NEC

NeoFace Watch real-time face recognition
How does it work?

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Global Face Recognition Centre of Excellence
NEC Europe

Executive Summary

There is much misunderstanding about the operation of real-time face recognition. Many incorrect assumptions are being made leading to conclusions that are not based on sound facts. Incomplete data is being used to make misleading statements on accuracy.

This overview document has been prepared by NEC to help people who are not face recognition specialists understand how NeoFace Watch real-time face recognition works. It is designed to explain a complex technology in a simple way, avoiding detailed technical discussion.

NeoFace Watch real-time face recognition is designed to find a needle in a haystack, reducing a very large problem down to a much smaller review process. It is used to determine the degree of similarity of facial images of people captured by cameras to watchlists of facial images. Human users are involved throughout the entire process, from managing the watchlist data, setting review thresholds, monitoring alerts and checking these and taking appropriate action where needed.

It is incorrect to state accuracy based simply on true positives vs false positives.

The quantity of faces presented for review by users is determined by setting and fine-tuning review thresholds and are affected by many environmental variables.

Poor quality images in the watchlists should be avoided as they may have insufficient data to provide good similarity scores.

Facial image data of people passing by cameras with faces that are below review thresholds are simply rejected by the system. No data below review thresholds is retained. Data relating to facial images highlighted for review to users will be deleted according to users operating procedures.

While NEC has consistently achieved the highest accuracy rankings from many tests by its customers and other independent bodies, it continues to enhance its face recognition system, embracing the latest AI and deep learning technologies; and makes this available to customers regularly. NEC does not have access to customer data, neither the database of images in the watchlists, nor the images of people captured by the cameras, and NEC does not use any of this specific data to improve the NeoFace Watch system.

much misunderstanding about real-time face recognition

designed to find a needle in a haystack

degree of similarity of facial images

human users involved throughout entire process

accuracy not based simply on true vs false positives

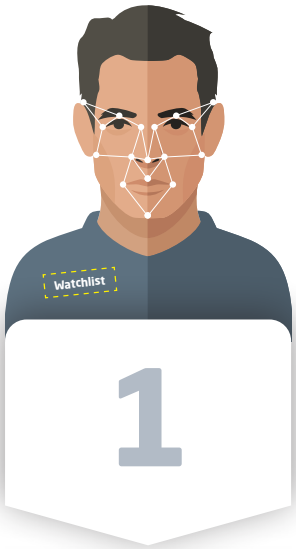
human users determine review thresholds

poor quality watchlist images should be avoided

no images below review thresholds are retained

NEC consistently achieves highest accuracy rankings

How does **NEC NeoFace Watch** real-time facial recognition work?



1

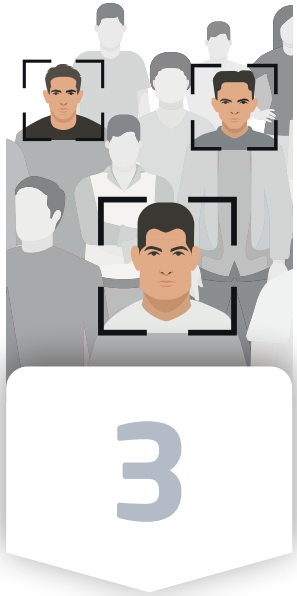
Create Watchlist

Customer chooses which facial images to add to a watchlist. The system creates a unique signature representing the features of each face.

2

Set Review Threshold

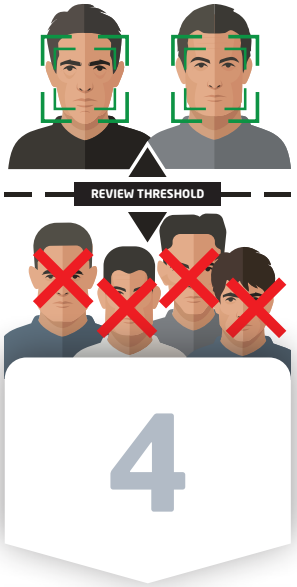
A review threshold is set by users to determine the degree of similarity for alerting and review by users. Adjustments are made for different operational needs.



