Orchestrating a brighter world

NEC

NEC Display Solutions

Le soluzioni di sicurezza tra innovazione ed efficienza

Convegno OSSIF, 14 Dicembre 2017

Massimiliano Carlesi

Vertical focus

Aviation & Transportation

Meeting room

Digital Signage

Media

Energy & Utility

Corporate Solutions

Retail

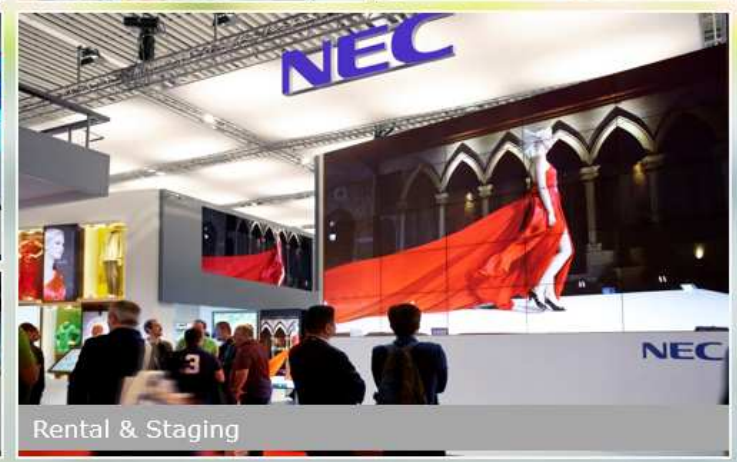
Cinema

Food & Beverages

Healthcare

Finance & Insurance

Entertainment &
Leisure & Museums



Rental & Staging

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NEC Display Value Proposition

- High quality products (e.g. metallic case, 12-bit LUT, colour calibration)
- Flexibility (e.g. OMi Open Modular intelligence)
- Scalability (horizontal and vertical)
- Integration (open API, AMX NetLinx support, Crestron RoomView support)
- Management and Control (NaViSet)
- Standard software platforms (Android, Linux, Windows)
- Wide range of HW solutions (LFD, Projectors, LED)
- Unique SW solutions (Neoface, Hiperwall)
- Service & Support

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Phisical Security

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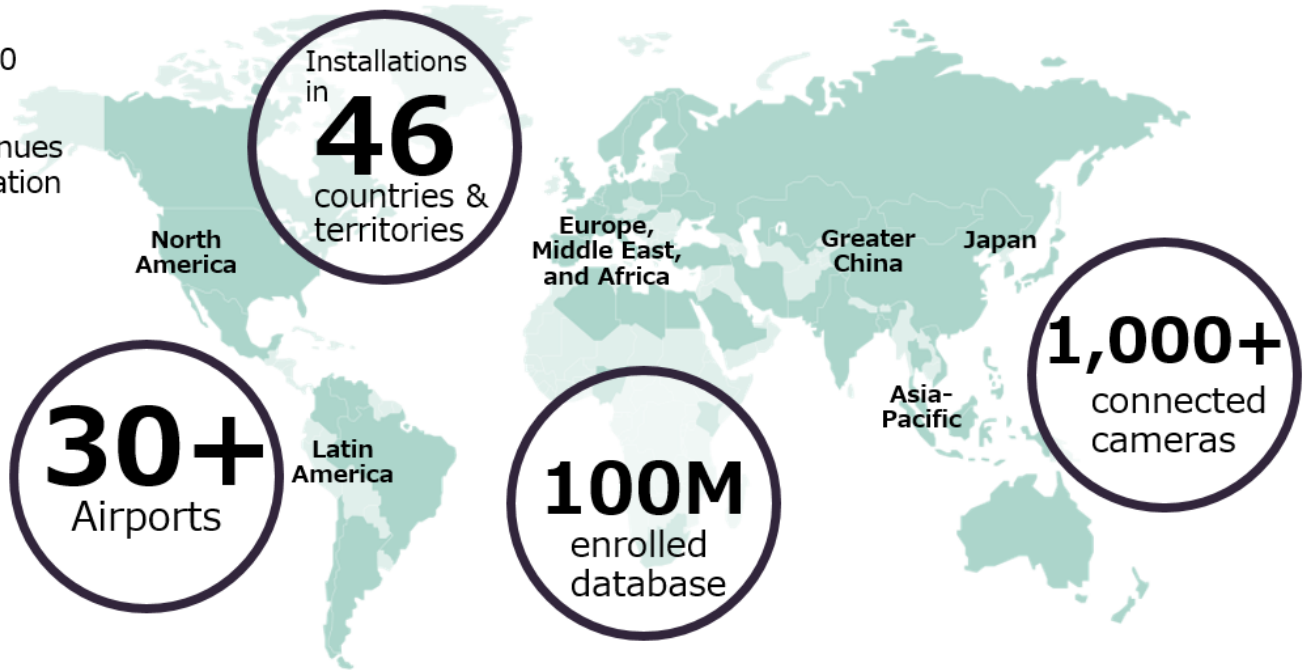
NEC's Global Face Recognition Platform

