader\Logs\Live Results (Windows XP) or

C:\Users\Public\Documents\Noldus\FaceReader\Logs\Live Results (Windows Vista)

Default setting – Option not selected.

External applications

- Allow external application commands** – Select this option if you want to start and stop classification from an external application (for instance, The Observer). Please see Chapter 5 for more information about using FaceReader in combination with The Observer.



You need to restart FaceReader after selecting this option.

Default setting – Option not selected.

Log values

By default, the Detailed log contains the classification output values for the six basic emotions and the neutral state. Select one of the options below to add extra information to the log file.

Default settings - Options not selected.

- Write personal characteristics to the log** – With this option selected, 6 extra columns are added to the Detailed log: 'Gender' (male/female), 'Bearded', 'Moustache', 'Glasses', 'Age' (an estimation of the test person's age) and 'Ethnicity' (Caucasian, Eastern Asian, African, South Asian or Other). For 'Bearded', 'Moustache' and 'Glasses', a value between 0 and 1 is given.
- Write identity label to the log** – If the person identification functionality is enabled, you can select this option to add the name of the test person to the log file.
- Write image quality to the log** – The image quality is indicated by a value between 0 and 1.
- Write valence value to the log file** – If you select this option the valence is added to the log file, indicating whether the facial expressions are positive or negative and to what degree.

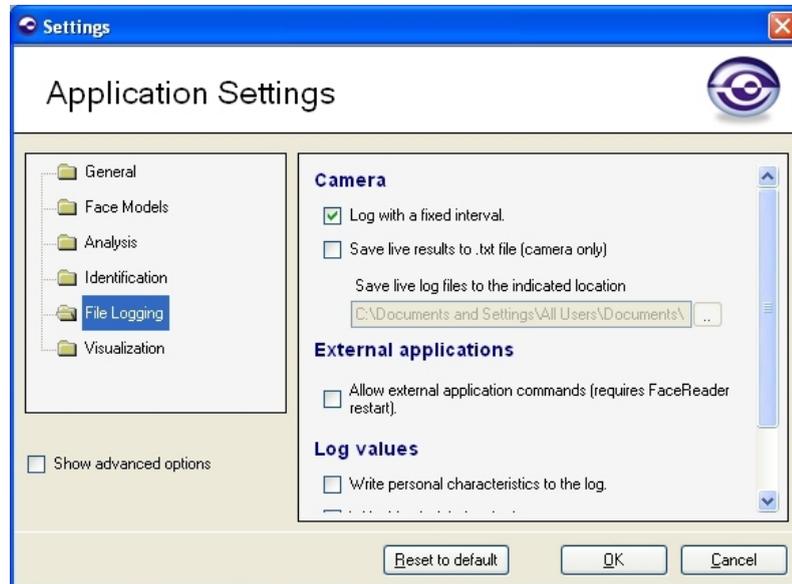


Figure 7.5 The **File Logging** settings.

7.6 Visualization setting

Video

- Repeat video** – This option is for demonstration purposes only. If you select this option your video is played continuously.

Default setting – Option not selected.

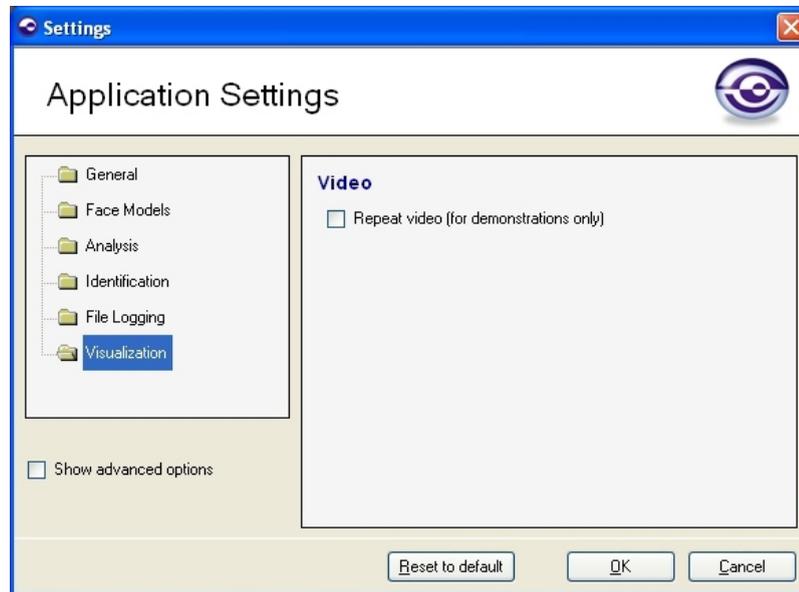


Figure 7.6 The **Visualization** setting.