3

Observe Crowd

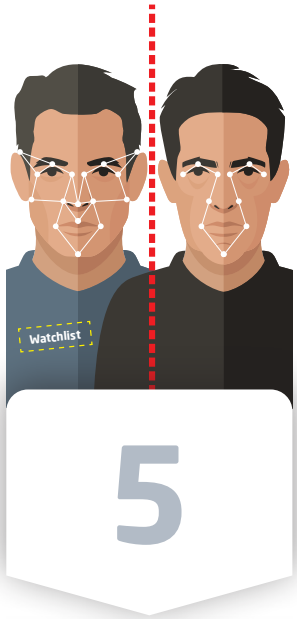
Video feeds from cameras are analysed in real-time. Faces found in the crowd are compared for similarity against those in the watchlist.



4

Raise Alerts

Similar facial images above the review threshold are raised as alerts to users. All other facial images are automatically discarded immediately.



5

Review Alerts

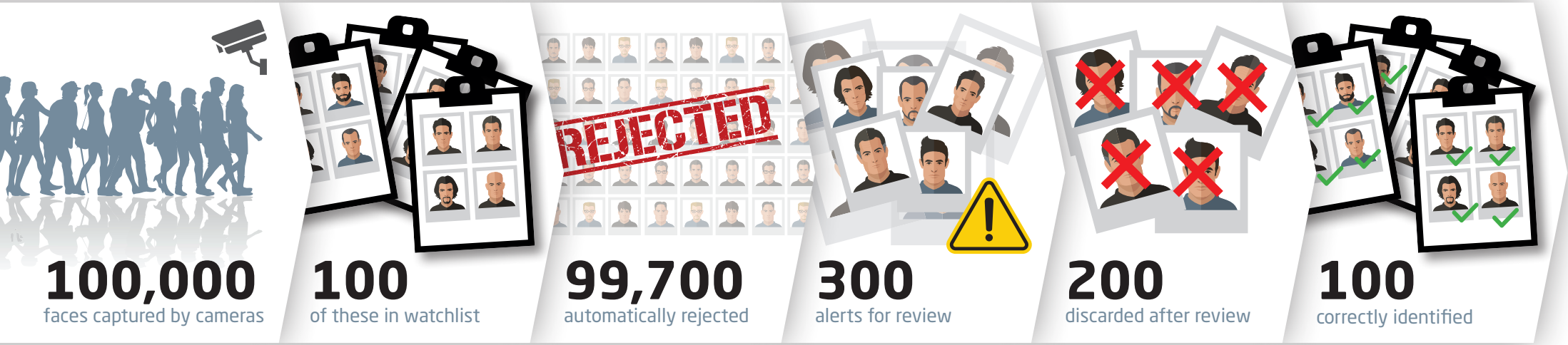
Users review the alerts, comparing facial images from cameras against the corresponding watchlist images to determine whether further action is needed.

6

Delete Data

Images in alerts are only retained for a limited, user-defined time period, in accordance with customer's policy.

