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BIOMETRICS

Face Recognition

NeoFace® Watch

High performance face recognition

For real-time video surveillance, offline video face search and high volume photo face search requirements and for integration with other systems using the NeoFace® Watch API

The most accurate and fastest face recognition software application available

Due to recent advances in reliability, accuracy and performance, face recognition has ‘come of age’. Unlike other systems, face recognition requires no physical or active interaction with the subject, making it one of the least intrusive yet highly accurate biometric modes.

NEC’s NeoFace® face recognition solution is the fastest and most accurate solution available, as measured in independent tests.

BIOMETRICS

NeoFace® Watch

NeoFace® Watch is a high performance face recognition software application for real-time video surveillance, offline video face search and high volume photo face search. It can be integrated easily with other systems using the NeoFace® Watch API.

The design objective is to be the fastest and most accurate face recognition software on the market, using common off-the-shelf hardware (cameras, networking, servers) and where possible, using existing infrastructure.

NeoFace® Watch is a distributed application for operation in a wide range of architectural configurations to suit local deployment conditions and requirements, including across multiple servers and multiple sites.

Developed using the latest Microsoft technologies and operating on robust Microsoft Server platforms, it is designed for scalability to handle millions of faces, thousands of cameras, and thousands of simultaneous user interface sessions.

Powerful system configuration tools and monitoring utilities provide the ability to tailor the system to meet specific operational requirements and also to ensure continued optimum operation.

Web service APIs enable integration with a wide range of other IT systems such as video management systems, customer relationship management systems and security management systems.

The user interface is delivered totally through HTML5 browser technology meaning that no special software needs installing on any of the users computers. Smart device applications for iOS and Android platforms are also available.

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ABOUT NEC'S

NeoFace® face recognition

- FASTEST
- MOST ACCURATE
- BEST WITH LOW QUALITY IMAGES
- VERY HIGH TOLERANCE TO SITUATIONAL VARIABLES

NEC's face recognition is independently recognized as the fastest and most accurate face recognition software on the market. NEC's NeoFace® acquired top rank in FRVT2013, an independent test conducted by the U.S. Government

The tests position NEC's face recognition software as the most accurate face recognition software even with low quality images. Independent tests also demonstrate that NEC provides the fastest matching capability that is the most resistant to variants in angle, age and race.

Through the utilisation of a unique matching face detection method, NeoFace provides high speed and high accuracy for facial detection and facial features extraction. NEC's face recognition relies on a modified Generalized Learning Vector Quantization (GLVQ) algorithm. GLVQ is not easily fooled by attempts to conceal identity through the usage of caps, hats or sunglasses.

How it works

1. CAPTURE

NeoFace® Watch uses real time video streams from surveillance cameras, CCTV or archived video footage at a rate of up to 30 frames per second. It can also automatically ingest large numbers of still images from handheld or mobile cameras, smart devices and digital storage.

2. ASSESS

The individual frames of video and still images are each assessed, faces are detected and then each face analysed to determine its unique facial signature. A small template is created for each unique face.

3. MATCH

NeoFace® Watch then compares each template image against an enrolled image database until a match is found. A history of matches is maintained.

4. REACT

Real-time alerts or messages can be configured to be sent if there is a positive match against a database image or on a negative match where an unknown face is captured in a secure area.

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High performance face recognition

Real-life scenarios are challenging.
Sufficient facial detail is required to be able to identify an individual and unconstrained (real-life) face recognition needs to address a number of significant challenges:

- **Camera positioning:** many existing camera installations are positioned to observe people and their behaviour rather than to capture facial images… often placed too high
- **Lighting:** poor illumination makes it difficult to see a face; uneven lighting causes shadows. Natural daylight conditions cause intensity issues and changing shadows
- **Distance of subjects:** a small facial image will not provide sufficient detail to match
- **Flow rate of subjects:** fast motion does not allow much time to attempt a match
- **Ethnicity:** face recognition algorithms are 'trained' with large databases of real faces. Inadequate training databases can lead to poor performance with some ethnicities
- **Real world complexity:** head coverings, scarves, spectacles, facial expression, facial hair, age of the database image… all impact the chances of success
- **Quality of database images:** poor quality images decrease the probability of matching

Many face recognition deployments use weaker algorithms that cannot handle real-life unconstrained scenarios with acceptable accuracy and speed… leading to the popular belief that face recognition systems do not work in this environment.

