Facial Recognition (FR) Architecture

The Acsys Enterprise system provides a multi-tier Client-Server architecture, based upon Component Object Model (COM) technology. Acsys application development libraries are provided in ATL, OCX and JAVA. Communication between Client and Server components is provided in both DCOM and HTTP protocols. The component architecture of the Acsys Enterprise core software modules for facial recognition (FR) are illustrated below.

Acsys Client modules perform facial tracking, facial verification (1:1 identification), classification (1:many search) and image capture for facial enrolment and processing. Up to 4000 FR Clients may communicate and operate in live connected mode with the Acsys Central Server and FR Database.

The Acsys Server components (Central Server, FR Database, Template Search, Template Generation) may reside on the same or separate physical computers. Biometric template search and generation modules are built upon a server farm architecture, whereby execution occurs in parallel and is automatically load balanced across an array of processing nodes. The Enterprise architecture provides a high level scalability for Enterprise level solutions.
The Acsys Modular system provides a single-tier architecture for development of mobile or embedded applications that are database independent. The Acsys Modular system contains most of the basic FR functionality provided within the full Enterprise system.

**Features Provided by AcSys Enterprise System:**

- Simultaneous tracking of up to 16 separate faces from live video feed (30 FPS). Support for capturing facial images from static images (JPEG, BMP, GIF, TIFF, etc.)
- A tracking thread may be assigned to one of up to 16 separate video feeds. Each FR Client module may process up to 16 separate video feeds.
- Each tracking thread is controlled independently by the application layer. For instance, thread A may be performing classification, while thread B is performing verification and C performing facial enrollment.
- A tracking thread may execute simultaneous operations (i.e. enrolment concurrent with verify or classify). This permits the application layer to integrate logic rules based upon recognition confidence levels while updating biometric templates.
- Client modules are fully functional (i.e. perform verify, classify and enrol operations) while disconnected from the FR Server. Clients automatically synchronize data between Client and Server components following reconnection.
- Customizable options for periodic data (biometric template) synchronization between Client modules and the central FR Database. This permits flexibility in integration of business rules for optimization of network traffic.
- Compatible with Common Biometric Exchange File Format (CBEFF), provides encryption of images and biometric templates transferred between FR Client and Server components.
- Allocation of dynamic session pools for support of large volume access requests and/or large numbers of distributed Client machines (no restriction applied). Supports unrestricted numbers of enrolled users and FR Client modules.
- Supports multiple training (template generation) FR Servers and facial search Servers. template generation time and facial search time is reduced in linear proportion to the number of processor nodes. Facial (template) search speed is 100K faces/sec/CPU.
- Storage requirement for biometric template is 8 Kbytes for All Aspect and 4 Kbytes for Mug Shot FR processing.
- Central FR database supports all versions of Microsoft SQL.
- COTS applications provided for physical access control (Veraport), logical access control (Verashield) and automated surveillance (Discovery)
- Simplified Modular version of FR library (single-tier) is provided. Modular library is database independent, requiring all biometric and template storage to be handled by the application layer.
- FRS modular is BioAPI compliant
Provides "Mug Shot" and "All Aspect" FR Technology

The AcSys technology integrates "Mug Shot" and "All Aspect" facial recognition into one application development toolset. "Mugshot" FR technology is most often applied within applications related to photo document processing (such as drivers license or passport) and typically involves large volume search operations (> 1 Million Users).

Conversely "All Aspect" FR technology is most effectively applied within surveillance and access control, whereby the system must be able to work reliably given a much broader range in head orientation and facial expression. In these application scenarios the system most often requires lower search volumes (typically less than 25K Users), or operates solely in verification mode (1:1 match). Operating characteristics for each of the AcSys FR technologies are summarized below:

Mug Shot (frontal portrait)

- Facial identification/search operations are performed from static photos
- Head orientation restricted to less than +/- 15 degrees from full frontal
- Requires compliance with NIST photo document standards (i.e. eyes open, neutral expression, mouth closed, controlled lighting and high image quality)
- Facial identification typically performed using medium to high resolution images (eye separation > 40 pixels)
- Segmentation of facial region performed using eye location
- Search performed by processing a galley of facial photos through the biometric template. This affords greater processing speeds (100K images/sec/CPU)
- Algorithm less complex, therefore requires smaller biometric template (4 KBytes)
- Applies Server farm architecture in the search operation, scalability accommodates real-time processing of very large facial databases (i.e. > 1 Million Users)

All Aspect

- Facial identification/search operations are performed from live or recorded video. The system may also operate from static imagery
- Range in head orientation extended to +/- 90 degrees from full frontal
- Does not require compliance with NIST photo document standards
- Facial tracking and identification typically performed from low resolution video (240x360 pixels); operates with eye separation down to 15 pixels (frontal view)
- Segmentation of facial region performed using head geometry (both eyes need not be visible)
- Search performed by processing captured facial image through a galley of biometric templates. This reduces processing speed to 25K templates/sec
- Algorithm more complex, therefore requires larger biometric template (8 KBytes)
- Provides real-time facial recognition for access control and surveillance applications, where subject is non-cooperative and/or positioned at a large distances from the camera sensor

Integration of the above diverse operational features into a single FR library allows the application to combine the unique strengths of each.
Biometric Specifications

<table>
<thead>
<tr>
<th></th>
<th>Mug Shot (frontal portrait)</th>
<th>All Aspect</th>
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</thead>
<tbody>
<tr>
<td><strong>Image Formats</strong></td>
<td>Static Image</td>
<td>Video, Static Image</td>
</tr>
<tr>
<td><strong>Head Orientation</strong></td>
<td>+/- 15° rotation</td>
<td>+/- 90° rotation</td>
</tr>
<tr>
<td></td>
<td>+/- 15° tilt</td>
<td>+/- 30° tilt</td>
</tr>
<tr>
<td><strong>Image Resolution</strong></td>
<td>eye center distance &gt; 40 pixels</td>
<td>eye center distance &gt; 15 pixels</td>
</tr>
<tr>
<td><strong>Segmentation Method</strong></td>
<td>eye positions</td>
<td>head orientation</td>
</tr>
<tr>
<td><strong>Template Size</strong></td>
<td>4K Bytes (compressed)</td>
<td>8K Bytes (compressed)</td>
</tr>
<tr>
<td><strong>Processing Rate</strong></td>
<td>100K images/sec/CPU</td>
<td>25K templates/sec</td>
</tr>
<tr>
<td><strong>Biometric Encryption</strong></td>
<td>Yes (128 bit)</td>
<td>Yes (128 bit)</td>
</tr>
<tr>
<td><strong>NIST Compliance</strong></td>
<td>Required</td>
<td>Not Required</td>
</tr>
<tr>
<td>(facial image capture)</td>
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The HNeT Technology

The Acsys facial recognition technology is based upon Holographic Neural Technology (HNeT) developed by AND Corporation. HNeT is the first and most advanced AI technology based upon neuromorphic principles (precise understanding and modeling of brain structures).

The underlying holographic process both learns and superimposes information applying phase coherence/decoherence properties. HNeT is the most precise neuromorphic model in existence, providing advanced modeling of cerebellar and neo-cortical structures. This achieves leaning capabilities far in advance of standard machine learning methods, approaching and often exceeding those displayed by animal cognition.

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