FaceIt® G6 Frequently Asked Technical Questions

Issue Date: September 10, 2004 (Last Update: May 20, 2005)

FaceIt® Technologies, Products and Services

Question	Answer
What facial recognition technologies does Identix supply?	*Identix supplies the following four technologies:* *a. Face finding: Given an image, find a face or faces. FaceIt® face finding technology returns the eye positions in the image.* *b. Face recognition: Given a face in an image and either another face image or a pre-processed facial template, compute the match score that indicates the likelihood that the two faces correspond to the same person.* *c. Liveness: Given a recognized person, verify that the recognized image is a real person and not a facsimile, such as a drawing, photograph, or model. Identix provides a multi-frame challenge/response test.* *d. Image Quality: Given a facial image, evaluate the likelihood that the image will support good face recognition performance and, in applications where it is appropriate, prompt for an improved image.*
How do you typically categorize the usage of the technologies?	*a. Identification: Using image quality, face finding and face recognition technologies, search through a database of faces to find a potential match or list of matches (candidate list). This is **one- to-many searching**, sometimes referred to as identification.* *b. Verification: Using face finding, face recognition, and, where appropriate, liveness detection, determine if a person who claims a particular identity (using a PIN, password, token, etc.) matches the corresponding entry in the database. This is **one-to-one matching**, sometimes referred to as verification.* *c. Facial screening: Using real time face finding, face recognition and tracking, follow the presence and position of a person in a video field of view; when combined with identification, identify a person in the live video input from a watch list. Output is a candidate list, in descending order of similarity.*
What facial products does Identix offer (i.e., how are the facial technologies packaged)?	*a. FaceIt SDK: For developing enrollment, one-to-one and one-to-many applications.* *b. FaceIt Surveillance SDK: Add-on to FaceIt SDK for developing facial screening applications.* *c. FaceIt Quality Assessment SDK with Standards Formatting*

Question	Answer
	Module: Automatic image quality assessment and international standards formatting tools. Enables integrators to create high performance standards-based face capture solutions. *Turn-key products developed for specialized applications of facial recognition:* a. *ABIS® System: A scalable, web-based multi-biometric search engine intended for conducting one-to-many searches in a manner analogous to AFIS fingerprint match systems. Provided as complete software package, including customization support.* b. *FaceIt ARGUS: A real time facial screening software package. Sets off audio and/or visual alarms when match of a live captured face against watch list database exceeds a user specified threshold.*
Does Identix provide custom development services? What if I'm interested in a facial system not included in this product list and don't have resources to develop it from an SDK?	*Yes, Identix has a Professional Services staff specifically for this purpose. From concept development to proposal creation to product delivery and testing services, our Professional Services team provides the full range of capabilities necessary to build a customized biometric software application or finished hardware/software solution.*

Facial Templates

Question	Answer
What is a facial template?	*A template is a mathematical representation of a biometric sample (i.e. a facial image). A template enables algorithms to work more quickly than would otherwise be possible, by encoding the relevant information in a series of bits and bytes.* *While one can always apply face recognition to two facial images, there are advantages to comparing a facial image against a facial template instead:* *1. Speed of comparison.* *2. Storage size.* *Identix offers template types optimized for speed and/or size, as described below. Templates cannot be reverse-engineered to create the original biometric sample.*
What types of facial templates does Identix use?	*Identix currently uses three types of templates for identification:* *a. The **vector template** is a small template, currently 648 bytes, that is used for very rapid searching over the entire database or query restricted sub-database of interest. This template type is used primarily for one-to-many searching.* *b. The **local feature analysis (LFA) template** is larger, 5.2KB in size. In 1:N matching, this template is used to perform a secondary search on the top N% (typically 5% or less) of ordered matches following the vector template search in a 1:n matching application.* *c. The **surface texture analysis (STA) template** is the largest of the three. It relies on the skin features in the image which contains the most detailed information that the system uses for analysis. The STA template is 6.7KB in size, and in 1:N matching applications, it is used to perform the final pass on the top N% of ordered matches following the LFA template search. Notwithstanding storage constraints, the STA template is the ideal one for verification applications.*
Can the identity of the person be obtained from the vector or full templates?	*No. The facial image cannot be reconstructed from these templates.*

