

# FaceCell 1.0 Algorithm Demo

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## Table of Contents

1. Introduction .....	1
2. Requirements .....	2
3. Installing .....	3
4. Image quality control .....	4
4.1. Pose .....	4
4.2. Expression .....	4
4.2.1. Examples of Non-Recommended Expressions .....	4
4.3. Face changes .....	4
4.4. Lighting .....	4
4.5. Eyeglasses .....	4
5. Application .....	6
5.1. Main window .....	6
5.2. Options dialog .....	7
5.3. Simple usage examples .....	8
6. Matching threshold and similarity .....	11

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## List of Figures

5.1. Main application window .....	6
5.2. Options dialog .....	7

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# Chapter 1. Introduction

FaceCell 1.0 Demo application is designed with aim to demonstrate the capabilities of FaceCell face recognition engine. The program is a Windows CE GUI application.

Evaluation software supports image acquisition from the external video source. Also it can read face images from .bmp, .tif, .jpg files.

The application has 2 operation modes:

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

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## Chapter 2. Requirements

- ARM based processor with at least 400 MHz CPU clock rate is recommended for face enrollment in less than two seconds.
- Supported ARM processor core families are: XScale, StrongArm, ARM11, ARM10, ARM9.
- At least 8 Mb of memory for FaceCell code and data arrays.
- MS Windows Mobile 2003 (or later).
- (Optional) Embedded camera with at least 320 x 240 pixels physical resolution. To use the embedded camera with the demo application the device must be running MS Windows Mobile 5.

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## Chapter 3. Installing

Before installing FaceCell 1.0 algorithm demo application make sure that your device meets the hardware and software [requirements](#).

To install the application simply copy the FccDemo.cpp.exe file to your device.



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# Chapter 4. Image quality control

Face recognition is very sensitive to image quality so maximum care should be attributed to image acquisition.

## 4.1. Pose

The frontal pose (full-face) must be used. Rotation of the head must be less than  $\pm 5$  degrees from frontal in every direction – up/down, rotated left/right, and tilted left/right.

## 4.2. Expression

The expression should be neutral (non-smiling) with both eyes open, and mouth closed. Every effort should be made to have supplied images comply with this specification. A smile with closed jaw is allowed but not recommended.

### 4.2.1. Examples of Non-Recommended Expressions

1. A smile where the inside of the mouth is exposed (jaw open).
2. Raised eyebrows.
3. Closed eyes.
4. Eyes looking away from the camera.
5. Squinting.
6. Frowning.
7. Hair covering eyes.
8. Rim of glasses covering part of the eye.

## 4.3. Face changes

Beard, moustache and other changeable face features influence face recognition quality and if frequent face changes are typical for some individual, face database should contain e.g. face with beard and cleanly shaved face enrolled with identical ID.

## 4.4. Lighting

Lighting must be equally distributed on each side of the face and from top to bottom. There should be no significant direction of the light or visible shadows. Care must be taken to avoid "hot spots". These artifacts are typically caused when one, high intensity, focused light source is used for illumination.

## 4.5. Eyeglasses

There should be no lighting artifacts on eyeglasses. This can typically be achieved by increasing the angle between the lighting, subject and camera to 45 degrees or more. If lighting reflections cannot be removed, then the glasses themselves should be removed. (However this

is not recommended as face recognition typically works best when matching people with eye-glasses against themselves wearing the same eyeglasses).

Glasses must be clear glass and transparent so the eyes and irises are clearly visible. Heavily tinted glasses are not acceptable.

