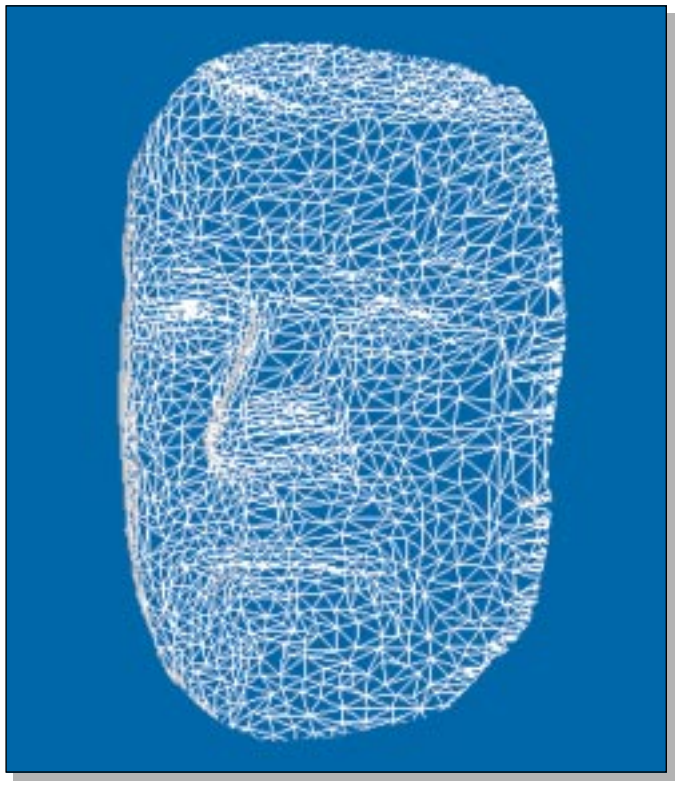


3D THE FUTURE OF FACIAL RECOGNITION

THE REAL THREAT OF TERRORIST ATTACK HAS INCREASED THE NEED TO IMPROVE OUR SURVEILLANCE CAPABILITIES AT ONE OF OUR MOST VULNERABLE TARGETS: MASS TRANSIT.

BY DAVID TUNNEL, VICE PRESIDENT, GOVERNMENT SOLUTIONS

The world continues to search for 'who the terrorists are', resulting in a database of photographs called a 'Watchlist'. However, how can we detect a terrorist threat before they strike when all we have to work from is a photograph?

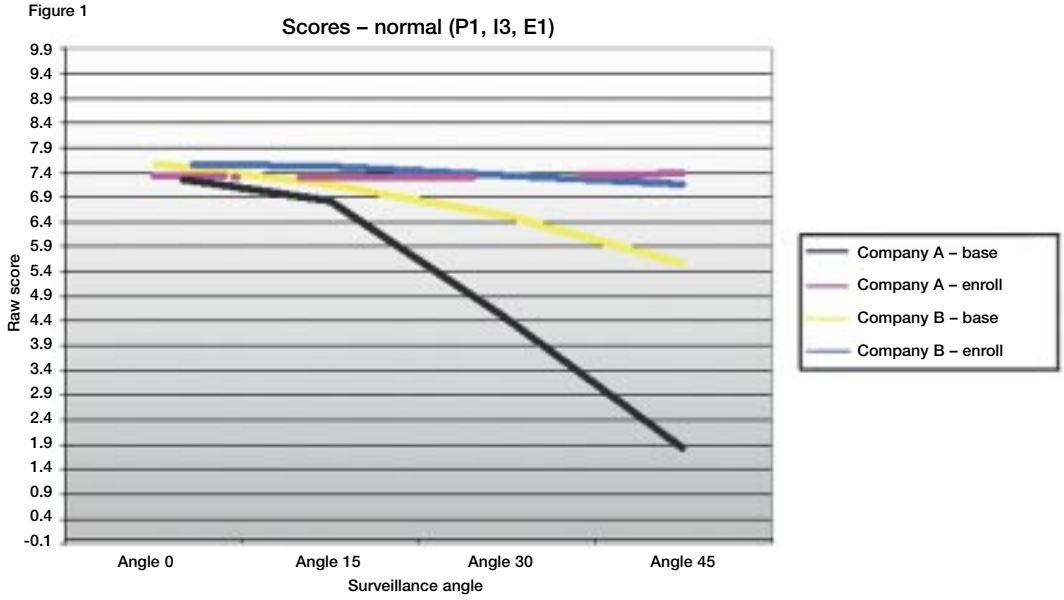
"FRVT 2000 and FRVT 2002 show that one of the more difficult tasks for modern facial recognition systems is recognising faces in non-frontal images. Most facial recognition systems perform well when all of the images are frontal. But, as a subject becomes more and more off angle (both horizontally and vertically), performance decreases." Source: Face Recognition Vendor Test 2002, Overview and Summary, March 2003.

Most agree that facial recognition has a major role to play in providing security at our airports. The ability to recognise an individual before they gain access to a door or board a plane is paramount to effective security. Likewise, the ability to recognise a face at every transit point, such as airport passport control, train stations and metros, is key to our protection. However, the sensitivity of existing 2D facial recognition systems to subject pose and lighting causes the technology to be questionable for both access control and Watchlist surveillance applications.

The limitations of 2D facial recognition have been known for some time and were confirmed in the recent Face Recognition Vendor Tests performed in the US under the auspices of the US government. The results are really not too surprising, given the fact that existing algorithms are trying to identify a 3-dimensional object – the face.

One conclusion of the study was that while facial recognition is improving, it is still not robust enough to stand on its own. In fact, NIST recommends a combination of facial recognition and fingerprints as the best biometric performance available today.