- Network of 9 Labs focused on Global Research
- Employs over 1,000 R&D Professionals
- 5% of Global Revenues Allocated to Innovation



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History of NEC's Face Recognition Technology

1963 Start character recognition technology R&D

1989 Start face recognition R&D
Application of pattern recognition technology established through character recognition R&D

2002 Commercialize face recognition SDK "NeoFace"

2009-2013 Rank No.1 in NIST*1 Evaluation

3 consecutive wins in Still Image Matching

2009(MBGC*2), 2010(MBE*3), 2013(FRVT*4)

2017 Newly rank No.1 in Video Face Recognition Evaluation
NIST Face in Video Evaluation (FIVE*5)

Evaluation under various environmental conditions

2017 NIST FIVE No.1

Video Face Recognition

1963 Character Recognition R&D

1989 Face Recognition R&D

2009 2010 2013 NIST Evaluation 3 Consecutive Wins

Still Image Matching

*1 US Institute of Standards and Technology
*2 MBGC (Multiple Biometric Grand Challenge)
*3 MBE (Multiple Biometrics Evaluation)
*4 FRVT (Face Recognition Vendor Test)
*5 FIVE (Face In Video Evaluation)

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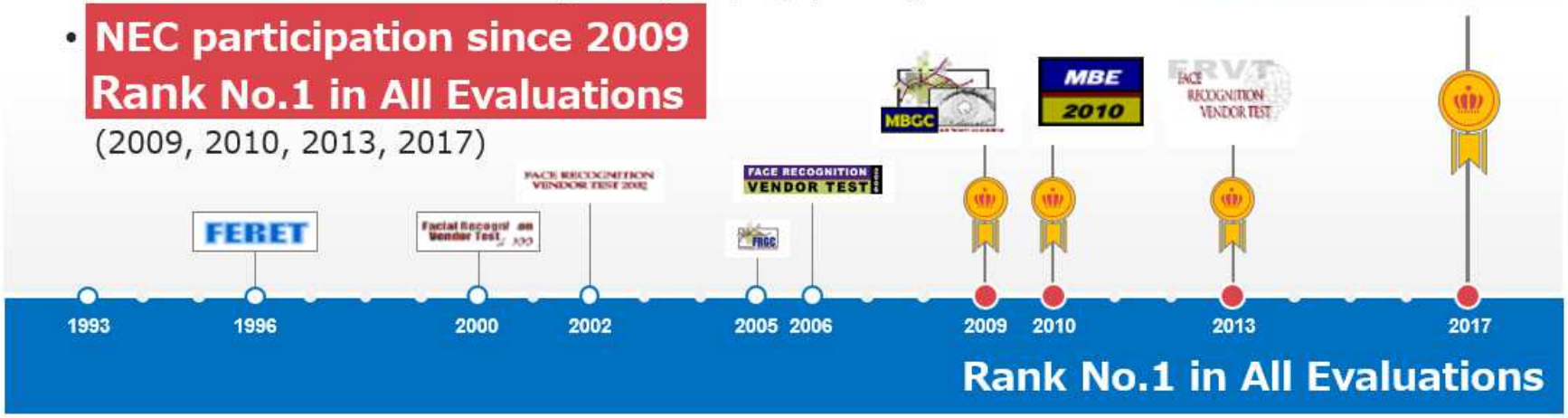
Face Recognition Technology Evaluation by NIST

Objective and fair evaluation of leading technology providers

- Conducted benchmark evaluation for the past 20 years
- Participated by leading technology providers, academia and research institutes from around the world
- Evaluation is done through blind testing and is rigorous and fair
- Identification of various subjects (sex, age, race)
- **NEC participation since 2009**
  Rank No.1 in All Evaluations
  (2009, 2010, 2013, 2017)

F I V E
Face In Video Evaluation (FIVE)



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Overview of Face In Video Evaluation (FIVE)

Benchmark evaluation of video face recognition
Evaluation of recognition of non-cooperative subjects

- Start evaluation in **February 2015.** Final report issued in **March 2017**
- 16 leading technology provider took part. Sponsored by Department of Homeland Security (DHS)
- Application for **Access Control** and **Detection of suspicious individuals**
- Tested under various conditions (dataset, index, camera location, etc.)