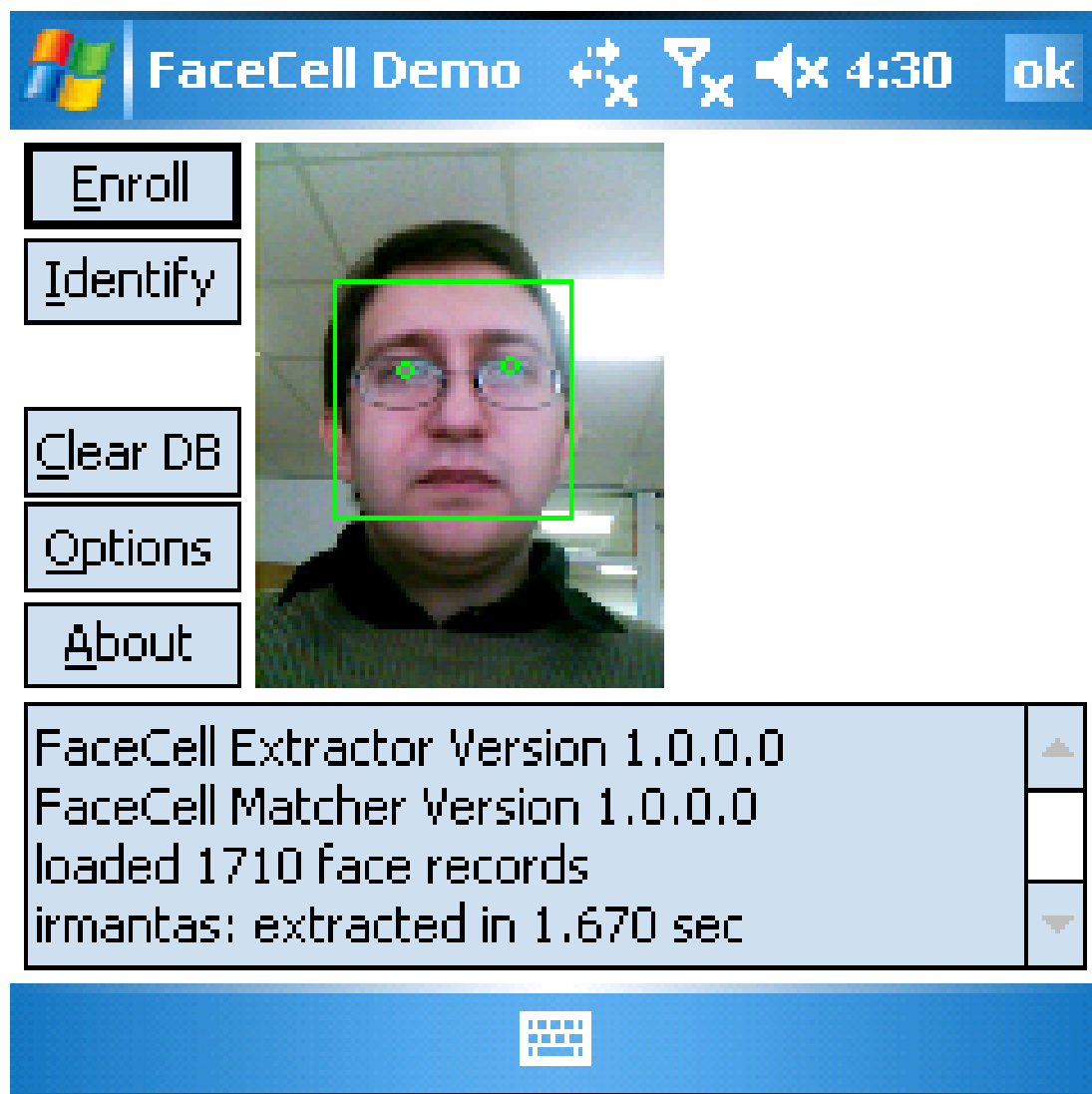
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# Chapter 5. Application

FaceCell demo application demonstrates FaceCell face recognition algorithm using video and still images.

## 5.1. Main window

Main application window has five buttons aligned along the left border of the window, a log field at the bottom of the window and input image filed in the centre.



**Figure 5.1. Main application window**

Main window buttons:

1. Enroll: opens up an enroll dialog.
2. Identify: opens up an identification dialog.
3. Clear DB: clears the demo program face database.
4. Options: opens up an options dialog, which is described further down in this document.
5. About: This displays the about dialog, which shows of which components the demo is composed of.

The log field in the main application window is used for system information and application progress messages (enrollement and identification operation results).

## 5.2. Options dialog

The screenshot shows the 'FaceCell Demo' application window with the 'Options' dialog box open. The dialog box has a blue title bar with the application name and standard icons. It contains three sections: 'Extraction', 'Generalization', and 'Matching'. The 'Extraction' section has two rows of controls: 'Inter-ocular Distance' with two spinners (40 and 250) and 'Face Quality Threshold' with a spinner (128). The 'Generalization' section has two rows: 'Threshold' with a spinner (0.625) and 'Count' with a spinner (3). The 'Matching' section has one row: 'Threshold' with a spinner (0.65). At the bottom of the dialog are two buttons: 'OK' and 'Default'. A status bar at the bottom right of the dialog shows a keyboard icon and a volume icon.

