

INNOVATOR IN FOCUS

A revolution in ROBOTICS

Over the past decade, Neuramatix Sdn Bhd has quietly worked to change the way we think about the way we think

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The high-tech conveniences we take for granted every day, such as smartphones and thumb drives, are frequently the product of unsung heroes, and for every Alfred Nobel or Thomas Edison there are scores of innovators whose stories have yet to garner the acclaim they deserve.

Such is the case with Neuramatix Sdn Bhd director Robert Hercus, whose 1995 proposal for integrated electronic payments at highway tolls to Plus Malaysia Bhd has evolved into the Touch 'n Go system, with six million cards issued to date and four million transactions daily across the country.

A lifelong love of learning

While Australian by birth and citizenship, Hercus has based himself on local shores for the past 40 years, marrying local entrepreneur and philanthropist Munirah Hamid, who would go on to found the Pertiwi Soup Kitchen project in Kuala Lumpur. "I've lived in Malaysia since 1972, so if I go back Down Under, people ask me, 'Where are you from?'" he laughs.

With decades of experience in developing large-scale hardware and software computing solutions, including military infrastructure, Hercus earned his BSc (Hons) degree in Information Science from Monash University, following a natural affinity for the field, which grew from a love of science fiction classics such as *Songmaster* by Orson Scott Card and the *Foundation* series by Isaac Asimov.

His interests led to the creation of NeuraBase, a proprietary engine with high-speed processing and analysis capabilities that can be used to build neuronal network systems of up to four billion nodes. It differs from conventional approaches by modelling the way in which the human mind continuously learns, based on previous experiences.

"Current models often rely on brute force. As an example, chess-playing intelligences just explore 100,000 moves ahead and choose the best option, which isn't the same as intelligence to me. Even the neuromorphic chips produced by Intel are programmed on the exact same algorithm from 50 years ago. There's been no change, no revolution," says Hercus.

Thinking outside the box

Establishing Neuramatix with Munirah in 2001 to further develop and commercialise NeuraBase, the company is unique among artificial intelligence specialists worldwide in that its solutions and engine are all based on a single algorithm, adds the soft-spoken 66-year old.

From data mining and information storage and retrieval to uses in neuromusculature, natural language learning and visual recognition, Hercus' versatile formula does it all, fulfilling the scientific criterion of elegance, which prioritises simple theories that explain and predict a wide range of phenomena.

"We're fairly convinced that this is the algorithm for representing how the brain works. It's a radical approach, so there's a lot of scepticism going forward, but we've taken the time and effort over the last 10

years to prove that it can be applied to all the core artificial intelligence focus areas," he says.

The NeuraBase model differs from Hebbian networks, which excel at identification, by allowing room for what Hercus dubs creativity: the creation of new patterns arising from recognition of prior chains. As such, it has large potential for applications in control systems governing sensor and motor elements, exhibiting functions analogous to learning and prediction.

A blueprint for a brainstorm

As testament to its far-reaching impact, patenting for Neuramatix's model was deceptively convoluted despite its algorithm's simplicity, with one office saying it represented no less than 11 inventions. In Europe, the claim was filed under four separate patents, with the company investing more than RM1mil in the process overall, including divisionals and annual renewals.

"The underlying concept goes back to Aristotle, who basically said that one movement follows another in the course of a thought. It's sequential. If you take that and put it into an algorithm, you get something that can process a sequence of events," said Hercus.

"What we do is we break systems down into their smallest component elements of information, and we link them together. If these elements are arranged in a hierarchical structure, the system becomes increasingly proficient at building complex connections."

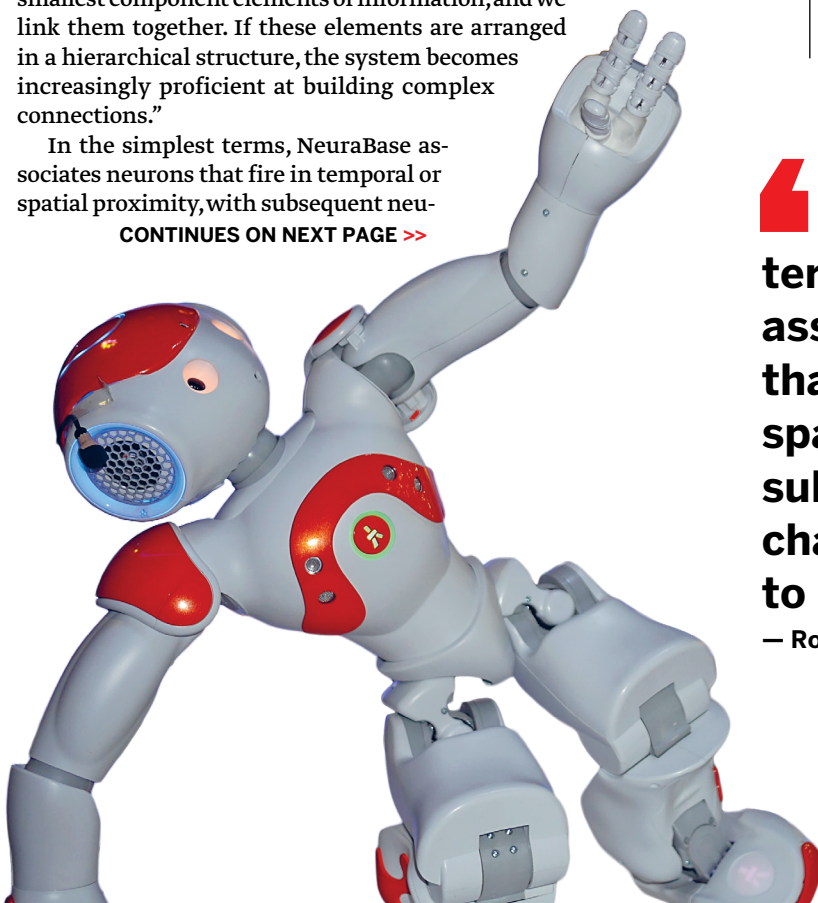
In the simplest terms, NeuraBase associates neurons that fire in temporal or spatial proximity, with subsequent neu-