Consequently face recognition deployments fall back to a constrained scenario. People are stopped under bright illumination, need to remove spectacles, are asked not to smile – all in an attempt to compensate for algorithm weaknesses. The reality is that this approach is unnecessary if weaker algorithms are avoided.

The NEC NeoFace® algorithm has been singled out as the most accurate and fastest for several years. It achieved a miss rate of 4.1% for recognition in a population size of 1.6 million… the next best algorithm achieved 9.1%. Putting this into perspective, the difference between NeoFace® and the next best algorithm can mean other algorithms missing 80,000 people or more in that population size. NeoFace® also continues to be fastest, capable of matching more than 3 million images per second (at least twice as fast as the next fastest and 35 times faster than some other algorithms used in competitive commercial face recognition systems today).

The algorithm is a key factor in face recognition application performance.

High frame rate CCTV video

And the best software applications also exploit other technology advances in terms of image capture and processing.

The ability to perform successful face recognition on a crowd of people is the most challenging scenario, particularly if the crowd is fast moving. It is imperative that enough of a face is captured to allow face matching to be attempted. A crowd of people will have many faces heading towards the camera, often not looking in the optimum direction. Templating a face at the split second that the person looks in the general direction of the camera is essential.

High frame rate video is required to achieve this. But for example, a crowd of 100 people being monitored by cameras running at 30 frames per second will require 3,000 faces per second to be detected, templated and submitted for face matching… and giving a real-time alert on matching. This requires significant central processing power and is costly.

However, the hardware footprint and cost can be collapsed by moving significant parts of the image processing to relatively cheap graphics processors.

Using a fast, highly accurate algorithm incorporated into a scalable architecture utilising best of breed camera and processor technologies allows unconstrained face recognition to be performed accurately, quickly and cost-effectively, even on large crowds.

And as a result, many real-life scenarios become possible, including:

- **Detecting subjects in a crowd:** in real time even at long distance using zoom lenses and high sensitivity cameras to counteract difficult light conditions
- **Protecting secure facilities from intruders:** perimeter access control can be strengthened and area surveillance can additionally protect inside the perimeter… people that should be there are recognised – anyone else is a potential intruder
- **Protecting secure zones:** zone surveillance can match faces with security levels
- **Automatically searching recorded CCTV or videos** for persons of interest
- **Automatically searching large quantities of photos** for persons of interest

Face recognition can do far more than is generally understood and in very challenging situations. It can be used with fixed, vehicle-mounted, hand-held and body-worn cameras. And used for fast, accurate identification in real-time, or for rapid forensic analysis after the event.