Evaluation Ex1 : Passenger Gate

Entry-exit management at an airport passenger gate

*Images processed for privacy

Evaluation Ex2 : Sports Arena

Detection of suspicious individuals at an indoor stadium

https://www.nist.gov/programs-projects/face-video-evaluation-five

Flusso incanalato e con luce controllata

Flusso non controllato e con poca luce

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Face Recognition Use Cases

	Real-Time Surveillance	Offline Face Search	Identity Verification
Use Cases	High performance, high accuracy, crowd surveillance, blacklist / whitelist access control	High volume, high performance, high accuracy face search against large databases	National ID (passports, drivers licenses), financial services & retail
Image / Video Sources	CCTV cameras (fixed, mobile, body-worn, vehicle-mounted, airborne) Smart devices VMS video feeds	Cameras Smart devices Images on media Recorded video	CCTV cameras Digital cameras Images on chip

NEC NeoFace

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Use Cases

LAW ENFORCEMENT & NATIONAL SECURITY

Enhance Investigations & Intelligence Analysis

- Speed investigations and close more cases using crime scene images and video.
- Process evidence from multiple camera sources including body worn, in-vehicle, fixed and citizen sourced.
- Monitor for persons of concern in high-crime impact zones and at critical infrastructure.
- Quickly validate identities against civil ID and mugphoto databases during field encounters and traffic stops.

STADIUMS & EVENT VENUES

Enhance Security, Operations & Investigations

- Monitor for persons of concern and automate alerts to security staff.
- Create searchable face logs for access control audits and investigation.
- Document security contacts for liability, investigations and reporting
- Monitor ticketing and security queue times assuring optimal customer experience.
- Speed authentication of credentialed visitors and scheduled staff, reducing time-card fraud and unauthorized access.

BORDER CONTROL & IDENTITY DOCUMENT ISSUANCE

Preserves the integrity of Immigration & Identity Assurance programs

- Authenticate identities against previously issued documents
- Speed identity authentication of low risk travelers.
- Identify instances of identity theft before documents have been issued
- Integrate with existing photo capture and card production systems

AIRPORTS & TRANSPORTATION

Enhance Security, Operational Efficiency and Investigations

- Monitor queue times and passenger journeys, assuring optimal service levels and customer experience.
- Speed identity authentication of low risk travelers.
- Monitor for persons of concern and automate alerts to security staff.
- Create searchable face logs for access control audits and passenger investigations.
- Document security contacts for identity confirmation, law enforcement investigations and reporting.

TRANSPORTATION SECURITY

Helps enhance safety, investigations and prevention of recurring incidents.

- Detect persons of concern.
- Automate alerts to security personnel.
- Perform forensic searches, speeding investigations using surveillance images and video.
- Document security contacts for liability, investigations and reporting.

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Authentication, Investigation, Identification, & Monitoring

1:1 Authentication

Is this person who they claim to be?

- 1 face compared to 1 face
- Typically High Quality Images
- Controlled Environment, Simplest Use Case
- Accuracy is Critical, Speed is Secondary
- The System Design determines if a High Match Score or Low Match Score triggers a follow-on action, or if a human is needed to review the results.

1:n Investigation / Forensic Searches

Do we know this person?

- Accuracy is Critical
- Speed is Secondary
- Examiners create a case / structure a search
- Each search returns a **RANKED CANDIDATE LIST**
- **Humans consider the top Ranked Candidates and make a match decision.**
- It takes a few seconds to perform one search

n:n Identification / Real-Time Monitoring

Can we find these people?

- Face Detection, Accuracy and Speed are Critical
- Every search returns a **CANDIDATE LIST & MATCH SCORES**
- **Computer Systems consider the Match Scores and initiate an Automated Alert if the score is above a threshold.**
- Humans are not involved
- Hundreds of searches occur every second

Static Identification → **Real-Time Identification in a Crowd**

Most FR systems cannot handle real-time identification properly!

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Neoface M20 Algorithm| Objectives

The existing NeoFace engine was designed for still image face recognition workflows. A new video-based engine was needed to solve some of the problems facing video workflows today.

Problem	Analysis of Cause	Solutions
▪ **High CPU load,** face detection requires large number of high performance servers / the need for support from GPU and other acceleration devices	▪ Video is a sequence of still images, and recognition is carried out for each face found in the images. ▪ Example: 3 people, 30 frames per second, 5 second video = 450 faces to detect and match.	▪ **Track faces from one frame to the next, carry out face recognition tasks on the best quality images only.** ▪ **Track faces and their face match scores, once high face match score is obtained, stop recognition and proceed with tracking only.** ▪ Example: 3 people, 30 fps, 5 sec video, 1/5 of faces are "higher" quality: 90 faces processed.
▪ Inability to recognize **small faces far from the camera**.	▪ Lower detection rates as faces drop below the 100 pixels recommended eye distance.	▪ Improve face detection engine to recognition faces at recommended minimum eye distance of at last 60 pixels.
▪ In ability to detect **non-frontal face images.**	▪ Only faces within the recommended tilt angle range of +/- 15 degrees tilt and +/- 30 degrees pan are recognized.	▪ Improved engine to enable detection of faces at +/-20 degrees tilt and +/- 40 degrees pan.