Face Recognition

Question	Answer
What scientific method does Identix FaceIt technology use to recognize faces?	*Identix FaceIt technology combines traditional facial recognition techniques (local feature analysis) with new skin biometrics to deliver unprecedented levels of accuracy. Local feature analysis looks at geometry of the face or the relative distances between predefined features (e.g., nose and mouth). Skin biometrics, on the other hand, looks for uniqueness in texture and randomly formed features to form a unique skinprint identifier. The skin algorithm is called Surface Texture Analysis (STA). Because skinprint technology relies on the same image capture devices and the same data, it is easily incorporated into traditional face recognition systems to yield exceptional levels of performance. In effect, two different traits of the same image are analyzed at the same time with the results fused together, yielding a performance boost greater than their individual results.*
How do changes in expression, such as smiling, frowning or blinking affect FaceIt face recognition?	*By combining LFA and STA, FaceIt has advantages over other approaches in terms of robustness to facial expression and other "extrinsic" variations. Compared with other approaches, such as "eigenfaces," FaceIt is relatively insensitive with respect to changes in expression, including blinking, frowning, and smiling.*
Is FaceIt face recognition sensitive to the growth of facial hair?	*No. In most cases, FaceIt has enough redundancy and robustness to be able to compensate for mustache or beard growth.*
Is FaceIt face recognition sensitive to hairstyle?	*No. However, if hair occludes a significant portion of the face, face recognition accuracy will naturally be compromised.*
Does FaceIt use neural network technology?	*The algorithms have been "trained" on human faces to determine the correct significance of each local feature. However, neural networks are not used in the usual sense.*
Can people be recognized at varying pose?	*For pose less than 10-15 degrees, there is no degradation in face recognition.* *From 15 to 35 degrees, the face recognition discrimination power decreases.* *Angled faces beyond 35 degrees do not match well to frontal faces with our current release technology. However, angled faces can be matched to other faces at the same angle as long as both eyes are clearly visible.*
Can FaceIt estimate pose angle and use this information to improve recognition?	*Yes, using proprietary techniques, we can determine from a static photo or video still the degree of rotation of the face away from the camera. Pose angle can thereby be compensated for, improving*

Question	Answer
recognition?	*matching performance.*
Can people be recognized with eyeglasses on or off?	*Yes, the FaceIt algorithm is able to compensate for many eyeglasses. However, when the eyes are obscured by sunglasses, or glare on glasses from nearby light sources prevents localization of the eyes, then FaceIt accuracy is affected.*
Is the technology sensitive to race or gender?	*No, special care has been taken to assure that Identix face recognition technology is invariant with respect to race or gender.*
Can an image captured with a digital camera be matched against a digital video camera or scanner?	*Yes, internal algorithms are applied to make the matching relatively invariant with respect to input type.*
What are the major causes of face recognition failure?	a. *Significant glare on eyeglasses that obstructs the eyes. Adjusting the lighting that causes the glare can typically solve this.* b. *Long hair obscuring the central part of the face.* c. *Poor lighting that would cause the face to be overexposed or underexposed (low contrast).* d. *Lack of resolution, in pixels, of the face. (Image was taken too far away.)*
Can the face recognition accurately match an image created with a photo-fit product (e.g., CD-Fit, comPHOTOfit, Suspect ID) against an actual image?	*If the photo-fit product produces smooth images, as opposed to high contrast sketch images, then FaceIt works well. The technology, however, is not designed for high contrast cartoon-like images.*
Can Identix' face recognition accurately match an image created with a face aging product against an actual image?	a. *Face recognition does not work optimally on images of children under the age of 5.* b. *We have studied the effect of aging from adolescence through adulthood using our technology and have found invariance with respect to aging beyond the completion of feature growth (roughly 13 years of age).* c. *The actual biometric performance of artificially generated images depends on the software product used and the quality of original images. This being said, STA appears to be the most stable automatic face recognition algorithm for subject aging.*
How does one characterize the accuracy of face recognition?	*Different methods are used to measure accuracy, depending on what application of face recognition is being evaluated.* *When performing recognition for **verification** or authentication purposes, one typically attempts to obtain a **score** above a fixed **threshold**. If the score is above or equal to the threshold, the person*