What is accuracy? – a worked example



0.3% images stored for user-defined period

0.2% false positive rate

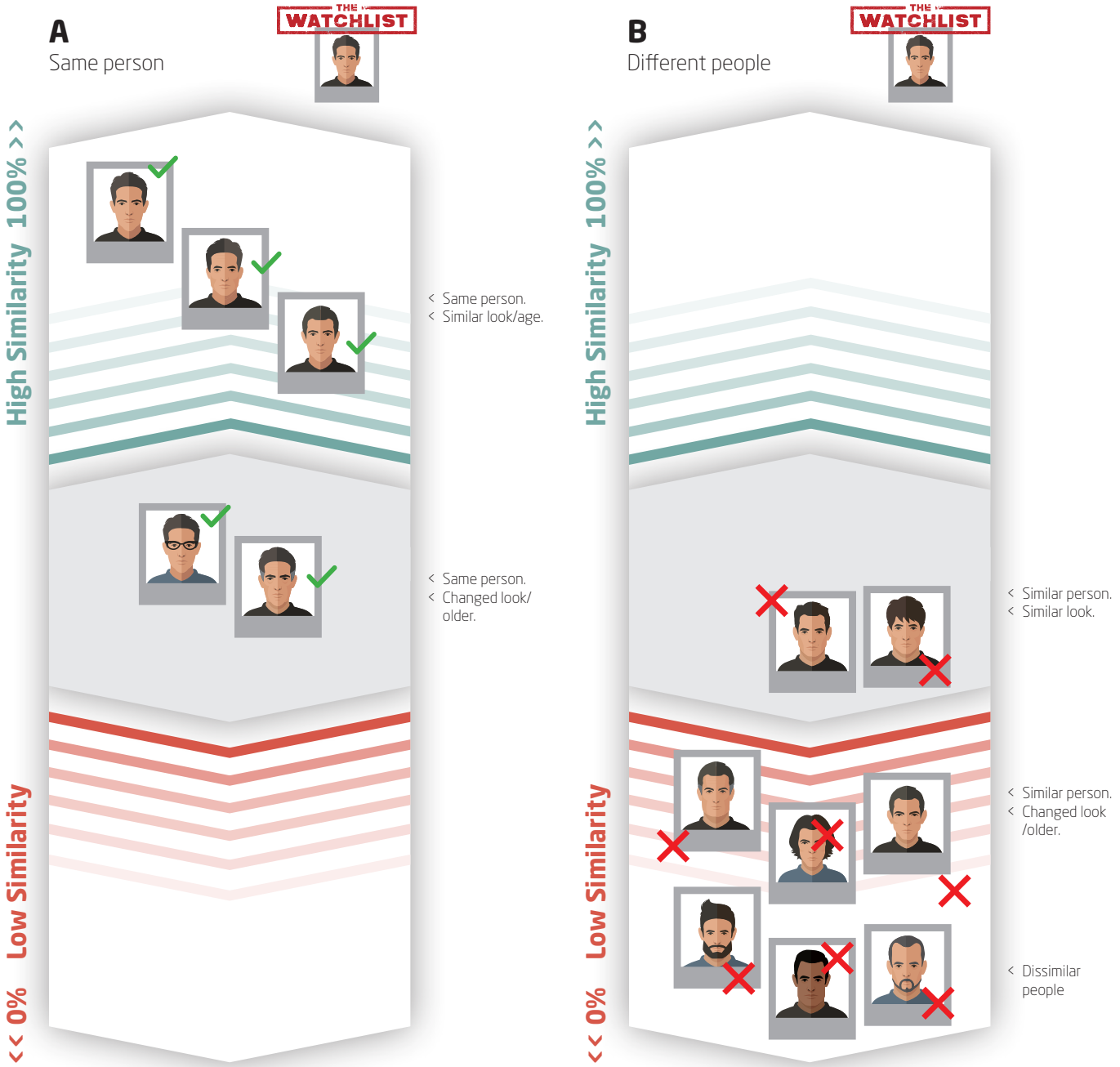
100% successful identifications

It is incorrect to state accuracy based simply on true positives vs false positives as these will vary with different image qualities, user-selected thresholds and other factors.

In the example given here, review thresholds have been optimised to maximise identifications. It would be wrong and misleading to conclude an accuracy rate of 33% based on a simplistic ratio of true positives to total positives.

The reality is that the identification success rate is 100% in this example. The **false positive rate is very low** but could be **reduced or eliminated** if required by some **further fine-tuning.**

Similarity scores – how it works



1

Two images will only match 100% when they are identical images. Even two photos of the same person taken sequentially will have a similarity score below 100%.

2

Images of the same person that look similar to the watchlist image will have a high similarity score while dissimilar images will have a lower score (A).

