Kimi Ora and the Total Access inspiration

Jessica Steele at Kimi Ora School in her Thompson Micropower Electric Wheelchair, which she manoeuvres by means of head movements. Kimi Ora is a special school catering for students with disabilities (Jessica has cerebral palsy), and a challenge to help another of its students set Neil Scott on his quest to break down access barriers of all kinds with the help of computer technology.

The Open Interface

Beyond Keyboards and Mice

Kiwi engineering professor Neil Scott is using technology originally designed to help disabled people use computers to pioneer a universal interface that could make life in the information age easier for everyone. KEITH NEWMAN reports on the Archimedes Project.

THE INSIGHTS AND INVENTIONS of former Cantabrian Neil Scott are challenging the IT establishment's traditional keyboard and mouse interface, and clearing the way for the disabled, the elderly and the illiterate to join the computer revolution. He and his team at Stanford University in San Francisco believe they have developed the ultimate bridge across the digital divide with their access system, which allows any input device to work with any type of computer.

Professor Scott's original New Zealand experiments with computer input devices for the disabled have given rise to the work of the Archimedes Project, which could change the way people access computers and the Internet. The advances now being offered to developers around the world could also bring the long-hyped "intelligent house" closer to reality, and make the computers in schools more practical, freeing up funds from endless technology upgrades to be used for education itself.

Professor Scott is perhaps better known and appreciated in the United States than he ever was in his home country. He was nominated in the 1997 *Discover* magazine awards as one of the five top computer hardware and electronics innovators in the US. He featured in the January 2000 issue of *San Francisco* magazine as one of 15 local futurists most likely to shape the way people live, think, work and play in the new millennium.

His work as founder, head visionary and chief of engineering at Stanford University's Archimedes Project began in 1992, six years after he emigrated to the US. The name of the project comes from the ancient Greek mathematician who once said: "Give me a lever long enough and a place to stand and I will move the earth".

For Neil Scott that lever is appropriate technology, which can provide the leverage for each person with a disability to move his or her world. That philosophy is now embodied in several patented technologies geared to challenge the dominance of mouse and keyboard.

"We were concerned the emerging Internet and World Wide Web might lead to a repetition of earlier mistakes that had disenfranchised certain groups of people. For instance, when the graphical user interface (GUI) was introduced developers assumed blind people wouldn't use it. What they didn't foresee was the time when text-based interfaces would disappear and blind people would have no option."

Professor Scott hadn't thought much about working with disabled people until the early 80s, when as head of the Electrical Engineering Department at Wellington Polytechnic he began developing cross-departmental courses with the Design School.

On his desk was a small computer that had been developed to teach engineers how to build and program microprocessors. "The Design tutor asked me if I could use that computer to turn lights on and off. I had no idea why he wanted to know but I wrote a small program to flash the front panel LEDs on and off." He thought no more about it until a phone call a week later asked, "Could you bring your computer down to the annual general meeting of the Crippled Children's Society and show them how you can control things?" He could.

He put together some demos, and at the conclusion of the meeting was challenged to develop an electronic schoolbook for a 10-year-old girl who had cerebral palsy.

"I visited the Kimi Ora Special Education School and met Jackie, who was like a big rag doll who couldn't speak or use her arms and hands to write. I found she could twitch her knees and decided to make a computer interface using Morse code, triggered by the sideways movement of her knees. To get her started I made a little box that squawked with different sounds for a dot or a dash." He imagined he had lots of time to design, build and program a Morse-code computer; but just two weeks later he got a call from her teacher, saying "Jackie knows the Morse code – what do we do now?"

Change of direction

After a rush to get the device built in a few weeks, Jackie and her teachers came to the Polytechnic for the unveiling of the small Morse computer, which drove a converted TV screen. The input consisted of three switches on stalks that attached to the wheelchair. "Jackie had obviously been primed by her teachers because she immediately typed onto the screen 'SCOTT IS OK'. Everyone cheered and my life did a big change in direction."

Another inspiration came from a 35-year-old woman with advanced multiple sclerosis who, given the ability to communicate using a simple touch pad, immediately expressed a wish to die. But within days of using Professor Scott's device she was cracking jokes and had decided to write a book.

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These experiences led to Professor Scott's own book, *Computer Assistance for People with Disabilities*, which became a standard reference work. When he moved to the USA in 1986 he was asked to produce an American version.

Today Professor Scott's brainchild, the Total Access System (TAS) can provide access to computers and other electronic devices via speech recognition, head and eye tracking, and other "human-centred interfaces".