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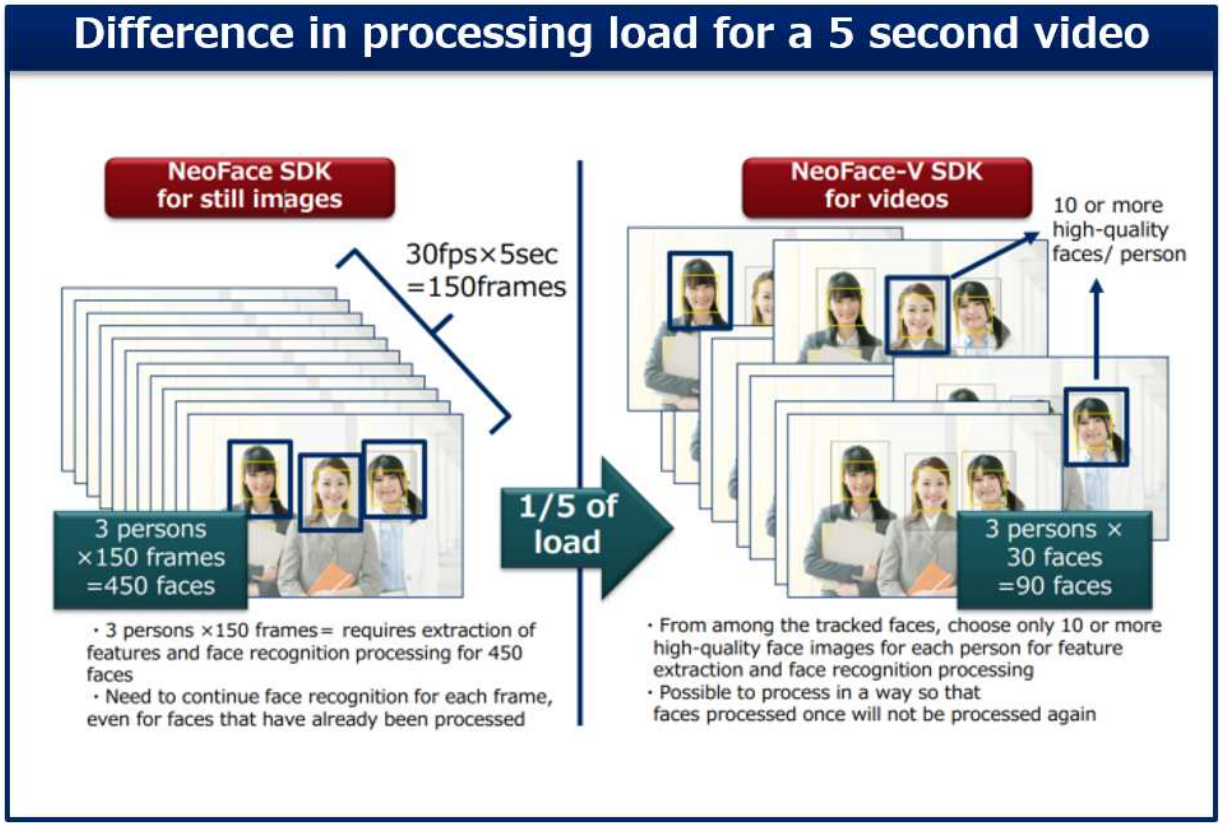
Neoface M20 Algorithm | Face Detection & Template Creation

Reduction in processing load using NeoFace V Face Tracking & Face Quality algo functions

- **Face Tracking:** Enables tracking of faces of the same person in different frames.
- **Face Quality:** Enables measuring quality of face to determine suitability for facial recognition from among the tracked faces for that person.