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Still images

Cameras

Digital cameras and SLRs, smart devices, stills from CCTV recordings

TRANSMISSION OVER MOBILE DATA NETWORK, WIFI OR BULK IMPORT

Digital storage

Portable storage, computer drives, online and cloud storage

BULK IMPORT

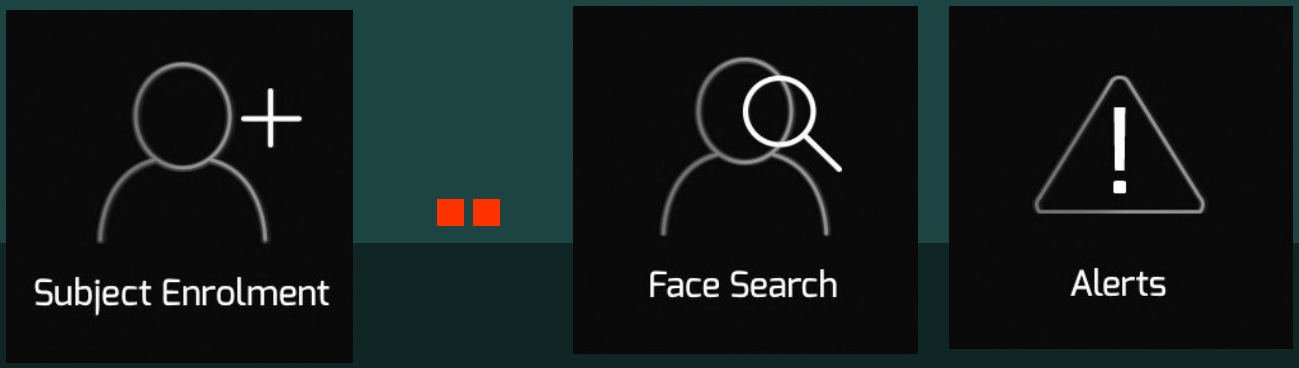
Applications

From other applications interfaced with NeoFace® Watch using integration APIs

VIA API

Assess & Match

Alert & Report



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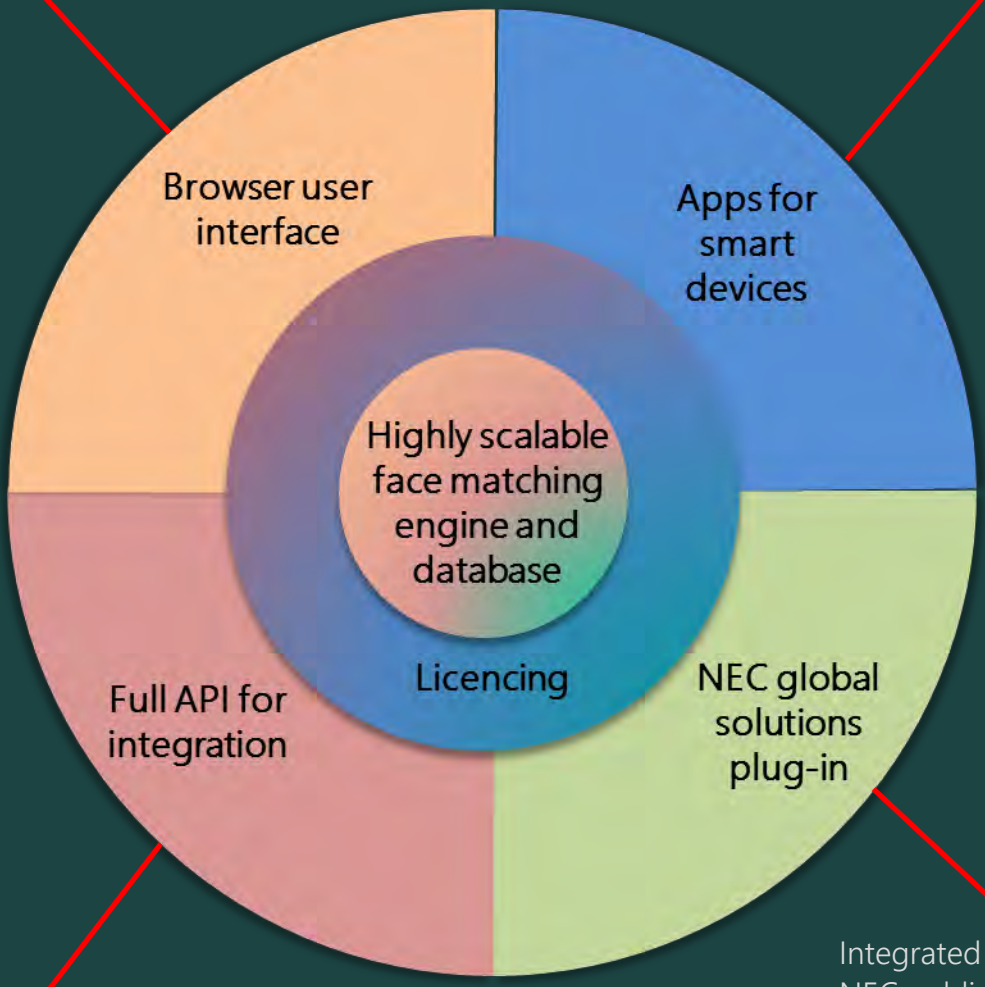
NeoFace Watch design overview