The Total Access Port (TAP) separates the user interface from the application software and the operating system, using a standard communications protocol to emulate the functions of the keyboard, mouse and screen on a target computer without interfering with their normal operation. The signals are passed on by any "accessor" (independent access peripheral) in the desired format.

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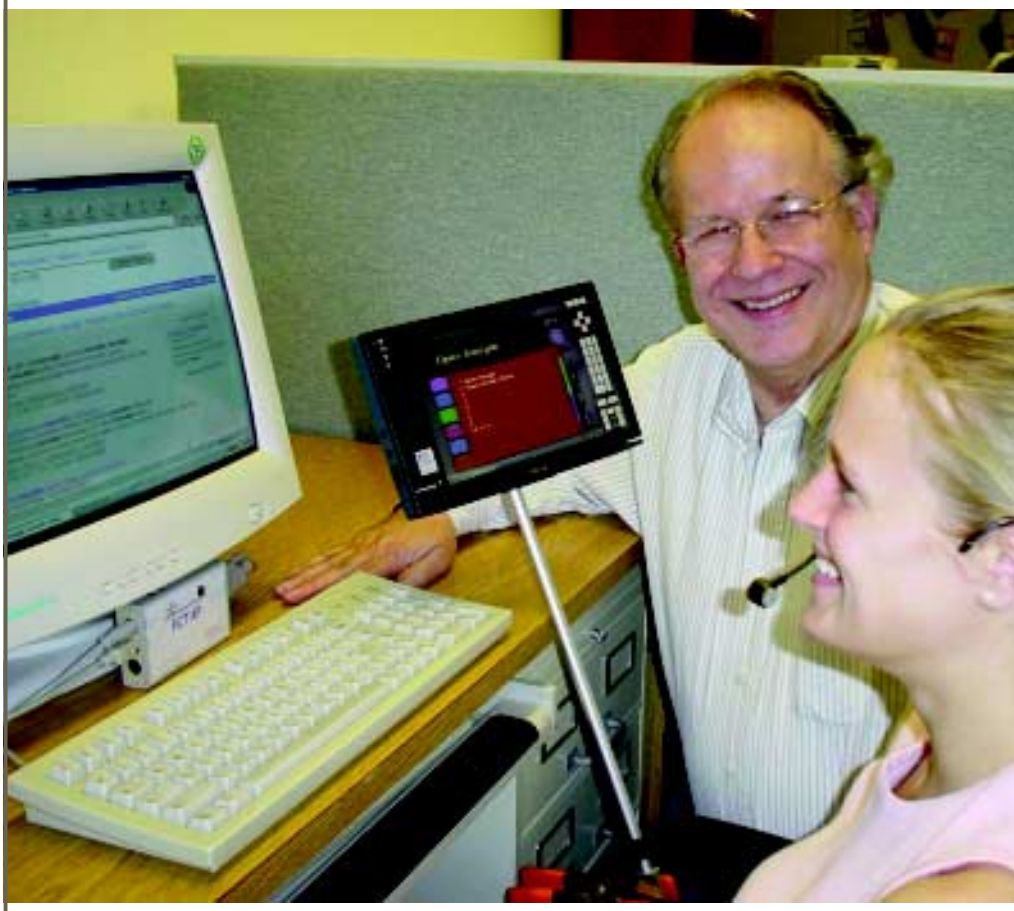

Professor Scott, with the Total Access System in action. A Total Access Port connects PC and interface.

TAS, now marketed by Synapse Adaptive, is increasingly finding favour as a mainstream productivity tool because it makes computer systems easier to use. The idea of using it to extend the value of computers in education is gathering momentum.

Professor Scott defines the ideal as a "comfortable learning environment for students where the computer is a window to information and activities that augment the learning process. It must be part of a richly interactive experience that supplements what the teacher is doing, and not a robotic substitute for a teacher."

Providing relief for people suffering from occupational overuse syndrome (OOS) or repetitive strain injury (RSI) was first investigated five years ago by the Archimedes Project. At that time the US Department of Commerce estimated that lost productivity was costing the economy $US20 billion a year. Voice recognition wasn't fast enough, and user training didn't port across machines and applications. Developing a solution for programmers also proved difficult.

Now that gigahertz-speed computing is available, Professor Scott has renewed his efforts and created a small Linux-based speech accessor, which can be plugged into any computer. The solution is ready to be ported to hand-held and wearable computers and, with a little tweaking, to distinguish command and control applications for programmers. It could soon be available commercially.

To date Archimedes accessors have been developed for special keyboards and switches, speech recognition, head and eye tracking, Braille and animated graphics systems, as well as for standard computer platforms such as IBM and Macintosh computers and Sun and SGI workstations. They're also available for home networks to control lights, doors, windows and appliances, and for industrial networks, where they can control machines and computer peripherals.