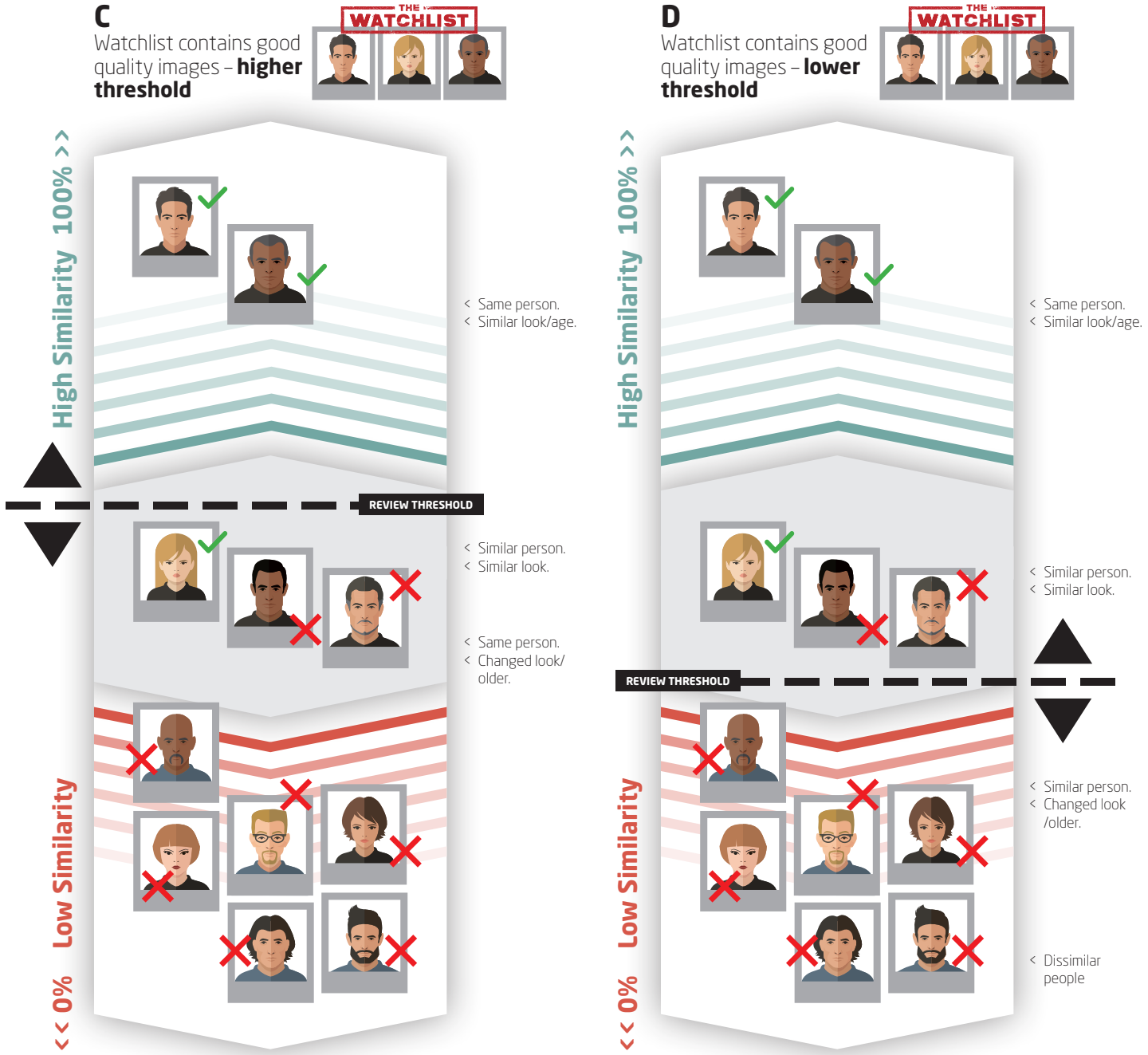
3

Images of different people will typically have a low similarity score. However, people with similar faces will have a higher score (B).