Server-based application with browser user interface presented using HTML5

Smart device apps to provide mobile enrolment using on-device cameras, submit remote searches against the server watchlists and receive real-time alerts



Integrated with other NEC public safety solutions for large scale safer city installations

Watch API: general purpose, flexible API providing access to objects and services in the system (subjects, photos, watchlists, matches, real-time alerts)

Web services API: as above but using WSDL and SOAP

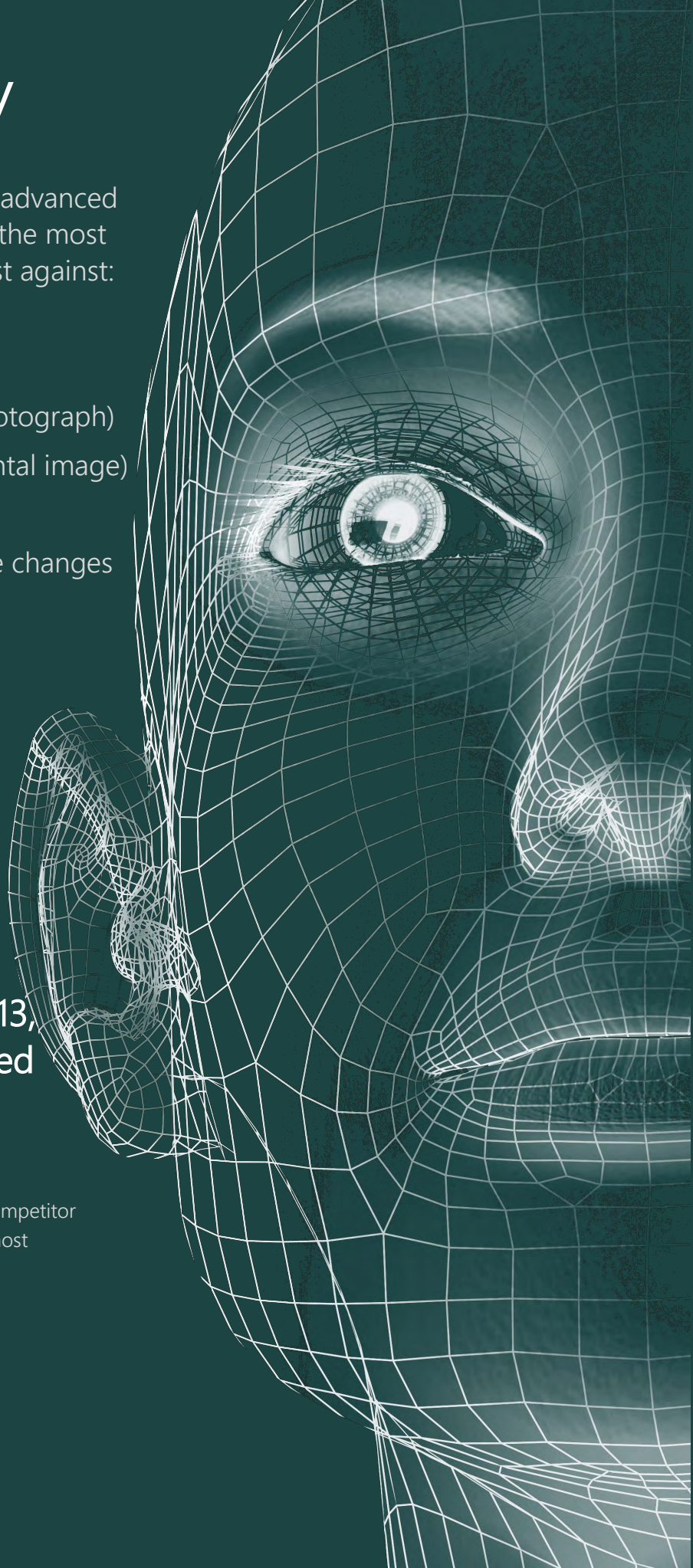
Embedded API: for embedded code environments