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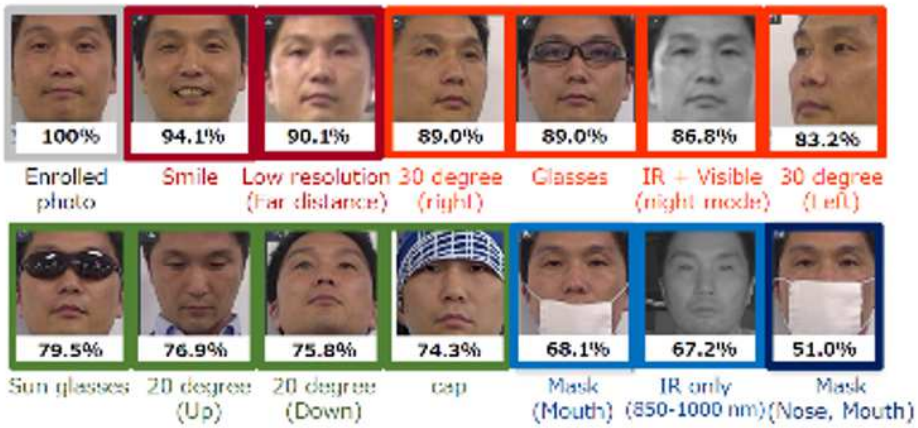
Neoface M20 Algorithm | Overview

NeoFace was recently voted the top performing algorithm (lowest miss rate) in NIST FIVE…

- New algorithm allows angles of up 40º yaw, 30º roll and 30º pitch.
- Template size reduced to 2.6k.
- Support for NEC Accelerator technology.
- Rapid face detection algorithms provides predictive tracking of faces in frame.
- 4K resolution support.
- Improved algorithm support for various ethnic groups.
- Algorithm tuning for common head wear such as the Ghutra.



Improved resilience to real-world scenarios

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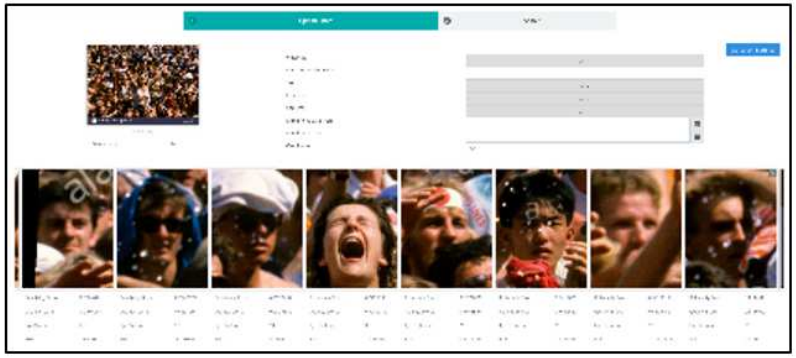
Neoface M20 Algorithm | Improved Real-life Tolerance

NeoFace M20 has improved tolerance to real-world scenarios…

- Improved pose angle limits with up to 30 degrees pitch (from 15) and 40 degrees yaw (from 30).
- Improved face extraction of poor quality and low resolution images.
- More resilient to obscured faces (hats, glasses etc.).

Pose	NFW 3	NFW 4 (M20)
Yaw (L-R)	30°	40°
Pitch (U-D)	15°	30°
Roll	30°	30°

Improved pose angle tolerance



Extraction of multiple faces for search (adjudicate)

Obscured face, 0.61 match score

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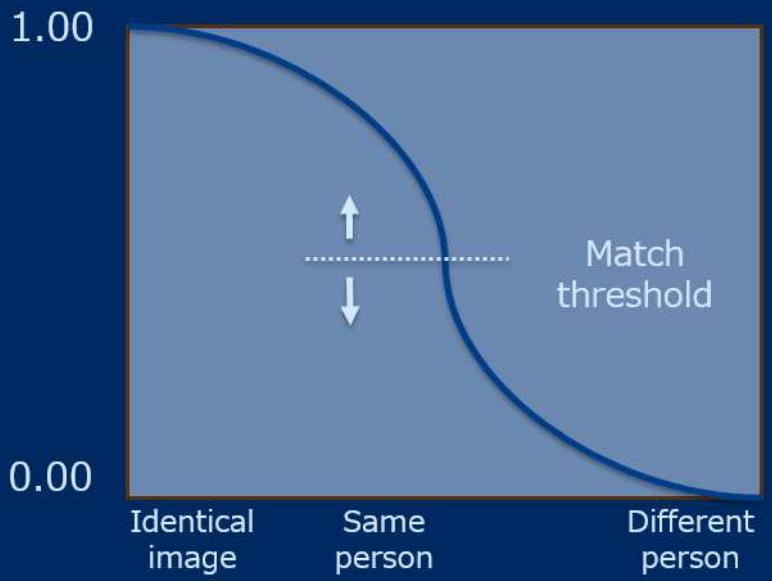
Match score: influencing factors



- Image quality
- Lighting
- Pose
- Expression
- Subject ageing
- Facial hair
- Head coverings

- More accurate algorithm
- Larger number of sampled images to increase chance of finding match above threshold

- Lower match threshold = higher probability of a real-time match
- But setting the threshold too low increases risk of false alarm
- Less accurate algorithms are more likely to generate false alarms