4

Similarity scores will be influenced by data quality and environmental conditions. Factors such as image quality, lighting, pose, facial expression, ageing will all have a significant effect.

Similarity scores – impact of review threshold



1. People passing in front of the cameras who are in watchlists will typically have a high similarity score (above the review threshold) and alerts will be provided to users (C).

2. However, some of the images of these people in front of the camera, may show lower similarity scores, and fall below the review threshold (C).

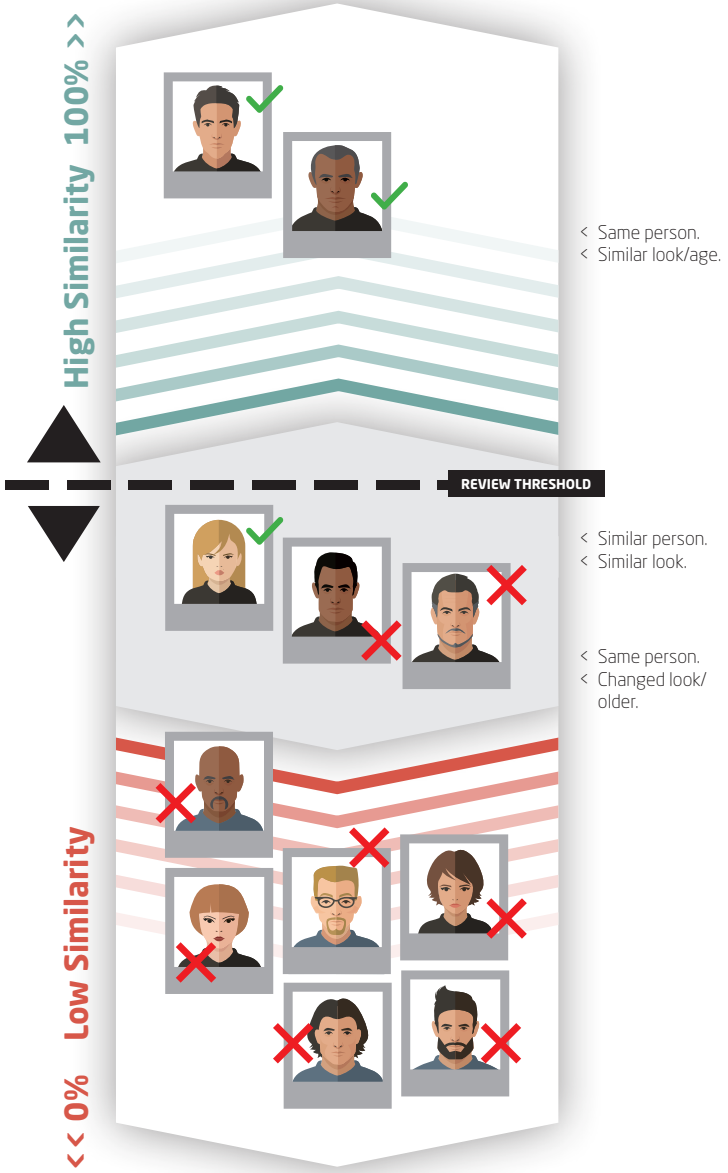
3. The review threshold can be decreased giving a higher chance of finding people in watchlists, but this will also increase the number of other people for review (D).

