Institution: University of Surrey
Unit of Assessment: UOA 13 Electrical and Electronic Engineering, Metallurgy and Materials
Title of case study: Automated Personal Identity Recognition Using Face Detection Spin Out OmniPerception

1. Summary of the impact (indicative maximum 100 words)

Research in biometrics carried out at Surrey since 1995 has generated IP relating to a number of aspects of automatic face recognition, which resulted in significant performance improvement, rendering this biometric technology commercially exploitable.

The advances made at Surrey include illumination invariant imaging, face detection/localisation using robust correlation, innovative face skin texture representation using a multiscale local binary pattern descriptor, a patented (and exceptionally compact) person specific discriminant analysis, facial component based matching, and patented multi-algorithmic fusion.

Through an IP agreement, these innovations have been commercially exploited by the University spinout company OmniPerception, which has developed products for various security applications.

2. Underpinning research (indicative maximum 500 words)

Research in face biometrics carried out at Surrey (and led by Professor Kittler) since 1995 has generated Intellectual Property relating to a number of aspects of the automatic face recognition process, which resulted in significant performance improvement in face recognition, rendering this biometric technology commercially exploitable. The advances made at Surrey include multispectral imaging and photometric normalisation to achieve illumination invariance [6], robust face detection and localisation using robust correlation [3,4], innovative representation of face skin texture using a multiscale local binary descriptor [2], a unique patented person specific discriminant analysis, which is exceptionally compact allowing face matching on a smart card [6], facial component based matching enhancing robustness to face localisation errors [5],[6], and multi-algorithmic fusion, exploiting a patented error correcting decision making approach [1].

The innovative method of face image representation and matching [6] invented by Professor Kittler in 2000, which is now protected by a European patent, has unique properties. Its low computational complexity opened, for the first time, the possibility of implementing face verification systems on a small computing platform, such as a smart card. This contrasts with previous solutions with computational complexity of 2-3 orders of magnitude greater. In parallel, a multi-classifier system based on the concept of error correcting coding was developed at Surrey by Kittler, Ghaderi and Windeatt, for face recognition scenarios where computing power was not a constraining factor. The work was published [1] after filing for protection in 2001 [6]. It has the capacity to enhance face recognition performance by a factor of two.

The intellectual property encompassed by the two patents was transferred to a university spin out company, OmniPerception Ltd. The technology transfer to OmniPerception Ltd was aided first by a KTP project KTP000982-A01 during the period 2005-2007. Further enhancements, involving 3D face model technology developed with the support from EPSRC Research Grant GR/S46543/01, entitled 2D+3D=ID, were transferred to OmniPerception with the financial assistance from a TSB Project K1533:' Visualisation tools for effective face matching' during 2007-2009, all projects headed by Professor Kittler. In addition, applied research carried out at Surrey after the spin out in 2002, resulted in significant enhancements of face detection [4] and face localisation [3] methods.

The former is achieved using a novel correlation method, which is robust to outliers (image degradation). The latter has been developed to perform face localisation in general conditions where the pose of the face image deviates from the frontal.

Another key contribution was the work on skin texture representation, carried out at Surrey in 2005-2007. the work, which was supported by EPSRC Project GR/S98528/01 and EU Network of Excellence in biometrics "BIOSECURE", resulted in a powerful innovative face descriptor based on the Local Binary Pattern operator. The proposed multiscale generalisation enhanced the performance of face recognition significantly.

3. References to the research (indicative maximum of six references)

1. J Kittler, R Ghaderi, T Windeatt, and J Matas. Face verification using error correcting output codes. Image and Vision Computing, 21:1163–1169, December 2003

2. Chi-Ho Chan, Josef Kittler, Kieron Messer: Multi-scale Local Binary Pattern Histograms for Face Recognition. ICB 2007: 809-818

3. M Hamouz, J Kittler, J-K Kamarainen, P Paalanen and J Matas, Feature based affine-invariant localisation of faces, IEEE Transactions on Pattern Analysis and Machine Intelligence, pp1490-1495, vol. 27, 2005.

4. AJ Fitch, A Kadyrov, WJ Christmas and J Kittler, Fast robust correlation, IEEE Transactions on Image Processing, pp 1063-1073, vol. 14, 2005

5. T-K Kim and J Kittler, Locally linear discriminant analysis for multimodally distributed classes for face recognition with a single model image, IEEE Transactions on Pattern Analysis and Machine Intelligence, pp318-327, vol. 27, 2005

6. http://www.omniperception.com/about-us/technology/technology-patents-ip/

4. Details of the impact (indicative maximum 750 words)

The promise of the Intellectual Property in face biometrics generated by Professor Kittler in the late 1990's, and filed for protection by Surrey at the turn of the millennium, was instrumental in setting up a unique commercialization framework.

