The Royal Society of Edinburgh

The Gannochy Trust Innovation Award Prize Lecture

Dr Colin Urquhart, CEO, Dimensional Imaging Ltd

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Report by Jennifer Trueland

Dr Colin Urquhart, winner of the prestigious Gannochy Trust Award for Innovation, which carries a £50,000 prize, invited a captivated RSE audience to don their 3D spectacles and view the revolutionary technology which is making a big impact in facial surgery, orthodontics and even the entertainment industry.

From the zombies in Hollywood blockbuster *28 Weeks Later* to burns units, psychology labs and orthodontic practice, the technology of Dimensional Imaging Ltd is making itself felt. The Scottish company has sold its products to customers around the world and is continuing to develop new and exciting technologies.

Chief Executive Officer, Dr Colin Urquhart, 2008 winner of the Gannochy Trust Innovation Award of the Royal Society of Edinburgh, described how the company was set up to exploit the technique of passive stereo photogrammetry, which is used to derive accurate, high resolution, three-dimensional surface images from stereo pairs of images captured by standard digital cameras. The company's DI3D (TM) system, the first commercial application of its type, is being used in diverse fields ranging from the medical and psychological to entertainment.

But it didn't start out like that. In an engaging lecture, Dr Urquhart took the RSE audience through a whistle-stop tour of the history of using stereo images to allow depth to be perceived, which was first described by Charles Wheatstone in 1838. This work was then refined by Dr David Brewster in 1849, who invented the prism stereoscope and went on to develop the technology further.

Dr Urquhart used this example to explain the difference between invention and innovation. Innovation is more about entrepreneurship, he believes, because it probably means introducing an invention to market. While Wheatstone invented the stereoscope, Brewster was the innovator. The Victorians realised they could take measurements from stereo photographs – a process called photogrammetry. A century later, in the 1970s, neuroscientists became interested in taking this further because they wanted to understand how we perceive depth. They used tools such as random dot stereograms, as developed by Dr Bela Julesz, which helped to show how depth is perceived by the human brain. The advent of computers meant that theories could be tested more easily.

But in 1989, when Dr Urquhart was working for his Masters degree, it still took days to compute images and the technology didn't work with natural images, possibly because they didn't have enough texture. Dr Urquhart and his supervisor, Dr J. Paul Siebert, developed active stereo photogrammetry (ASP) which involved projecting random patterns on to the same images, and was able to capture a three-dimensional model. Dr Urquhart described how he and his supervisor were very excited about this, so published their findings. Had they patented them, things may have taken a different course, he said ruefully. Unlike traditional methods of creating 3D pictures, which use lasers and can take up to several seconds to scan an object, ASP was instantaneous; indeed, its applications are still in use today.
In 1995, Dr Urquhart worked with facial surgeons at Canniesburn Hospital and helped to develop a technique which involved combining the ASP technology with x-ray, to give a

picture of hard and soft tissue. Again, this technology was probably patentable; but again Dr Urquhart and his colleagues chose to publish instead.

Further developments were made to the ASP technology, including the addition of colour, but attempts to commercialise it were unsuccessful. Around this time, however, at the turn of the Millennium, digital camera technology was moving on apace. Returning to Glasgow University, Dr Urquhart and his former supervisor used two high-specification Kodak cameras to create 3D surface images which were even higher resolution and better quality than those previously achieved with ASP. There was no need to capture a second image and colour was 'built-in'. This was to become passive stereo photogrammetry, which definitely had commercial possibilities.

Following Proof of Concept funding from Scottish Enterprise, Dr Urquhart and colleagues developed a demonstration reel, which showed how real people could be turned into virtual characters. Their target was the video games market, with the idea that life-like 3D images of anyone – be they celebrities or ordinary punters – could be dropped into games. A company, then called Virtual Clones, was formed in January 2003.

Dr Urquhart showed the company's development from its very early stages, with particular reference to financial challenges. He believes it was the right approach that he and his co-founder set up the company, rather than the university. Entrepreneurs should set up companies, he believes, because they will drive it forward.