Question	Answer
	is recognized, otherwise the person is not recognized. *Accuracy for verification applications is often characterized in terms of two probabilities at a given threshold:* *1.* **False Acceptance Rate (FAR):** *The chance that an imposter will be erroneously recognized (obtain a matching score equal to or higher than the threshold).* *2.* **False Rejection Rate (FRR):** *The chance that an authorized person will not obtain a score equal to or above the threshold.* *Both the FAR and FRR are functions of threshold. The value where the two probabilities are the same is* **the Equal Error Rate (EER)***. The EER is a useful technology descriptor in that it describes performance with a single number. For example, if the EER is 1%, that means 1% of the right people are rejected and 1% of the wrong people are accepted above a certain threshold in a verification task. However, typical real-world implementations do not operate in this equal probability of error regime. Usually, the FAR must be very low but at the sacrifice of a much higher FRR.*
How are FAR, FRR and EER determined?	*These numbers are determined by applying the face recognition algorithm to a database of faces in which the correct matches have been pre-determined. For results to be statistically valid, the database should be reasonably large.* *Note: The accuracy of any face recognition system is strongly dependent on the quality of the database used for analysis.*
Do the FAR and FRR values depend upon the database used in the analysis?	*Yes. The False Rejection Rate (FRR) is strongly sensitive to the database used to calculate the result. This is because the rejection of an individual may occur simply because the image quality of the database is poor.* *The False Acceptance Rate (FAR) is less sensitive to the image quality of the database. However, databases still vary in recognition "difficulty."* *Therefore, both the FRR and FAR (to a lesser extent) are sensitive to the database used for analysis.*
What is the FRVT test?	*FRVT or Facial Recognition Vendor Test is a successor to FERET. It is an independent evaluation conducted by the US government's National Institute for Standards and Technology (NIST) and co-sponsored by the Counterdrug Technology Development Program Office, the National Institute of Justice (NIJ) the Defense Advanced Research Projects Agency (DARPA) and the Naval Surface Warfare*

Question	Answer
	Center (NAVSEA) and other agencies. FRVT 2002 was designed to assess and differentiate the capabilities of the various commercially available facial recognition technologies to meet real world applications. The most recent test was administered in July and August of 2002. For results, refer to http://www.frvt.org
How does the latest FaceIt technology (G6) compare to the version that was tested in FRVT 2002?	*The latest FaceIt technology (G6) produces FAR and FRR rates of less than 1% for one to one applications, a leapfrog in performance, that is on par with fingerprint.* *Similarly, for one to many applications, a jump of 25 percentage points or more in Correct Alarm Rate performance – depending on database size and image quality – has been clearly demonstrated. This brings rank 1 match probability do the 95% range, as opposed to the 70% range demonstrated by the 3 top tier vendors (which included Identix) in the last FRVT 2002 evaluation conducted by the U.S. government.*

Face Finding

Question	Answer
What scientific method is used for face finding?	*FaceIt face finding uses a combination of geometrical queues and pattern matching to find heads and facial features.* *Identix face finding can detect simultaneously the presence of multiple faces in an image or in video frames, and can accurately determine the position of each of the faces.*
Does the user have to supply clues for the face finding to work?	*No, the entire face finding process is fully automated, continuous and functions in real-time on a standard off-the shelf processor. The user does not have to click on the image as a clue.*
Does the person have to be facing the camera for the face finding to work?	*No, faces can be found at +/- 90° from the frontal pose. However, for facial recognition functions the face image should be at +/- 15° from frontal, with diminishing performance up to 35°. Note the distinction here between face finding and face recognition.*
Can FaceIt automatically measure the pose-offset angle of the face?	*Yes, pose angle can be estimated and, for some applications, this can be used to improve recognition performance.*
Can the distance from the face automatically be measured?	*FaceIt technology returns the eye positions and subsequently the size of the face in the image. If the focal length of the camera and the CCD size are known, distance from the camera to the face can be easily calculated.*
Does the face finding technology require the face to be of a certain size or in a certain position?	*FaceIt technology can find faces anywhere in the image at arbitrary scale. For optimal face recognition performance there should be at least 90 pixels between the centers of the eyes, preferably 120. Likewise, it is also suggested that the maximum size of a face in an image be defined to ensure that large faces, which might exceed the size of the image, are not processed.*
How accurate is the face finding?	*The face finding technology finds faces and returns a score indicating the "goodness" of the face found (known as the alignment quality). This way, the small percentage (on order of 0.1%) of improperly aligned faces can be manually aligned to complete the template creation process for a large database.*