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Neoface Advanced Technologies

Enhanced Technology

Enhanced Robustness Against Partial Occlusion

Find features of the face even in crowded environment when face is partially occluded

Crowded Environment
(Partial Occlusion)

Enhanced Technology

Enhanced Deep Learning

Enable face comparison and matching with angled or low resolution (captured at a distance from a camera) images

Change in Angle

Far from Camera
(Low Resolution)

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Brazil Airports: Real-Time Border Control Monitoring

- Face Recognition for customs
- Detect passengers tagged as “high risk” at customs clearance
- 14 Airports + 1 central site
- 66 Surveillance Cameras

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Colombia: Medellin Atanasio Girardot Stadium

- To combat violent hooligans, all attendees are registered and photos entered into NeoFace Watch before entering the stadium
- Covers 40 entrances, halls and the grandstands
- 140 Surveillance Cameras

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India: Lemon Tree Hotels

- Lemon Tree Hotels is India's fastest growing chain of upscale, midscale and economy hotels.
- Owns and operates 26 hotels in 15 cities.
- The customer experience plays a major role in the hospitality sector, as they get a significant amount of their business from repeat and referred customers.
- Lemon Tree uses Neoface® Watch Face Recognition to craeate a more positive and satisfactory experience for all their customers, while offering that additional "Special Service" to their VIP and members registered in their system.
- Situated in the upcoming Aerocity Hospitality District, in close proximity to the international airport, Lemon Tree Premier needed to have a top-end surveillance and security system.
- Two solutions in one:
  - VIP identification for hospitality
  - Unwanted detection for security

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Cyprus:
Merit Casinos

- Real-time surveillance looking for blacklisted players and whitelist VIPs
- During POC, NFW detected a blacklisted gambler
- Agreement signed for 10 casinos
- First casino deployed
- Other Cyprus casino chains now running POCs

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Houston Airports System: Security Screening Wait Times

- HAS tested Bluetooth, Wifi and Face Recognition to understand passenger journey and queue times.
- Only NFW provided sufficient data points and auditability (+75% sample rate NFW vs 3% for Bluetooth)
- Faces are captured, enrolled and matched anonymously.
- Faces are automatically removed from the system daily.
- Time of enrolment and subsequent match times provide journey and queue time information to monitor service levels and passenger travel times inside the airport.

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U.K. High Street Retailer: Retail Fraud and Loss Prevention

- One of the UK's largest high-street retailers
- Have major problems with shrinkage, loosing multiple millions in London alone from theft (Loss Prevention Team)
- A significant percentage of this theft comes from known offenders working as part of highly organized gangs
- Trialed other vendors and found facial recognition was not working for them (around 17% hit rate)
- Trialed NEC and saw the hit rate move to approximately 85%
- Currently in 25 stores in London, with a nationwide deployment planned.

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U.K. Kings Cross Estate Open Spaces

- The challenge facing the Kings Cross Estate Security team is to recognise missing, suspect and wanted persons in the busy estate and alert then work with the MET Police upon positive match.
- A Neoface® Watch face recognition solution is installed in and around the Kings Cross Estate and monitors for a changeable list of "Known Persons Of Interest".
- Technology: Neoface Watch, IP Full HD Cameras, Alerts, Matching and reporting. Future possible integration hooks to Milestone VMS for reviewing matches in the VMS front end.
- Fully deployed system by Fibre Technologies (NEC UK Partner).

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South Wales Police - Champions League Final 2017

- Facial Recognition Solution for Champions League Final at Cardiff Stadium
- Solutions required
  - Events Team & Counter Terrorism Real Time Solution
  - Custody Suite Static Face Search and Video Importer Solution
  - Professional services
  - 2LM & 3LM Support
- Event date: Saturday 3rd June 2017
- Procurement Process: Open commercial tender
  - Awarded 28/3/17
  - Evaluation criterion: 80% Technical functionality, 20% Price

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Access Control for Immigration & Checkpoints Authority (e-gates)

- **Fiumicino**
- **Ciampino**
- **Napoli**
- **Bologna**
- **Firenze**

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Immigration control

- Rugged device immigrant pictures
- Pictures loaded inside DataBase
- 1:n investigation