This IP was vested in a University spinout company, OmniPerception Ltd, in 2001. The spinout company was initially assisted both, financially, from the University seed fund and Cascade fund, and intellectually, on a long-term basis, by the University committing any pipeline IP, to be generated by Professor Kittler after OmniPerception had been formed, for the benefit of the company. The relationship between the University and the company mirrored the business and exploitation model used by the Stanford University in setting up the speech recognition company Nuance at about the same time.

The output of the applied research in biometrics carried out at the University of Surrey after the formation of the company with EPSRC and EU support, jointly with government assisted technology transfer programmes including SMART, KTP, and DTI Technology (TSB) projects, had generated innovative core face biometrics technology that attracted a Venture Capital investment of more than £2 million to enable product development and engineering. In 2009, the production of the OmniPerception technology was accelerated by a major investment from BAe Systems via its Investment in Innovation (I3) Programme, with a part of the funding (£250k) subcontracted back to the University to develop solutions for cross spectral face matching and pose invariant face recognition.

The software engineering and product development have been facilitated by the use of common open source image processing library RAVL. This ensured that common classes and structures were used for algorithm development. In April 2012 the company merged with Visimetrics, a major UK biometrics technology integrator, to create an enterprise with the combined capability to manufacture high technology products, and to integrate them in advanced security applications.

In 2013 Visimetrics was acquired by Digital Barriers, a fast growing SME in Homeland Security with then more than 200 employees. A number of University of Surrey PhD graduates have joined the company.

The series of products that have been launched by OmniPerception since 2008 includes:

1. **Face biometric access control systems** CheckPoint and CheckPoint.S. Both use illumination invariant imaging technology (enhanced by photometric normalization), and the multiscale Local Binary Pattern representation coupled with facial component based matching. The former system requires user cooperation. It is deployed for access control to data centres in banks, and by Menzies to enhance security at UK airports to control access to the air-side by cargo handling staff. The latter version, launched only in 2011 captures and processes face image on the move, without the subject's awareness. This is important for watchlist applications as diverse as those enhancing national security, as well as crime prevention in shopping malls and player exclusion in casinos.

2. **Face search engine** Collossus allows a rapid matching of an input face with a huge database of faces for retrieval purposes or for recognition. The search engine uses the basic face technology modules, including face detection and localisation, photometric normalisation, skin texture representation, and discriminative face matching, with multi-algorithm search solutions available as options. The search engine is used by the UK Police Forces to identify suspects, by United Nations, and as a core subsystem in stand alone biometric access control solutions (e.g. time and attendance).

In April 2012 OmniPerception Ltd merged with Visimetrics, an integrator, to create a company of greater critical mass, with enhanced access to security markets. The annual turnover of the new company was in excess of £3 million and is growing. With the proven track record of its security product installation at the Heathrow airport, the most recent successes of the company include the introduction of the OmniPerception face access control systems to Manchester and other UK airports by Menzies.

Quoting VP IT Operations and Communications, Menzies Aviation plc

*"**We analysed numerous biometric technologies and suppliers back in 2009 and concluded that OmniPerception both as a technology and organisation fitted in with the Menzies Aviation philosophy.**"*

5. Sources to corroborate the impact (indicative maximum of 10 references)

  C1. CEO of OmniPerception. Contact details provided.

  C2. OmniPerception

   http://www.omniperception.com
   http://www.omniperception.com/about-us/technology/
   http://www.omniperception.com/about-us/case-studies/access-control- airport-cargo/

Examples of product sales and installations include:

C3. Facial capture and search engine for police custody suits to facilitate law enforcement

http://www.omniperception.com/markets/law-enforcement/

C4. Suspect identification (UK Police Forces)

http://www.omniperception.com/about-us/case-studies/case-studies-secure-facial-control/

C5. Access control to air side in airports for personnel handling air cargo (e.g. Heathrow, Manchester)

http://www.omniperception.com/about-us/case-studies/access-control-airport-cargo/

C6. Secure access to data centres in financial institutions

http://www.omniperception.com/about-us/case-studies/case-studies-secure-facial-control/

http://www.omniperception.com/news/2013/01/07/digital-barriers-acquires-OmniPerception/