Image Quality Evaluation

Question	Answer
What is the FaceIt Quality Assessment SDK with Standards Formatting Module	*The FaceIt Quality Assessment SDK with Standards Formatting Module is a developer's toolkit for embedding face image quality checking into applications – typically face capture applications. It analyzes whether an image is suitable for facial recognition using ISO best practices and resizes a captured image to comply with the requirements of ISO's biometric data interchange standard for face images (ISO 19794-5) using ISO best practices Region of Interest compression techniques. Image quality can be automatically evaluated following image capture but prior to permanent storage in a database or prior to a matching attempt, in order to verify that the facial image will be useful in automated face recognition. It can also be used to give an operator in a live enrollment scenario feedback that can be used to acquire a better image, should the initial image rate poorly. The image quality library is also built into the ABIS system and image quality assessment is conducted on all images supplied to ABIS system for enrollment.*
How long does it take to test image quality?	*Less than $1/10^{th}$ of a second, when images are run in batch mode. Less than 1 second when the test is performed on an individual image.*
What aspects of the image does the Image Quality Evaluation System test?	1. *Head size – Is the face large enough?* 2. *Cropping – Is the entire face visible in the image?* 3. *Centering – Is the face sufficiently centered to allow re-dimensioning to standard size?* 4. *Exposure – Is the image over-exposed or under-exposed?* 5. *Eyes Clear – Is the person wearing glasses and if so are the eyes visible or obscured?* 6. *Focus – Is the image well focused?* 7. *Compression – is the image so overly compressed as to remove skin details?* 8. *Texture – does the skin surface contain detectable texture for use in face recognition?* 9. *Resolution – does the image have minimum, adequate or optimum resolution, measured as pixels between the eyes?* 10. *Faceness – can the object detected in the image be said to be a human face or not?* *Information from all of these categories is combined to compute an Overall Quality score, which can be used by a human operator, or by the computer (when running in automatic mode) to decide*

Question	Answer
	whether to perform further processing on the image or, where possible, prompt the operator on how to acquire a better image.
What is "faceness"?	*"Faceness" is the name given to a quality factor that is measured by the FaceIt quality assessment library. The faceness is a measure of the confidence that the object found in an image is a human face and not some arbitrary object that resembles a human head, such as a clock face or a random shadow pattern.*

Face Recognition and Face Finding Speed

Question	Answer
How fast is the face recognition search speed?	*Search performance depends on many factors, such as database size, hardware configurations and, most importantly, the implementation architecture. This makes it impractical to assert a quantitative 'speed' metric.* *FaceIt SDK, however, is well positioned to provide developers with scalable options to tailor implementations to meet various speed requirements.* *Ideally a system would search all images using VFA, LFA and STA. This provides the most accurate results and is well suited to situations where the Database size is small, or search time is not a critical factor.* *When database size is large or there are significant time objectives, FaceIt SDK allows developers to take a more efficient approach by optimizing search sizes in a three-pass approach that uses VFA, LFA and STA.* *In the first pass, the vector template of the probe is compared to all vector templates in the database at high speed – almost 2 million per second on a 2Ghz CPU. The highest scoring results are forwarded to the second pass, the number of results passed being in the range of 0.5% to 5% of the total database size.* *In the second pass, the LFA template of the probe is compared to each of the LFA templates passed forward from the first pass; search speeds for the intensive template are one thousand times slower than the vector template search speed.* *In the third pass, the STA template of the probe is compared to each of the STA templates passed forward from the second pass; search speeds for the STA template are ten times slower than the LFA template search speed.* *Search speed is also dependent on whether the searched templates are held in RAM only ("raw" speed) or are paged from disk ("paged" speed).*
How long does it take to create a template?	*On a typical 2GHz CPU, the template creation times are:* 1. *Vector creation time: 0.69 seconds* 2. *LFA template creation time: 0.01 seconds.* 3. *STA template creation time: 0.08 seconds*
How fast is the face finding speed?	*Face finding on a typical input image of 400x300 pixels takes about 0.25 seconds, depending upon the size and quality of the face in the*