Extraction	
Inter-ocular Distance:	<input type="text" value="40"/> <input type="text" value="250"/>
Face Quality Threshold:	<input type="text" value="128"/>

Generalization	
Threshold	<input type="text" value="0.625"/>
Count:	<input type="text" value="3"/>

Matching	
Threshold	<input type="text" value="0.65"/>

## Figure 5.2. Options dialog

- Minimal IOD – minimal distance between eyes in the input image.
- Maximal IOD – maximal distance between eyes in the input image.
- Generalization threshold – similarity value that has to be mutually exceeded by each feature template used for generalization.
- Generalization image count – number of images to use for enrollment with generalization.
- Matching threshold – threshold that separates identical and different subjects. Matching threshold is linked to false acceptance rate (FAR, different subjects erroneously accepted as of the same) of matching algorithm. The higher is threshold, the lower is FAR and higher FRR (false rejection rate, same subjects erroneously accepted as different) and vice versa.

You can find all these thresholds in "[Matching threshold](#)" table

- Default button sets all the option values to their default values.

## 5.3. Simple usage examples

In this section simple basic scenarios of using VeriLook algorithm demo application are described in a step by step fashion.

### Enrolling from camera

1. Select "Enroll" button in the main window.
2. In newly opened window select image source, in our case - camera.
3. In the mode field select single enrollement mode.
4. In the id field type the id for the person to be enrolled.
5. After pressing "ok" standard image capture window of Windows CE should open. Capture the image and press "back". (Note: the face in the image should occupy almost all the space). The program will return to main window and the found face will be displayed in the central part of it, with the face outlined by a green rectangle and eyes marked by green dots. The detailed results of the enrollement operation will be displayed in the bottom log window. If the face was successfully found in the image its details will be extracted and stored in the program face database.

### Matching from camera

1. Select "Identify" button in the main window.

2. In newly opened window select image source, in our case - camera.
3. After pressing "ok" standard image capture window of Windows CE should open. Capture the image and press "back". (Note: the face in the image should occupy almost all the space). The program will return to main window and the found face will be displayed in the central part of it, with the face outlined by a green rectangle and eyes marked by green dots. The detailed results of the extraction operation will be displayed in the bottom log window. If the face was successfully found in the image its details will be extracted and matched against the programs face database. The most probable id from the database will be displayed in the bottom log window.

## **Enrolling from file**

1. Select "Enroll" button in the main window.
2. In newly opened window select image source, in our case - file.
3. In the mode field select single enrollement mode.
4. In the id field type the id for the person to be enrolled.
5. After pressing "ok" standard file open dialog of Windows CE should open. Select the file. (Note: the face in the image should occupy almost all the space). The program will return to main window and the found face will be displayed in the central part of it, with the face outlined by a green rectangle and eyes marked by green dots. The detailed results of the enrollement operation will be displayed in the bottom log window. If the face was successfully found in the image its details will be extracted and stored in the program face database.

## **Matching from file**

1. Select "Identify" button in the main window.
2. In newly opened window select image source, in our case - file.
3. After pressing "ok" standard file open dialog of Windows CE should open. Select the file. (Note: the face in the image should occupy almost all the space). The program will return to main window and the found face will be displayed in the central part of it, with the face outlined by a green rectangle and eyes marked by green dots. The detailed results of the extraction operation will be displayed in the bottom log window. If the face was successfully found in the image its details will be extracted and matched against the programs face database. The most probable id from the database will be displayed in the bottom log window.

## Enrolling with generalization

Generalization enables face feature extraction from multiple images of the same person thus allowing more details to be precisely extracted, increasing the reliability of matching operations. To perform enrollement using generalization follow these steps:

1. Select "Enroll" button in the main window.
2. In newly opened window select image source, either file or camera.
3. In the mode field select generalization enrollement mode.
4. After pressing "ok" depending on selected image source either standard video capture dialog or file open dialog will appear. Capture the image or open the file, after this the program should return automatically to its main window, perform feature extraction and again return to capture dialog to get another image. The program will repeat these steps untill number of images set in options dialog section "threshold image count" will be captured. After that the program will return to its main window and perform final feature extraction from all the captured images and the found face will be displayed in the central part of the window, with the face outlined by a green rectangle and eyes marked by green dots. Detailed results of the enrollement operation will be displayed in the bottom log window. If the face was successfully found in the images its details will be extracted and stored in the program face database.

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## Chapter 6. Matching threshold and similarity

VeriLook features matching algorithm provides value of features collections similarity as a result. The higher is similarity, the higher is probability that features collections are obtained from the same person.

Matching threshold is linked to false acceptance rate (FAR, different subjects erroneously accepted as of the same) of matching algorithm. The higher is threshold, the lower is FAR and higher FRR (false rejection rate, same subjects erroneously accepted as different) and vice versa.

FAR	Threshold
1%	0.625
0.1%	0.650
0.01%	0.675
0.001%	0.700
0.0001%	0.725
0.00001%	0.750