The goal is access that is independent of what Microsoft and the other big names, and as affordable as possible. "The accessor and TAP allow a person to interact with whatever the big companies come

up with. There are already many web-based applications that do not need Microsoft, and a lot of pressure in third world countries to use Linux systems," he says.

The systems being developed for ageing people focus on easy inexpensive control of appliances, lamps and entertainment systems, using TAPs, low-cost X10 controller modules and intelligent accessors. Demonstration systems are already working and soon manufacturers, including some in New Zealand, will be offered a licensing deal.

Elderly show way

Professor Scott always believed the elderly would provide the catalyst to force the manufacturers of ordinary computers to make them compatible with affordable common input and output devices, as they had the numbers and the disposable income.

"Sending old people to nursing homes is very expensive and also carries a stigma. We need to do everything we can to allow them to age with dignity. Kids are blown away by hip grandparents who can email them, and grandparents love getting email and drawings from grand-kids. It helps keep families intact," says Professor Scott.

Regulatory changes in the US and elsewhere may also help to take the developments of the Archimedes Project mainstream. The US government has passed several laws making access to technology mandatory for all federally funded products and services. Ultimately, however, the market will decide the way forward. Professor Scott hopes that significant funding will come from organisations like the World Bank and Unesco once they see that there are cost-effective alternatives.

Archimedes satellite projects have been established in Ireland, the US, the UK and Japan. Professor Scott is a Visiting Professor at the College of Policy Science, Ritsumeikan University in Kyoto, where he is heading a virtual laboratory project on smart houses.

He has a small grant to develop components for controlling home appliances using touch panels and speech recognition. A separate project involves building a collaborative framework to develop access technologies for ageing and disabled people, and tools for improving medical management in nursing homes for ageing people. This project is being undertaken jointly with Ritsumeikan University, a business development foundation in Osaka called B-Platz, and numerous small to medium companies in the Kansai area of that city.

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Professor Scott has also recently completed a one-year project with Iizuka City in Fukuoka Prefecture, developing new interfaces that enable severely disabled people to operate a Sony PlayStation 2 video game console. "This was to help the city develop a new IT industry by showing them how to design and develop a product for a particular application. I was the project leader for a consortium of researchers, rehabilitation engineers and several small hardware and software companies." >>>

Keen for collaboration

In his search of collaborators and partnership to take devices to the commercial market, Neil Scott has not forgotten New Zealand. He is encouraging local developers – specifically companies working with embedded processor designs – to develop prototype products using his breakthrough technology. The first steps have already been taken to include New Zealand in university-based research and a mix of profit-based and non-profit product development. A partnership has been formed with commercialisation start-up Realize Technology, based at Auckland's University of Technology's TechPark.

Professor Scott says that in the past it has been impossible to get investors interested in disability-related products. "The plan we have is for the researchers to do 'proof of concept' and look at ways to turn the research results into prototypes that are sufficiently complete to interest funding and licensing through the for-profit part of the company," says Professor Scott.

He's exploring ways to facilitate local and global clustering of companies that might want to work together using video conferencing and shared workspace software.

From Little Professor to Big Ideas

Neil Scott was born in Queenstown in 1941. His father was a motor mechanic and bus driver. His parents moved to a farm at Moa Flat and at the age of 5 years he was living with his grandmother in Dunedin, where he became known as 'the little Professor' because he was always reading books, even walking to and from school.

At 15 he attended Southland Boys' High School in Invercargill where for three years he specialised in science with a particular interest in biology, zoology and physics. Then it was on to Otago University where a promising career in medicine was interrupted when he contracted hepatitis soon after passing his exams.

He opted for a role as technician with the New Zealand Broadcasting Corporation where he progressed to the head office engineering section. After four years of night school he gained his New Zealand Certificate in Engineering with Distinction and was accepted into the third year of the engineering course at Canterbury University. At the age of 28 and with four children he completed an Electrical Engineering Degree with First Class Honours.

Moving back to Wellington, he worked in the Radio Studio Equipment Development Lab where he again indulged his fascination with electronics and designed "lots of studio sound equipment."

At Wellington Polytechnic he completed his professional engineering degree, and started tutoring in electronics and industrial electronics, working his way up to become the youngest ever head of department.

Professor Scott first went to the US on a Fulbright Scholarship in 1982, and found people there were actually getting paid for the kind of work he was doing.