Low-level API: for frame injection (images or faces)

NeoFace Technology

The NeoFace® algorithm is the most advanced available, independently tested to be the most accurate and fastest, and highly robust against:

- gesture changes
- aging (typically 10 years from photograph)
- pose (+/- 30° deviation from frontal image)
- partial face occlusion
- beards, moustaches and hairstyle changes
- glasses
- lighting variations
- low quality images



Achieved top rank in FRVT2013, an independent test conducted by the US Government

Most accurate

- at least 2x more accurate than next nearest competitor
- more accurate with low quality images than most competitors with high quality images
- across all age groups

Fastest

- for small and large databases
- 3m+ searches per second
- 2x faster than next nearest competitor
- 35x faster than some commonly used systems

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Features

Real time surveillance

- Integrates with all modern IP network cameras using industry standard H264 RTSP and motion-JPEG protocols
- Harnesses GPU acceleration to maximize system performance with high speed cameras in challenging real-time use cases
- Finds multiple faces simultaneously
- Compares each face to those in multiple watchlists to determine subjects of interest
- Raises alerts based on predefined watchlist rules, including popup notifications, smartphone notifications and email alerts
- Generates real-time alerts with the originally enrolled watchlist photograph, the captured face from the camera and the overall scene image of the camera
- Allows matching thresholds to be tailored to a high degree of granularity to configure the system behaviour to local conditions and user requirements
- Provides configurable 'dashboard' user interface to allow users to configure their screen presentation for their individual requirements
- Provides a wide range of user-configurable dashboard 'widgets' to display recent matches, alarm stacks, live camera feeds and statistical information
- Performs anonymous video analytics for people flow applications
- Provides a comprehensive set of reporting tools to view historical face matches
- Provides an automatic enrolment option to assist identification of unknown persons of potential interest passing a location
- Allows replication of watchlist databases between sites in a multi-site configuration
- Accepts manual or bulk import of watchlist persons and images

Video footage import

- Imports footage in standard Windows file formats such as AVI and MP4
- Compares each face to those in multiple watchlists to determine subjects of interest
- Provides users with the ability to scroll through all the matches found in the video footage and to confirm identities

Still image matching

- Image acquisition can be from local or remote cameras or from digital storage (JPEG, JPEG2000, PNG, BMP)
- One to many search across one or more watchlists
- Filtering by metadata such as gender or age
- Customised candidate list size
- Results are presented in highest matching score order
- Image enhancement including manual eye location correction, cropping, and sharpness, contrast and smoothing filters
- Side-by-side image comparison for details verification
- Batch image file processing is also available

Smart phone applications

- Apple iOS and Android versions
- Receive watchlist notifications when persons of interest are found passing a camera
- Enrol new persons into a watchlist
- Submit a photograph for still image searching
- Communication with matching server using wifi or mobile carrier network

NeoFace® Watch licensing

NeoFace® Watch is available for a wide range of applications and is licenced based upon:

- Number of cameras
- Number of users
- Enrolled database size
- Enhanced system functions

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Security applications

NeoFace® Watch face recognition can be used in a variety of security applications and environments for everyday tasks that can be automated, authenticated or enhanced, providing people with a better quality of life and an improved level of security. Door access control, retail, hospitality, border control, immigration, CCTV surveillance and law enforcement are just some of the use cases for NeoFace® Watch worldwide.

DETECTING PERSONS OF INTEREST

Identifying individuals who pose a risk to security or are known trouble makers or offenders is essential for public safety.

NeoFace® Watch constantly monitors the area of concern and compares against watchlists. Where a match is found, security personnel can be alerted both on screen in the control room as well as by discreetly sending the information to the most appropriate personnel best placed to react, enabling a quick response to the potential threat.