7.7 Advanced settings

We recommend that you use the advanced settings only at the advice of Noldus, or if you have experience with face recognition algorithms. To view the **Advanced** settings, select the **Show advanced options** checkbox in the **Settings** window.

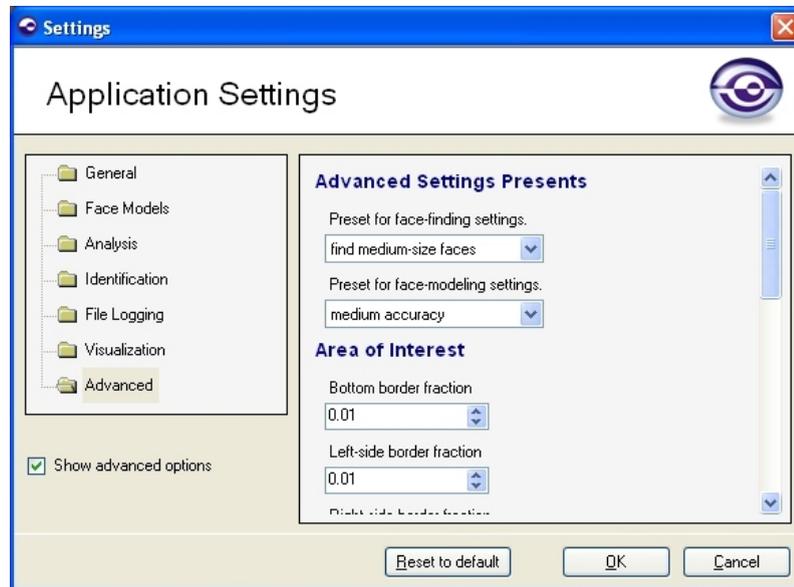


Figure 7.7 The **Advanced** settings.

Advanced Settings Presets

Preset for face finding settings — Changing this preset will change the **Size of Interest** (the size of the frame that moves over the video image searching for the face, see page 84). By default, FaceReader starts searching for the face with a frame size that is 11% of the video image size (minimum face fraction = 0.11). It searches the whole video image and if it does not find the face, it increases the frame size with 10% (face size scaling factor = 1.10) and searches again. FaceReader increases the frame size 10 times (number of face scaling steps = 10) and goes on searching until the face fraction is 0.30 (maximum face fraction). Changing one of the **Size of Interest** settings, sets the **Preset for face finding settings** to [custom].

Make sure that the **Size of Interest** is comparable to the size of the face in the video image. Choose one of the following options:

Find all faces (slow) – Select this option if the default setting does not work properly or if you want to include faces from people who sit a bit far from the camera. With this option selected, the minimum face fraction is 0.08, the maximum face fraction 0.30, the face size scaling factor 1.10 and the number of face scaling steps 13. Because FaceReader starts searching with a smaller frame, it takes longer to search the whole video image than with the default setting.

Find medium size faces – This is the default setting which normally works fine when the test person sits at a normal distance from the camera. With this option selected, the minimum face fraction is 0.11, the maximum face fraction 0.30, the face size scaling factor 1.10 and the number of face scaling steps 10.

Find large faces only (fast) – Select this option if speed of classification is very important and you only have close-up images of your test persons. With this option selected, the minimum face fraction is 0.20, the maximum face fraction is 0.30, the face size scaling factor is 1.10 and the number of face scaling steps is 4.

Default setting – Find medium size faces.