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Government Customers

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Control Room

Hiperwall ®

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Control Room

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Hiperwall

Software Package

Output - Unlimited Number of Displays

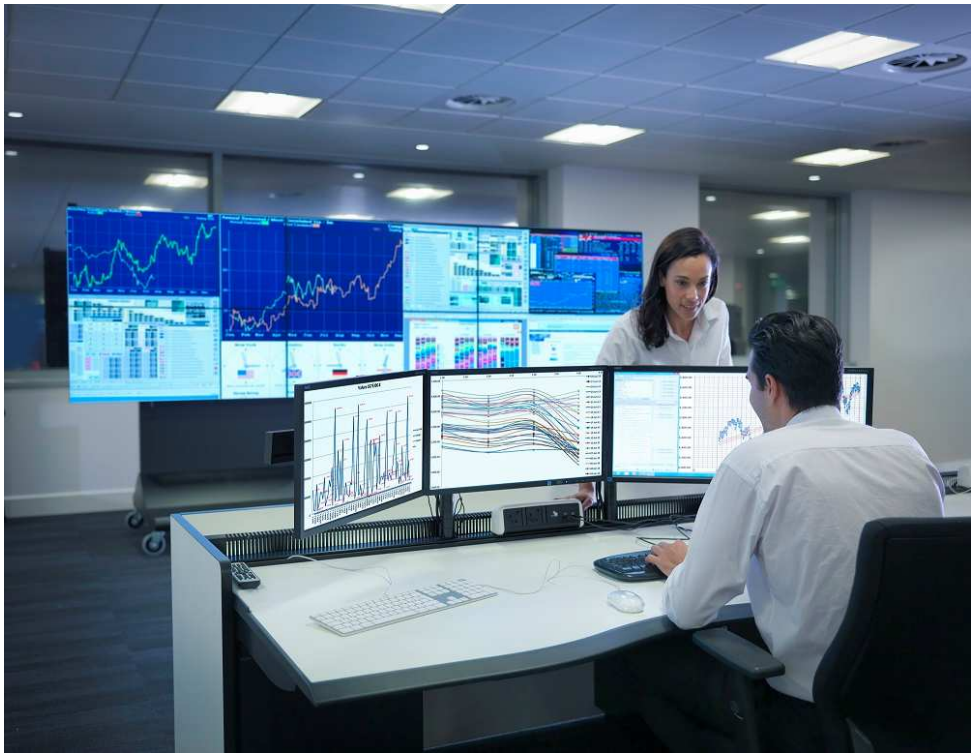
- Scalable in size of video walls
- Each display equipped with a PC & connected via defined network

Input – Infinite Number of Sources

- Source PCs also connected via Network
- Eliminates servers, matrix switches and distributors

Combinations of Different Content types

- High Resolution Images >1GB
- Videos & Streaming content including HD and 4K
- Static, Dynamic and Interactive PC applications



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Hiperwall | Distributed System and Resolution

- Each display equipped with a Slot-in PC (OPS)
- Each display used with full native resolution
- Enabling total resolution of all displays – e.g. 4x3 video wall
  - Native Full HD Resolution per Display of 1920x1080: ~ 24 Megapixel

4x3 NEC Display Video Wall – 12x Slot-in PC connected via LAN

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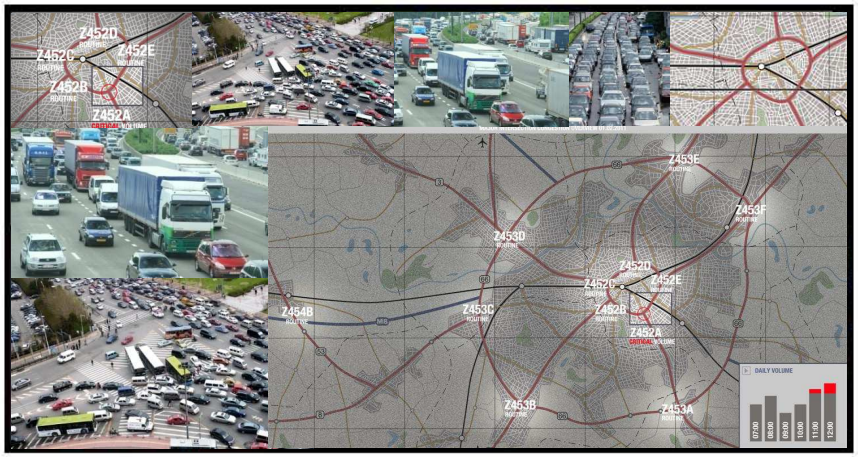
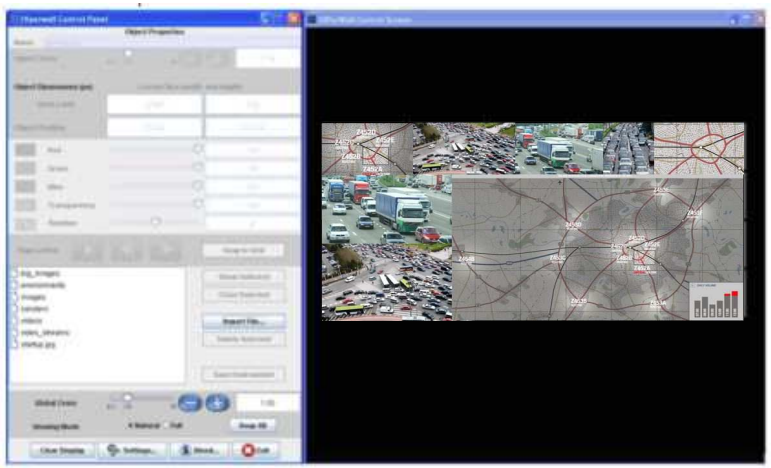
Hiperwall | User friendly Interface

