

NEC Innovation Series

# Facing the Future

NEC's award-winning NeoFace® face recognition technology is now finding real-world applications to make our lives more convenient—and safer

The Boston Marathon bombing heightened awareness of face recognition technology. According to many reports, such systems were unable to identify the suspects, despite images being captured at the scene.

However, in a trial of face recognition systems conducted by Michigan State University, NEC's state-of-the-art NeoFace technology achieved an almost instant "rank one" match of one suspect, using the same query photos taken at the scene of the incident as those used by the police.

NEC continues to distinguish itself as a world leader in biometric technology. Along with the company's fingerprint identification solutions and portable DNA analyzer, NEC's NeoFace face recognition system, which achieved the highest ranking in the Multiple Biometric Evaluation 2010 and the Multiple Biometric Grand Challenge 2009 award from the National Institute of Standards and Technology (NIST) in the U.S., stands out. The NeoFace system results from nearly 50 years' experience in computer image recognition by NEC, starting in 1969 with a postal code reading application.

Raffie Beroukhim, Vice President of NEC Corporation of America, Biometrics

Solutions Division, says that the market for face recognition systems is expanding. This noninvasive, highly accurate and speedy authentication technology is now deployed in an expanding range of applications, and at an estimated \$1.4 billion global market in 2014, it comprises 15 percent of the total biometrics sector (a 22 percent year-on-year increase).

In addition to personal authentication, the NeoFace system is used for identification in the law enforcement and security fields, where images from security cameras, etc. can be scanned to identify suspected wrongdoers whose faces are already on file.

NEC's award-winning NeoFace face recognition technology combines high speed with unsurpassed accuracy



Raffie Beroukhim, during an interview at the offices of NEC Corporation of America, Long Beach, California.

### The challenge ...

Dr. Hitoshi Imaoka, a Research Fellow at NEC's Information and Media Processing Laboratories, explains that a major challenge of face recognition technology, especially in identification applications, is the difference between target faces to be recognized and face templates stored for comparison.

Passports, for example, have a life of up to 10 years. In that time, hairstyles change, eyewear is adopted or discarded, and so on. When deployed in ID control applications, face recognition systems must cope with changes due to aging of the subject.

Target images from security cameras pose other problems: low resolution; differences in angles and lighting from the original image; and facial expressions. NeoFace technology must be able to deal with all of these.

### ... and the response

The NeoFace system uses a variety of techniques to achieve its high matching accuracy. By referencing a large collection of anonymous images, ranging from children to older people, and using special matching techniques, aging processes can be modeled in software. Imaoka also explains that

a virtual 3D model is produced from a headshot, and manipulated to produce a range of images that might be produced from such a model, with different angles, lighting, etc. These are all stored in a database, and when a target image is presented to the NeoFace system, the database is searched for a match. "NeoFace can even recognize my 30-year-old photo," jokes Imaoka.

NEC's Super Resolution image enhancement can recognize even blurred images of faces captured using low-resolution sensors. The system can match a target against degraded templates to produce a face which may be recognized easily by humans, even with images with a mere 24 pixels of image between the eyes of the subject.

According to Imaoka, the NIST test results showed the NeoFace system matching images against a database of 1.6 million subjects with a degree of accuracy orders



Dr. Hitoshi Imaoka, with an experimental multi-camera 3D capture system

of magnitude better than rival systems (0.3 percent false rejection with 0.1 percent false acceptance) in less than one-third of a second, many times faster than its nearest rival.

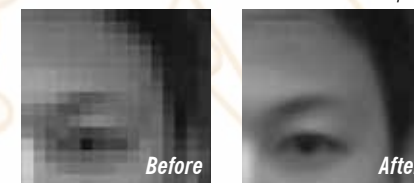
### Practical applications

In the future, Beroukhim wants face recognition to acquire the accepted standards and levels of expertise now enjoyed by fingerprint technology. He emphasizes that face recognition systems such as NeoFace technology

contribute to "the development of smarter, safer cities," quoting a number of other current and future uses for the system. The police and security services of 20 countries now use NeoFace technology. Applications include border control (Singapore and Hong Kong) and voter identification (Bolivia). Holders of annual studio passes to the Universal Studios Japan® theme park are also identified using NeoFace technology, and in an unusual application, NEC's NeoFace system was used to verify the unique identities of the famous Terracotta Warriors in China.

In the future, Beroukhim predicts, our faces may well be the key to our identification, allowing us secure access to our electronic banking, providing a better retail experience and helping create safer borders and communities, all thanks to the expanding deployment of NeoFace-based solutions. — Hugh Ashton

Super Resolution techniques developed by NEC can produce a high-resolution, easily recognizable image from a blurred capture



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