Preset for face modeling settings – Changing this preset will change the **Number of model fit iterations** (see page 84). You can also change the **Number of model fit iterations** directly. If you do so, the **Preset for face modeling settings** is set to **[custom]**. Choose one of the following options:

Maximum accuracy (slow) – This sets the **Number of model fit iterations** to 12.

Medium accuracy – With this option selected, the **Number of model fit iterations** is 8.

Low accuracy (fast) – This option sets the **Number of model fit iterations** to 5.

Default setting – Medium accuracy.

Area of Interest

By setting the **Area of Interest**, you can crop the video image and only analyze that part of the image that contains the face. In this way, you can decrease the area to search in the face finding step and, thus, increase the speed of classification. This setting is also useful for video images that contain two or more faces. You can "cut out" the face that you want to analyze and ignore the other faces or analyze them later.

Bottom border fraction – Percentage of the bottom part of the image to ignore when searching for faces.

Left-side border fraction – Percentage of the left side of the image to ignore when searching for faces.

Right-side border fraction – Percentage of the right side of the image to ignore when searching for faces.

Top border fraction – Percentage of the top part of the image to ignore when searching for faces.

Accepted values: 0 - 0.5

Default values: 0.01

Face Finding

Minimum face detector classifier score – Minimum classification score for a face to be considered a true instance of a face. If you use the default setting of 0.50, FaceReader will report that it cannot find a face if the detection score is lower than 0.50. If the score is higher than 0.50, FaceReader will report to the face modeling step that it has found a face. It is useful to increase this value if FaceReader finds false positive faces (for instance, if it finds a face in the background where there is none).

Accepted values: 0.50 - 0.99.

Default value: 0.50

Face modeling

Number of model fit iterations — Number of updates of the appearance model. FaceReader starts with an "average" face and updates this in a number of steps (iterations) so that it resembles the face of the test person. Higher values give a more accurate fit. You can set the **Number of model fit iterations** by clicking the up and down arrows or by changing the **Preset for face modeling settings** (see page 82).

Accepted values: 0 - 20

Default value: 8

Size of Interest

You can set the **Size of Interest** either by clicking the up and down arrows or by changing the **Preset for face finding settings** (see page 81).

Minimum face fraction — Minimum fraction of the face surface relative to the entire image surface.

Accepted values: 0.01 - 1

Default setting: 0.11

Maximum face fraction — Maximum percentage of the face surface relative to the entire image surface.

Accepted values: 0 - 1

Default value: 0.30

Face size scaling factor — Factor by which the face surface is increased between the minimum and maximum face size.

Accepted values: 1.01 - 2

Default value: 1.10

Number of face scaling steps – Number of steps when scaling from minimum to maximum face size.

A

Video and image formats

Video formats

FaceReader supports the following video formats:

Container	Code	Name/Encoder
mpg	mpg1	MPEG-1 Part 2
mpg	mpg2	MPEG-2
vob (DVD)	mpg2	MPEG-2
mp4	mp4v	MPEG-4 Video
mov	mp4v	MPEG-4 Quicktime
avi	XVID	XviD ISO MPEG-4
avi	XVID	XviD 1.1.0 Final
avi	DIB (_RGB)	BI_RGB Raw Bitmap
avi	DIV3	DivX 3 Low-Motion
avi	DIV5	DivX 5.x/6.x

Appendix A

Container	Code	Name/Encoder
avi	DIVX	DivX 4
avi	dvsd	DVC/DV Video
avi	DX50	DivX 6.0.0
avi	DX50	DivX 5.x
avi	CRAM	Microsoft Video 1
avi	cvid	Cinepak
avi	IV32	Indeo 3.x
avi	MJPG	Motion JPEG
avi	MP42	S-Mpeg 4 version 2
avi	WMV3	WMP v9 (VC-1 Simple/Main)
asf (.wmv)	WMV1	WMP v7
asf (.wmv)	WMV2	WMP v8
asf (.wmv)	WMV3	WMP v9 (VC-1 Simple/Main)
asf	MP43	S-Mpeg 4 version 3
3gp	s263	ITU H.263 video (3GPP)



If you are not sure what the format of your video files is, you can use a program like GSpot to find this out. Browse to www.headbands.com/gspot to download GSpot (free of charge).