CONTINUES ON NEXT PAGE >>



TOP:
Robert Hercus, founder of Neuramatix Sdn Bhd

BOTTOM:
The NeuraBase model has seen applications in technology ranging from interactive speech to robotic equilibrium



In the simplest terms, NeuraBase associates neurons that fire in temporal or spatial proximity, with subsequent neurons in the chain having the capacity to recall earlier nodes.

— Robert Hercus

PHOTO BY ANWAR FAIZ



TOP:
Hercus' 1995 proposal for integrated electronic payments at highway tolls evolved into the nation's Touch 'n Go system

RIGHT:
The Touch 'n Go system has seen six million cards issued to date with four million transactions daily across the country



PHOTO BY SHARIL AMIN

Deep learning in machines

>> FROM PREVIOUS PAGE

rons in the chain having the capacity to recall earlier nodes. As a software-based approach, it offers superlative speeds without the added hardware costs of server farms and supercomputers.

Ruminations reflecting reality

The model also has the advantage of mirroring the processes of many biological systems, which often integrate feedback components in their structure. In human nervous systems, for example, thinking is intricately linked with language, so much so that thought initiation sends a subthreshold signal to the vocal apparatus.

"I have a rule in Neuramatix: we're not allowed to use mathematics. For dynamic physical systems, we don't calculate forces, velocity or acceleration anymore than you would when you learn how to walk or play ping pong. That was one of our earlier proofs of concept in our robotics applications," says Hercus.

Though his fascination with the discipline has been lifelong, career obligations and technological limitations conspired to keep him from exploring his interest until the turn of the millennium. Drawing inspiration from observing how his grandchildren matured, Hercus developed his model accounting for complex behaviours arising out of sequential inputs.

After studying the market and realising that he was breaking new ground, he founded Neuramatix and filed its first patent in 2004. While initially concentrating on establishing an ecosystem of related services through sister companies, Hercus is now gearing Neuramatix towards realising his dream of truly intelligent robotics and systems.

Commercialising a cognitive concept

"We started on it about three years ago, in 2011. Prior to that, I didn't have any staff working on artificial intelligence. We just had the algorithm, which we applied to things like translation and data mining as part of our focus on business and generating income. We were one of the first companies in Malaysia to do bioinformatics, including training and workshops, which contributed a large part to its development here," he says.

Since then, the NeuraBase model has seen applications in technology ranging from interactive speech to autonomous flight control, artificial musculature and robotic equilibrium. The latter is a particularly impressive feat, as bipedal locomotion is a key challenge in the development of humanoid robots.

The backing of investors including Encipta Ltd, a

venture fund under Mimos Bhd, also allowed Hercus to build up associated companies, such as Synamatix Sdn Bhd, which specialises in managing and analysing genomic data sets, and Linguamatix Sdn Bhd, offering high-throughput machine translation services. In 2010, the Malaysian Genomics Resource Centre, a wholly-owned subsidiary under Neuramatix, was listed on the Ace Market of Bursa Malaysia, further increasing its profile.

Moving forward, Hercus is positioning Neuramatix at the forefront of the field, banking on the convergence of favourable conditions given China search giant Baidu's recent establishment of a Silicon Valley artificial intelligence lab dedicated to deep learning in machines.

"For the next stage, we'll be sourcing significant investment. We're encouraged by the fact that AI specialists such as DeepMind, a UK-based start-up established just two years ago, sold to Google for US\$400mil (RM1.4bil), and all it did was teach computers how to play computer games. We could do the same in six weeks!" he concludes with a laugh. ■

RIGHT:

The NeuraBase model associates neurons that fire in temporal or physical proximity, allowing the building of complex connections

BOTTOM:

Current models of artificial intelligence rely on brute force, with comparatively little change in the past few decades