Question	Answer
	image and the complexity of the surrounding scene. *Note that the time can be decreased if a higher failure to enroll is acceptable. The failure to enroll rate is the failure to pinpoint the face in an image. Also, this time can be reduced if the rough sizes of the faces in the images are known beforehand. In that case, the face finding algorithm does not need to spend time looking for faces of all sizes. The user can set a parameter so that only faces at the appropriate scale are searched.*

FaceIt® SDK, FaceIt® Surveillance SDK and FaceIt® Quality Assessment SDK with Standards Formatting Module

Question	Answer
What is an SDK?	*An SDK (software development kit) is a self-contained library of face recognition and face finding functions that can be used by programmers to add Identix FaceIt technology to their applications.*
What can an SDK do?	*On its own, nothing. What an SDK allows, is for software developers to embed state-of-the-art biometric technology into applications. .*
What is the current FaceIt SDK product line-up?	*There are three FaceIt SDKs available for building high-performing face recognition applications:* *1.* **FaceIt SDK** *– C APIs that provide functionality to build enrollment, 1:1 and 1:N applications. Contains modules for face finding, template creation, quality analysis, 1:1, 1:N and watchlist searches.* *2.* **FaceIt Surveillance SDK** *– Active X and COM objects for use in live video one-to-many (facial screening) applications. Allows for fast face segmentation (and multiple face finding) for near real-time performance. In order to perform face recognition after finding faces using this SDK, the FaceIt SDK is required. The face finding algorithms in the Surveillance SDK have been optimized for speed and are designed for use with images captured from live video or video playback.* *3. FaceIt* **Quality Assessment** *SDK with Standards Formatting Module – collection of Active X controls and a C API for evaluating and classifying faces and writing to standards-based data formats. Helps to find faces at non-frontal pose and to estimate the angle of rotation of the face. Other quality parameters supported are: head size, head cropping, brightness, darkness, blur, glasses on/off, and glasses glare, compression and resolution. It also contains COM and ActiveX interfaces to export images to ISO face data interchange formats.* *In addition, the Identix Professional Services Group can assist customers in porting the C++ FaceIt libraries to UNIX, Linux or other non-Windows platforms. Please contact Identix for more information and a quotation.*
What programming languages can be used with the SDKs?	*Developers use Microsoft C and C++ with the FaceIt SDK. For the FaceIt Surveillance SDK and the FaceIt Quality Assessment SDK with Standards Formatting Module, other languages that are compatible with COM and ActiveX technology can be used. These*

Question	Answer
	include Microsoft Visual Basic, Microsoft Visual C++, and Borland Delphi.
What is COM and why do you use it in the FaceIt Surveillance SDK?	*COM (Component Object Model) is Microsoft's unified object model format. Each COM interface inherits functionality from a standard set of functions that allow the programmer to query the interface for remaining functions. The COM model is used on the Microsoft specific win32 platform only.* *COM is a very convenient language to distribute technology on the Windows platform. It is a language or API (Application Programming Interface) designed for use by both Visual Basic and C++ programmers.*
What is a COM object?	*COM is a software architecture that allows the components made by Identix to be combined into a variety of applications. COM defines a standard for component interoperability, is not dependent on any particular programming language, is available on multiple platforms, and is extensible.*
What is an ActiveX control?	*ActiveX is Microsoft's definition of a custom GUI (Graphical User Interface) element, such as a button, etc. that is seen by a user in a dialog box, web browser, etc. ActiveX is based on COM.*
What is the difference between COM and ActiveX?	*COM is a set of back-end functions. The user does not "see" a COM object in an application. ActiveX is a front- end control. The user sees the ActiveX control.* *From the Identix point of view, FaceIt technology is distributed in COM objects. The combination of (a) COM object(s) and a visual display element, image or video multimedia, is an ActiveX control.* **ActiveX = COM + visual element.**

