FIXING HUMAN ERROR
"Humans are poor detectors, but they're great decision makers"

AIRPORT VISIONARY

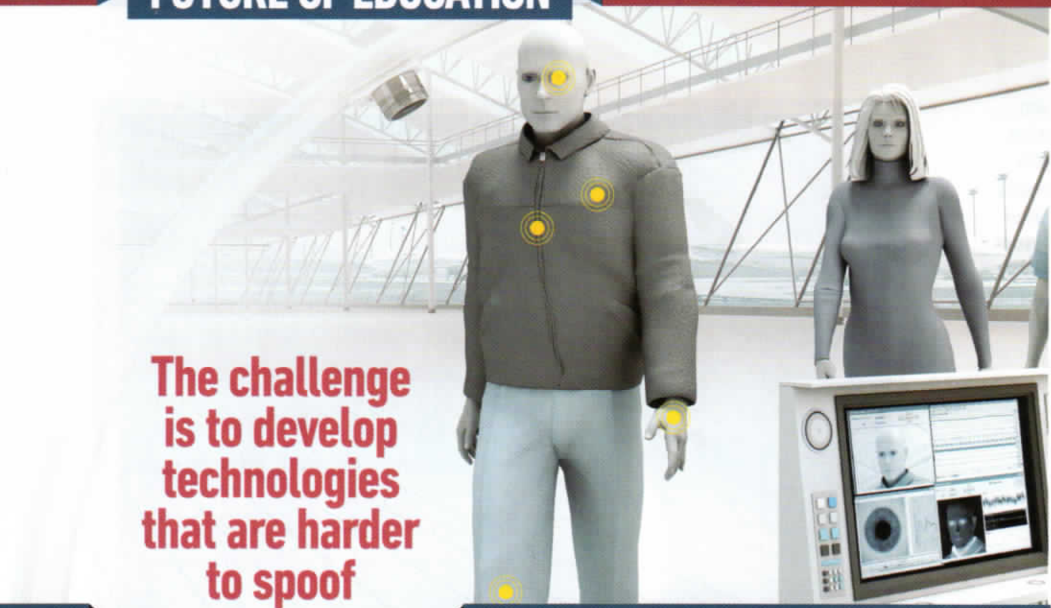
Surveillance cameras fill airports and other transport hubs, yet they're usually only helpful in detecting problems after the fact. Even then, the task of scrolling through video footage is extremely slow and labour-intensive. It took dozens of intelligence agents countless hours to screen closed-circuit TV footage from the London bombings in 2005.

Clinton Fookes is working on computer vision and intelligent surveillance systems that would help detect threats in real time. They could also help airports and other public facilities operate more effectively. The 32-year-old senior research fellow at Queensland University of Technology is technical director of a program called Airports of the Future. The aim of the cross-disciplinary project is to improve security, efficiency and the passenger experience in airports across Australia. "Australia is more dependent on aviation than any other country in the world," says Fookes, "because we're so far away from most other countries and because our major cities are so dispersed."

AUTOMATED ALERTS

An airport may have as many as 1,000 surveillance cameras, but with only one or two operators monitoring the feeds, at most, the chances of spotting and responding to an emergency as it happens are virtually nil. That's how an incident such as the fatal bikie gang fight at the Sydney airport in March 2009 could happen without speedy detection. A motorcycle club member was bludgeoned to death right under the surveillance cameras. "My philosophy is humans are poor detectors but they're great decision makers," says Fookes. "So we want to try to automate the surveillance process as much as possible and just present alerts to people who can then make the decisions and respond."

Fookes' team is developing software that can track people and recognize them from a distance, using biometric measures. Biometrics comprises methods for identifying an individual based on unique physical or behavioural traits, such as facial appearance, fingerprints or voice. Two-dimensional face recognition is



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already used in Australia and New Zealand at SmartGate kiosks in major airports. But the technology is limited in that the person must be located in a certain position and under particular lighting. And 2D technology on its own can be spoofed by people wearing disguises. Some systems can even be tricked by a photograph. The challenge is to develop technologies that are harder to spoof, and can work in diverse environments in which the subject is further away, under any lighting and standing in any pose.

BETTER BIOMETRICS

Part of the solution Fookes is looking at lies in using multiple biometrics, including soft biometrics – features such as height, and hair, skin and clothing colour – which can be tracked without the person's knowledge. Fookes is also working on 3D face recognition systems, which are significantly more accurate than 2D systems. And, he's researching gait recognition. Gait measures joint angles and periodic motion around a person's unique walking style. It is especially valuable in identifying a person in a crowd if their face is covered.

Sensors and hardware for putting these systems together are already readily available today. The hard part is the brain power. "It's a real challenge to distill [the information] down to what the key features are you're looking for and to manage all that information," says Fookes. "It builds on areas such as computer vision, pattern recognition and artificial intelligence – teaching computers to learn what important events we're looking for and what the important features are."

ENABLING TECHNOLOGIES

Not many years ago, it would have taken super-computers to muscle through the tasks Fookes is working on. But these days, computing power has improved so much that personal computers can do most of the work. His team is developing a vehicle tracking system that requires just one PC to monitor up to eight cameras.

HOW IT WORKS
The bar on the right shows the number of people in the scene which, is determined using motion segmentation to locate regions of interest. This approach enables the algorithm to be applied in multi-camera environments so that it can measure crowd density in airports.

Based on that assessment, a typical airport might need about 125 processors to monitor 1,000 cameras.

Tomorrow's technology is also enabled by better algorithms. Years of research in computer science and computer vision have led to more sophisticated formulas that Fookes and his team are now building on.

PEOPLE-TRACKING BREAKTHROUGHS

The team is making important headway into the research of holistic crowd monitoring. One of its systems can count the number of people in a particular area of an airport and then track how many of them move from one space to another. That capability can help pinpoint bottlenecks so that, ultimately, queues can move more quickly. Other technologies can do similar things but Fookes' version uses the airport's available surveillance cameras, which requires less new infrastructure, making it more cost-efficient.

Fookes is now working on prototypes of soft biometrics systems that use data mining and large camera networks to find people and track them over a period of time. The system would ultimately enable policing agencies to search for a person and figure out where he came from, who he interacted with and what incidents led up to an event of interest. Fookes is also researching how to achieve this through simple text-based queries concerning a specific person. For instance, the Australian Federal Police could type in a query for a woman with blonde hair, a red jacket and a black suitcase in the Brisbane airport. The algorithms would then search for a person based on those characteristics and pull up video of everywhere she had been in the airport. **—YG**