Figure 1



A NEW DIMENSION TO FACIAL RECOGNITION

That may soon change as 3D companies bring their understanding of the dimensions of the face to the biometric market. One of the leaders in this development, Genex Technologies, has been working in the 3D field for more than eight years. Funded by a variety of US governmental agencies interested in developing 3D facial recognition, the company has taken a unique approach to using 3D information to improve facial recognition.

Although 'true 3D' facial recognition is definitely somewhere in the future – that is, using 3D enrollment cameras, 3D surveillance cameras and 3D facial recognition algorithms – Genex believes that much can be done to improve the performance of existing 2D facial recognition well before true 3D arrives. Rather than force the infrastructure to change by purchasing all-new surveillance cameras and software, the goal is to improve 2D facial recognition sufficiently so that its performance can be significantly enhanced using existing 2D infrastructure.

Key to such a strategy is the understanding that virtually all 2D facial recognition algorithms are attempting to match the surveillance photo with a database of 'enrolled' photos. As long as the two photos are relatively the same in terms of angle and lighting, the matching results can be acceptable. However, when non-frontal surveillance photos are compared to a database of frontal enrollment pictures, matching drops dramatically to levels that are untenable. The same is true when strongly-lit surveillance photos (for example, strong sunlight from one side) are compared to a database of professionally (and frontally-lit) enrollment pictures.

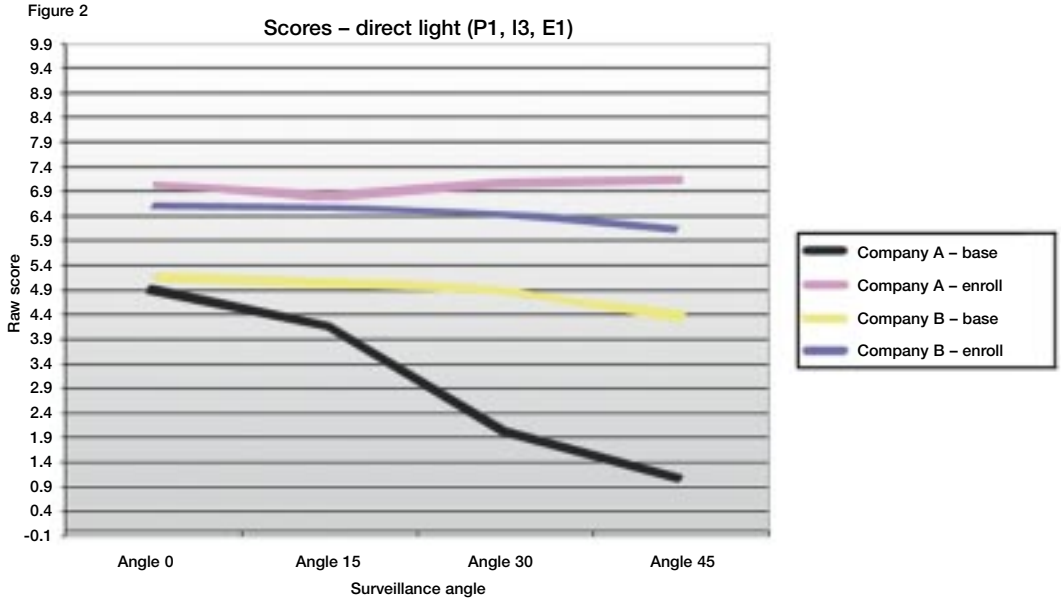
ACCESS CONTROL

To counter this weakness, Genex has introduced a software suite (SureMatch 3D) that begins with a 3D enrollment image taken of the employee or other authorised individual. The expense of a single 3D camera at a central enrollment location is far less than 3D cameras at every monitoring point. From that one 3D image, the software creates a variety of 2D images, accurately showing the face as if 2D photos had been taken of the individual from different angles and under different lighting conditions.

> **The ability to recognise a face at every transit point, such as airport passport control, train stations and metros, is key to our protection**

The software then automatically populates the database with a rich variety of 2D images, one of which is going to be relatively close to the angle and lighting conditions encountered by the surveillance camera. The result is that instead of a rapidly declining performance as angles from frontal increase, the matching performance continues virtually untouched (see figure 1). Even more dramatic improvement in performance results when a variety of lighting conditions are enrolled into the database (see figure 2).

Figure 2



These charts show that enrollment of multiple 2D photographs with varying pose and lighting can dramatically improve the performance of 2D facial recognition systems. The advantage of this approach is that it can work with existing 2D cameras and 2D facial recognition infrastructure.

DATABASE SPEED

One of the challenges of this approach is that the database grows exponentially, which has the potential to slow down comparisons dramatically. This hurdle can be overcome by embracing new, cutting-edge distributed network computing technology that can search a million picture database in under a second. The combination of 3D facial recognition and high-speed database technologies make facial recognition a viable solution for any pose or lighting condition.

WATCHLIST SURVEILLANCE FROM A SINGLE 2D PHOTOGRAPH

Another major challenge to a 3D approach is that until passport and other governmental ID photos are taken with 3D cameras, most of the Watchlist individuals will not have 3D photos from which a rich enrollment database can be created. Genex has solved this issue with 2D to 3D software (FaceMatch), which uses proprietary algorithms to automatically map a 2D picture and uses key indicators to make estimates of the 3-dimensional shape of the face. While more photos of an individual make the conversion increasingly accurate, even a single photo is enough to dramatically improve facial recognition performance at off angles and varying lighting conditions.

> **The combination of 3D facial recognition and high-speed database technologies make facial recognition a viable solution for any pose or lighting condition**

As true 3D facial recognition technology gets closer, facial recognition will undoubtedly grow considerably faster and enjoy greater acceptance, especially if 3D enhancements devised by companies like Genex can make the existing 2D infrastructure more effective as a biometric tool. ■