Database Storage

Question	Answer
Do you have any specific storage requirements in regards to 1:N matching?	*Storage of facial templates is outside the scope of the FaceIt Identification SDK. When using this SDK, the application designer is responsible for ensuring that template storage is included.* *In addition to storing the VFA, LFA & STA templates, developers should also consider a plan for storing the original images. Storing original images allows easy migration to new generations of FaceIt technology through the batch creation of templates.*
Does your technology require a proprietary database format for 1:N matching?	*The facial technologies in the FaceIt SDKs are database platform independent. FaceIt technology converts facial images into facial templates and computes matching probabilities that can be turned into ordered lists. The technology can be used directly through the APIs provided in the SDKs. Storage of templates in databases is outside the scope of the FaceIt SDKs.* *The ABIS system and FaceIt ARGUS, however, both use Oracle 9i for storing templates in databases. Other databases can be provided in these products by special arrangement.*
Is there a limit to the database size for 1:N matching that FaceIt technology can handle?	*No.*

Image Input

Question	Answer
Do you have any recommendations for digital cameras to use when capturing face images for enrollment in a database of images for facial searching?	*We recommend against the use of desktop cameras, such as webcams, in which the face is very close to the camera, e.g. 2 feet or less. This is because these devices have very short focal length lenses and they create a fisheye effect that distorts the shape of the face. We recommend instead the use of consumer-grade digital cameras with lens focal lengths that are 50mm (35mm film equivalent) or longer. The exact focal length chosen will depend on the planned distance between the camera and the subject.* *In general, there are a large number of adequate digital cameras for the task of photo imaging for face recognition task. The best solution for a given application depends upon price, feature requirements for the application of interest and form factor*
What sort of image enhancements might be required for the image input?	*The internal algorithms in FaceIt have built-in image enhancement technology. No external image enhancement is required, nor is it recommended as this can affect matching performance by altering the original data.*
What is the minimum photo input specifications required for the Identix technology to maintain effectiveness?	*The minimum quality image would be 320 x 240 x 8-bit grayscale and 60 pixels between the centers of the eyes. This corresponds with the minimum size of the ISO token image specified in standard ISO 19794-5. However, it is highly recommended that the images are 120 pixels between the centers of the eyes. This corresponds to the recommended images size of the ISO standard.*

Video Input

Question	Answer
What video device standards do you support on the Windows platform?	*Our products currently support the Microsoft Video For Windows (VFW) and DirectShow standards. Most video input devices designed for the Windows OS support VfW and/or DirectShow.* *Using the low-level API calls provided by our SDKs, however, a programmer can connect any video device to our algorithms. Special purpose drivers must be supplied by the device manufacturer or a third party.*
Do you support USB cameras?	*If the camera manufacturer provides a VFW or DirectShow software driver for their device, then that device will work with our products and developer software. **Our software does not connect directly to hardware.***
What image capture hardware or cameras do you recommend for use with your technology?	*A separate document is available. Please contact your Identix sales representative for further information.* ***Note regarding Surveillance Cameras:** We recommend that surveillance cameras be chosen on the basis of a number of factors, some of which include the client's plans for facial surveillance implementation. Please contact your Identix representative to arrange a discussion.*
How can the quality of video be controlled to ensure optimal results?	*Avoid including a bright light source in the video field of view such as the sun, or when indoors, a window in the background field of view. In general, avoid situations that will generate either back lighting or glare on the subject's face.* *The most important factors for FaceIt are good gray scale contrast (including a range of values from bright to dark) and sufficient resolution (numbers of pixels) to resolve local features.*