The chosen market – entertainment – was not to prove fruitful at first, however. In August 2003 they made their first sale, but it was to the Glasgow Dental Hospital and Southern General – users of the previous ASP technology. A change of focus followed, and the young company turned its attention more closely to the medical market. The move was successful. Since then, the technology has been used to create 'virtual patients', on whom techniques can be tested and measured. It lets maxillofacial surgeons observe precise images of patients before and after surgery and measure outcomes objectively. 'It allows them to see, measure and assess what they are doing – they can capture the patient at all stages of treatment,' he said.

In 2005 the company name was changed to Dimensional Imaging, which better reflected the medical focus. At the same time, the company was able to exploit advances in digital camera technology which, as Dr Urquhart put it, meant you could get more pixels for your pound. Cameras are getting cheaper and higher resolution all the time, and Dimensional Imaging can use these advances to provide ever-better products.

Other applications have since been developed. These include using the technology to treat facial burns – where previously the patient would have to undergo an unpleasant plaster-casting of the face, probably involving an anaesthetic, the DI3D system allows a highly accurate 'mask' to be made without even touching the patient.

The technology is also of interest to psychologists, who use it to morph the shape and appearance of a number of people into a single image – a technique very useful in the growing discipline of facial recognition, where applications include witness identification. And finally, as if to come full circle, the entertainment industry has been knocking at the company's door. As well as being used to create some of the zombies in *28 Weeks Later*, Dimensional Imaging systems have now been sold to major UK and US video games companies. 'Our original business plan wasn't wrong – just five years ahead of its time,' he smiled.

Last year the company made a profit for the first time and Dr Urquhart plans to invest the £50,000 Gannochy Prize in Dimensional Imaging to help it to develop new technologies and

to continue to innovate. He aims to use any future returns from the investment of the Prize to help support other young innovative Scottish companies.

Dr Urquhart finished with a brief description of the company's latest innovation, which adds the fourth dimension – time – with the use of video cameras. This can capture three-dimensional sequences of dynamically changing surfaces, which allows even very subtle changes to be captured accurately. In facial surgery, for example, the data can be used to measure facial function, while in video games it creates more realistic facial animation. It's a novel technology on the world scale and is revolutionising our ability to track temporal changes.

In conclusion, Dr Urquhart summed up some of the lessons he has learned. Innovation is harder than invention, he believes. It's tough, but satisfying to see products that embody technology you have developed sold across the world. You can innovate with existing technologies – arguably his innovation is based on an invention from 160 years ago.

Cash is king – and so is the customer: talking to and getting feedback from those who use the equipment is vital to development. And you have to adapt to survive. His company started with a focus on entertainment, moved to medical applications, and this financial year so far, a third of the sales have come from entertainment. He ended with an advert – anyone interested in the technology should contact him for a chat. http://www.di3d.com/

Questions

Dr Urquhart was asked whether there are limits to the technology. For example, because texture is essential, would the technology be able to capture very smooth skin. He replied that there are theoretical limits – eg, a blank piece of white paper cannot be captured – but that it has been demonstrated to work on humans of all different ethnicity and all ages from small babies to older people. He was also recently pleased to be able to capture a black hoof on a black horse for a vet school, which would be impossible with most other 3D capture methods.

Asked how it is used in orthodontics, Dr Urquhart said one example is that it gives an objective assessment of surgical outcomes, for example, in cleft lip and palate surgery, and allows different techniques to be compared against the 'gold standard'. It can also be used to predict outcomes and involve the patient in saying what he or she wants.

Asked by a cleft surgeon if the company will continue down the medical applications route now that the entertainment industry is using the technology, Dr Urquhart said he definitely would. While entertainment looks 'glossy' it isn't as commercially exciting as you might thing – whereas there is a market of 10,000 orthodontists in the US.

Asked about other applications, such as full body capture, Dr Urquhart said that is difficult to define and to do, but said some of Dimensional Imaging's customers are adapting the DI3D technology for their own applications, including body capture – something about which he is very happy.

The vote of thanks was delivered by Professor Andy Walker of Heriot-Watt University, who was a member of the Gannochy judging panel. He was particularly impressed by Dr Urquhart's willingness to rewrite the business plan – and also in his plans to support innovation in Scotland.