He married an American citizen who came to New Zealand in 1983. A sabbatical took him to Washington DC the following year, and after a trip around the US to scope out potential places to live he fell in love with San Francisco. Following a grant from a US Government overseas aid organisation for a year-long project in New Zealand on distance teaching, he and his wife decided to immigrate in 1986.

Initially he had no job, but was confident that he could get consulting work relating to computer access for the disabled. He wrote a couple of books, one on "assistive" technologies and one on computer organisation and architecture. His extensive experience with speech recognition and its application to help people with disabilities attracted considerable interest in both academic and engineering quarters.

He took a job with California State University in Northridge, near Los Angeles, in 1987 and was asked to participate in several White House committees on access issues.

In 1992 he was asked to establish and head the Archimedes Project based at the Centre for the Study of Language and Information at Stanford University. Its objective is to ensure that all people can participate fully in the global information society, regardless of individual needs, abilities and preferences, or cultural differences.

"Using computers will become a natural interaction that is seamlessly intertwined with all the other things we do. They will become invisible and more intelligent. The ones we have now are incredibly stupid."

The big question is how to get companies to collaborate on prototype designs and share ownership of the resulting intellectual property. To that end the Archimedes team is setting up AARTI Holdings – a subsidiary of the non-profit AARTI (Archimedes Access Research and Technology International) organisation – as a trusted "fair broker" to hold IP on behalf of the participants and ensure they all receive due recognition and royalties.

"The incentive for companies to join will be access to global markets they couldn't otherwise reach. For example, a product developed in New Zealand could be adapted by Japanese collaborators for the Asian market."

Professor Scott sees himself as a kind of talent scout, putting together leading-edge innovators and new technologies to solve real-world problems. "There must be other people like me scouting out new technologies and introducing them to potential implementers. Wise and knowledgeable problem solvers roaming the world could identify problems to relay back to people in New Zealand who could make a solution in hours or days and ship it back electronically."

Solutions to real problems

However local software developers and inventors must identify real markets and "focus, focus, focus" on solving real problems – rather than making things they *think* people might want. "Don't reinvent the wheel unless it is fantastically better at a fraction of the price. Make alliances and partnerships with overseas companies who already have parts of the solution."

To many people in the IT sector Professor Scott's work is revolutionary, helping to break down the technological and social barriers that keep computing expensive, proprietary and difficult to learn. For others he's a nuisance, whose grand ideas threaten multinational IT companies with a vested interest in the status quo.

That prejudice was made clear to him when attending a conference of elite movers and shakers in Atlanta last November. He was asked to join Nicholas Negroponte of MIT Media Labs, John Perry Barlow of the Electronic Frontier Foundation, Bill Joy the co-founder of Sun Microsystems, and speech recognition and OCR guru Dr Ray Kurzweil as a keynote speaker at the Vanguard Advisory Board annual get-together. He spoke alongside senior technology strategists from large public and private organisations on the subject *Where People and Technology Meet*.

Professor Scott was determined to "sensitise" attendees to the requirements for the next generation of computers. "It would be reasonable to say that many of the access problems we have today are a direct consequence of the short-sightedness and biases of some of the people in that audience. In the discussion and interruptions during the presentation I had heated debates with some of the revered pioneers in the computer field who were responsible for the current designs. Some of the very famous people were absolutely down to earth and really neat, others were arrogant and had closed minds. It was very obvious that some use intimidation to stifle innovations that might threaten their original implementations."

After the conference Professor Scott followed up with some key industry people who were looking for answers to real questions about next-generation interfaces. "This meeting helped give me the confidence to stick my neck out and start developing such interfaces."

Invisible computers

The people he looks to for inspiration and encouragement as he tries to introduce a new paradigm to the world of computing include Doug Engelbart, inventor of the mouse, the GUI, and the concept of hyper-linking, and "about five retired people from IBM and HP" who are helping cement his ideas. "These guys came from the era where buggy software was not an option and the client was always right. They are teaching me how projects are done professionally."

Professor Scott is not excited by the current state of voice recognition, which is "still too difficult for most people to learn and use" and ultimately needs to be fully integrated with pointing devices. However neural chip networks and distributed agent technologies – the core of what he describes as 'smart silicon' – do get his adrenaline flowing. He believes smart silicon can eventually deliver invisible interfaces and background processes to look after our well-being.

Professor Scott's vision for the future? "Using computers will become a natural interaction that is seamlessly intertwined with all the other things we do. They will become invisible and more intelligent. The ones we have now are incredibly stupid. Microsoft will become a blip on the way to rational, reliable, natural and invisible computing. The third world will embrace a different computer model from the one we are stuck with. If we develop the right answers to their problems, the potential third-world market is huge beyond our experience."

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