- Hiperwall uses a simple and intuitive user interface
  - Freely determine size and position of the content by drag & drop
- Real time preview via software
- Size in relationship to video wall



Content on Video Wall



Content on Control PC

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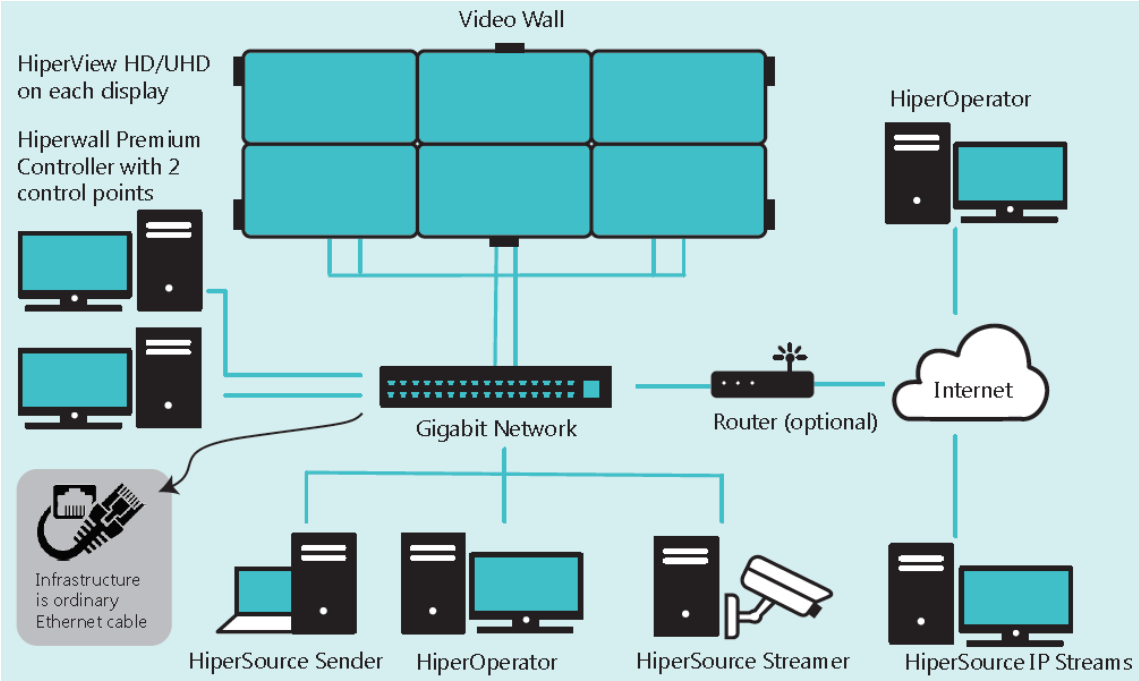
Hiperwall | Advantages

- Simple to integrate, install, configure & use
- Eliminates specialized video hardware
- Reduces cost, complexity, footprint
- Provides greatest configuration flexibility
- Eliminates scalability limitations
- Easy incremental expansion over time
- Cat 5/6 cabling: simpler to install, lower cost and longer length limits
- Distributed architecture
- Maintain performance for small or large deployments



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Corporate Communication

Meeting rooms and Corporate Digital Signage

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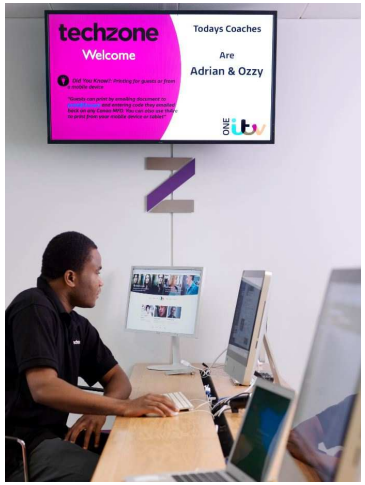
Meeting Rooms and Corporate Digital Signage

Internal security messages provided by meeting room and Corporate Digital Signage displays



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