ACCESS CONTROL

Face recognition can be used for access control solutions. This can include area perimeter or building entry where face recognition is used to allow or deny access and integrated with a door or turnstile.

This may be used in combination with a second token such as an entry pass.

A positive match in the database triggers the opening of the door or turnstile, allowing the individual entry. It can also be integrated into an automated registration kiosk for visitors.

SECURE AREA MONITORING

Secure area monitoring works in identifying individuals within a specific area. The solution monitors faces and positively matches them against a database which can include staff, contractors and visitors.

In this application, if an individual is not matched in the database, they are identified as a potential risk or threat. Security personnel can be alerted both on screen in the control room as well as by discreetly sending the information to the most appropriate personnel best placed to react, enabling a quick response to the potential threat.

Commercial applications

Harnessing the benefits of face recognition for non-security based uses can provide organisations with a number of benefits in terms of improving customer service and enhanced business intelligence, as well as offering a real competitive advantage.

Many opportunities exist to use face recognition in the hospitality, leisure and retail markets to promote better and more personalised service levels to important customers as well as the prevention of undesirable visitors.

CUSTOMER LOYALTY

Customer loyalty is important, whether it is to simply alert personnel to the presence of an important customer or to automate access to a specific area to improve the customer experience.

In other instances, the identification of a key customer in the database can trigger an alert or work process for personnel to perhaps provide some degree of special attention. The solution works by matching the captured image in the customer database. Alerts can then be sent to key personnel, along with enhanced data on the individual.

QUEUE MONITORING

Queues are an annoyance, inefficient and a potential health and safety issue.

NeoFace® Watch measures the movement of people between multiple points, providing information on queue length and waiting time.

Alerts can then be triggered allowing staff to take remedial action such as opening new access or check points to help reduce queue lengths and times.

Public areas can be monitored anonymously and real-time alerts generated when the area becomes too busy or overcrowded, reducing the risk to public safety.

BUSINESS INTELLIGENCE

Face recognition can also be used to monitor, measure and collect data about people in a specific area to gather priceless intelligence to improve business activities and operations. For example, this can include counting people, age, gender, facial expressions and time in the area. This data can be collated and analysed retrospectively or can even be used dynamically to trigger a real time event such as changing a message or content on digital signage.

Understanding more about the people in a specific area can help organisations to tailor activities to gain both commercial and customer experience benefits.

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NEC facial recognition technology: The world's best accuracy and speed

NEC was ranked #1 in 3 consecutive facial recognition benchmark tests conducted by the National Institute of Standards and Technology (NIST), exceeding all other vendors in both accuracy and speed by a large margin. *

Best accuracy

- #1 in matching high resolution image
- #1 in matching low resolution image
- High matching accuracy with images of different lighting and angles from original images

High speed matching

- 6 Million matches per second (against 1.6 million records)

** http://biometrics.nist.gov/cs_links/face/frvt/frvt2013/NIST_8009.pdf*

ABOUT NEC

IN PUBLIC SAFETY

NEC has a proven track record in public safety and continually aims to bring its best-of-breed cutting-edge security technologies and total solutions to help public and private institutions safeguard lives and property in both the real and virtual worlds. With a strong global footprint, NEC can leverage across regions to keep cities safer.

'Safer Cities' is an integral part of NEC's vision for Smart Cities, where people are able to live, work, and play in safety and comfort while also coexisting in harmony with the environment. NEC offers advanced technologies and solutions to make this a reality.

NEC has developed biometric technologies for more than 30 years and has solutions used by more than 1000 customers in over 30 countries worldwide. NEC's fingerprint and face recognition solutions are recognised in independent tests as the world's fastest and most accurate biometric technologies for identification.

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NEC Australia specialises in information and communications technology solutions and services in multi-vendor environments. Solutions and services include: IT applications and solutions development, unified communications, complex communications solutions, network solutions, display solutions, identity management, research and development services, systems integration and professional, technical and managed services.

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