Video and image formats

For a number of other formats, codecs are included, but these formats have not been tested. We can, therefore, not guarantee that they work.

Container	code	Name/Encoder
avi	DIV1, DIV2, mp41, MPG4, MPG3	Divx (1,2,3)
avi	DIV4, DIV6, col1,col0,3ivd	DivX 4, 5, 6, 3ivx D4, MPEG-4
avi	h261	H.261
avi	h262	H.262
avi	h263	H.263/H.263i
avi	h264, s264, AVC1, DAVC, H264, X264, VSSH	
avi	IV31	Indeo Video 3
avi	mp4s, m4s2, fmp4, 3iv2, smp4	MPEG-4 Part 2 (AVP), Xvid
avi	SVQ 1	Sorenson 1 (Quicktime)
avi	SVQ 3	Sorenson 3 (Quicktime)
avi	VP31, VP30, VP3	On2 VP3
avi	VP50, VP5, VP51	On2 VP5
avi	VP60, VP61, VP62, VP6F, VP6A	On2 VP6 (used by FLV)

Appendix A

Container	Code	Name/Encoder
flv	FSV1	Flash Screen Video
mpg	mp2v, mpg2, vcr2, hdv1, hdv2, hdv3, mx*n, mx*p	MPEG-2 Part 2
mpg	mpeg, mp1v, PIM1	MPEG-1 Part 2
rm	RV10, RV13, RV20	Real Video 1.0, 1.3, 2.0
wmv	wmv1, wmv2	WMV 1/2 (7/8)
wmv	wmv3, wvc1, wmva	WMV 3/WMV-9/VC-1*

* Not all profiles are supported.

Video formats that are not supported (codecs are not included and installing the codecs yourself will not work):

Container	Code	Name/Encoder
avi	IV50, IV51	Indeo 5.x
avi	tsc	TechSmith Screen Capture
avi	IV41	Indeo 4.x
avi	I263	H.263
avi	cvid(_RGB)	BI_RGB Raw Bitmap
avi	(_RGB)	BI_RGB Raw Bitmap (8bit)

Video and image formats

Container	Code	Name/Encoder
mp4	avc1	H.264/MPEG-4 AVC
mov	3IV1	3ivx (MPEG-4 based)
mov	avc1	H.264
mov	svq3	Unknown
mov	avc1	H.264/MPEG-4 AVC

Image formats

FaceReader supports the following image formats:

JPG
BMP
GIF
TIF
PNG

Animated GIFs are not supported, FaceReader uses the first frame of the animated GIF.

The minimum dimensions of your images should be about 640 x 480 pixels (200 x 200 for the face area). For FaceReader to work at a reasonable speed, the maximum dimensions should not be greater than about 2000 x 2000 pixels.

B

Technical Support

B.1 Help Desk

If you have any problems, questions, remarks or comments, please let us know. You can contact us via our web site (www.noldus.com) and fill out a Support Request Form (preferred), phone during working hours in two time zones or fax.



Please check the online help or reference manual before contacting our support department. Press **F1** to start the help, then type in the index a keyword related to what you are having problems with.

Before you contact Technical Support, please have the version number and license number of your copy of FaceReader available. To find these numbers, from the **Help** menu select **About**.

Please refer to the **About Noldus - Contact us** section on our web site (www.noldus.com) for other contact information.

B.2 Service contracts

Your license of FaceReader comes with a standard service contract of one year. We also recommend a training upon installation of FaceReader.

We can offer you even greater value and reassurance by providing comprehensive service contracts. Our Plus and Premium service contracts both extend the standard service you are entitled to as well as provide peace of mind at reasonable cost.

Please look on our web site (www.noldus.com) in the **Services - Service contracts** section for more information.

C

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Open Source Computer Vision Library – Face detection

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For Open Source Computer Vision Library

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FFmpeg - video file decoding

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Source code is available at at <http://ffmpeg.mplayerhq.hu/>

Appendix C

ZedGraph – pie charts

ZedGraph is free software: you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

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Source code is available at <http://sourceforge.net/projects/zedgraph/>

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