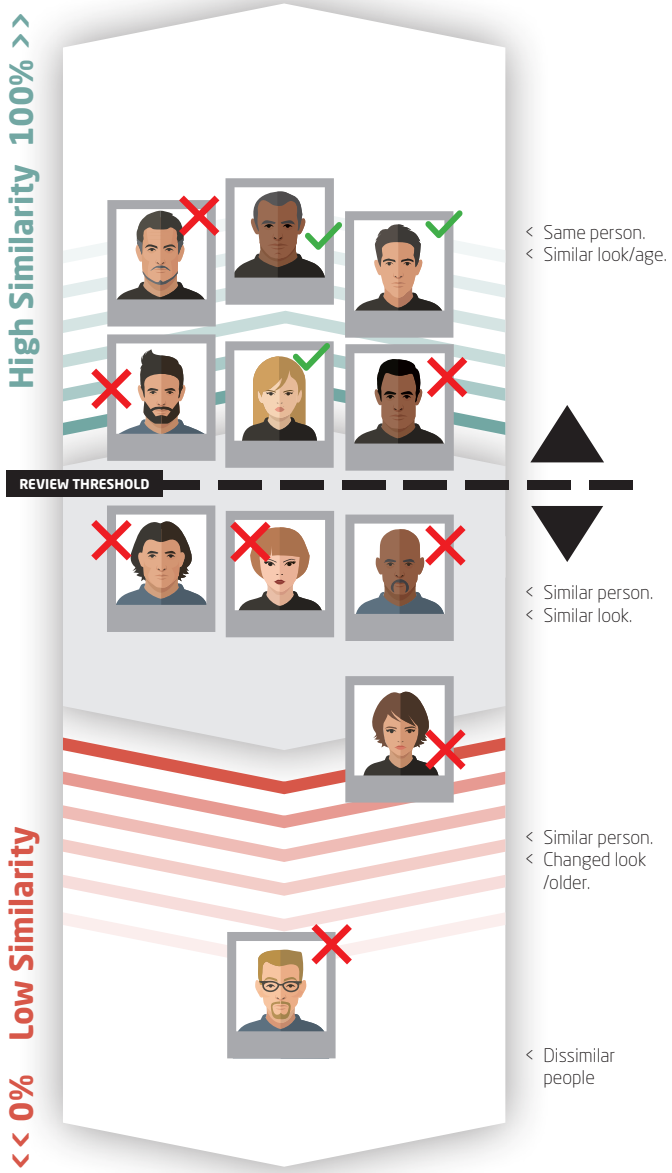
4. The review threshold is an important tool for users to calibrate or fine-tune the system to deal with image data quality and camera image conditions, in order to maximise success rates while minimising review workload.

Similarity scores – impact of poor quality images

C
Watchlist contains good quality images – **higher threshold**

E
Watchlist contains **poor quality images - higher threshold**





1
Watchlists should contain images of a reasonable quality to maximise the effectiveness of the similarity scoring process.

2
Introducing images into the watchlist with insufficient detail (particularly those that a human could not identify) will not provide the system with enough information to make meaningful similarity scores.

3
Even a single poor quality image could cause a large number of alerts for review, as the system will see similarity between the limited information in the watchlist image and many people passing the cameras (E).

4
For this reason, the review threshold can also be adjusted for individual watchlist images, to allow users to choose to accept more review alerts where it is important to find specific people.

Although the general principles featured in this document may also apply to other face recognition systems, it is likely that there will be differences (possibly significant) in the way these different systems will operate and behave.

NEOFACE WATCH

NEC is a global technology leader and has been developing biometric solutions for over 40 years, using pioneering research in image recognition and artificial intelligence.

NEC's flagship global face recognition platform and application, NeoFace Watch, has now been deployed in 55 countries worldwide since it was first released in 2013. It is deployed across a range of vertical markets including law enforcement and national security, airports and borders, transportation and critical infrastructure, stadiums and major events, hospitality and gaming, banking and financial services, retail and general commercial. NeoFace Watch is continually improved and enhanced based on customer feedback from these real world projects, including large-scale deployments across cities.

NEC's NeoFace algorithms have been independently evaluated on a consistent basis as being the fastest, most accurate face recognition system available and particularly strong in handling challenging environmental variables and poorer quality images typically found in real-life scenarios. This underscores the high capability of NeoFace Watch at handling complex requirements for real-time surveillance; real-time large database search; offline identification analysis of recorded video and static images; and identity verification.

FURTHER INFORMATION

For more detailed information on features, capabilities and other specifications, please contact your local NEC office.

Email enquiries can be sent to: neoface@emea.nec.com