Rethinking Robots

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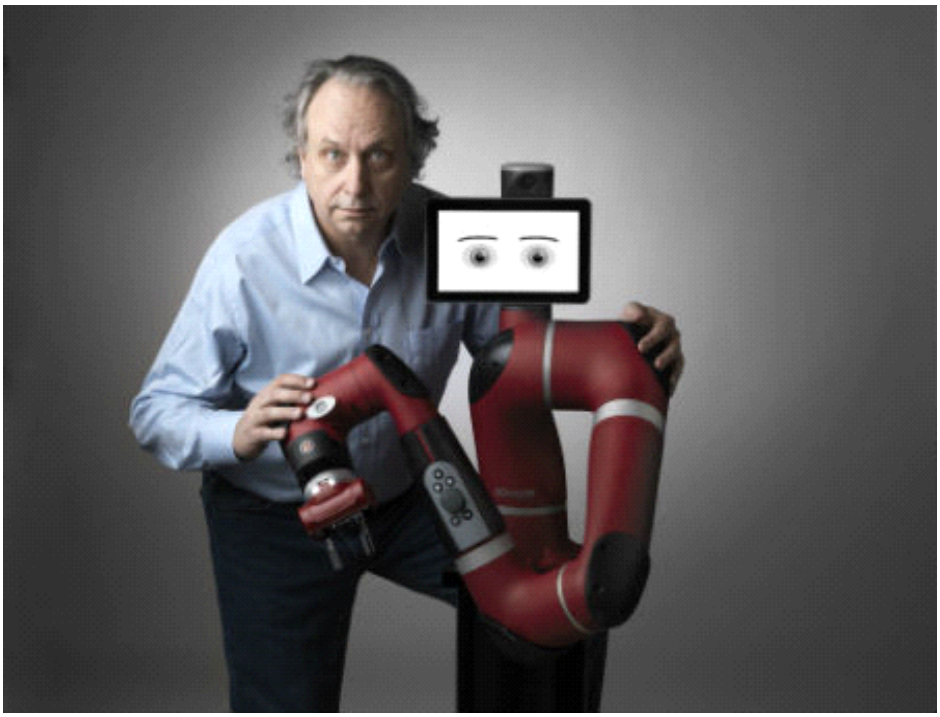

Rodney Brooks was an eight year old boy in Adelaide in the 1960s when he started building his own computers.

“I had a few books and I tried to build things, mostly machines that could play games and beat people at them,” he recalls. “I called them computers; they were my version of it.”

Half a century later, Brooks is a global robotics pioneer, the Panasonic Professor of Robotics (emeritus) at Massachusetts Institute of Technology (MIT) and the founder and chairman of Rethink Robotics, which is revolutionising the way robots are used in manufacturing.

He has produced robots that are cheaper, smarter and easier to use than their predecessors. They range from vacuum cleaning robots to robots used to detonate bombs in Iraq and the manufacturing robots, which he now plans to take worldwide.

Brooks says that although it might sound “pretty inane”, the same thing that attracted him to build computer games as an eight-year-old was what attracted him to get involved in robotics. “You switch them on and they come alive, they do stuff, the lights flash, things move.”

In fact, he credits growing up in Adelaide and its remoteness for the inventiveness and problem solving skills which he later deployed in robotics.

He’d read British and American magazines that were already three months out of date when they arrived in Adelaide and he’d see parts and components that he couldn’t get his hands on.

“So I’d have to figure out how to make do with what I could get and that made me very inventive – I think that had a big, big influence. How could I make do with what’s available? To do this engineering task, I should get A, B and C and put them together and then it will work. But I could only find D, E, and F in Adelaide, so I would ask: ‘how do I put those pieces together and get what I want?’”

As a stepping stone to studying computer science, Brooks enrolled in a bachelor’s degree in pure maths at Adelaide’s Flinders University.

At the time, Flinders had one mainframe computer, an IBM 1130, which had 16 kilobytes of memory and required four full-time operators. It was unused over the weekend, so Brooks and another student were given access every Sunday from 9am until 9pm. “We taught ourselves everything at that time,” says Brooks, now aged 60. “That was the greatest thing that happened to me – getting access to that machine.”

Brooks studied maths and physics at a high level at high school and finished his undergraduate degree when he turned 20. “I had a really big mathematics education by that time.”

He went on to do a PhD in Computer Science at Stanford University, then held research or faculty positions at Stanford, Carnegie Mellon University and MIT, ultimately becoming Professor of Robotics at MIT.

At MIT he became interested in how insects with their simple nervous systems could do things much better than any computers and robots. He tried to understand biological systems and how he could replicate them in electro-mechanical computational systems.

Brooks came up with a new approach to robotics, which he terms “behaviour-based”. In the past, roboticists had tried to build a complete representation of the world then plan the robot actions that would happen within that representation. But taking his cue from insects, Brooks’ designed robots that would only perceive and “understand” the aspects of the world that related to the tasks they had to perform. Instead of having a deep understanding of their world, the robots react to the world with some overall hard-wired goal.

It was a controversial approach.

His paper from the mid-1980s *A robust layered control system for a mobile robot* was rejected by reviewers, but published anyway. Now it is mandatory reading for all PhD students at Stanford in computer science and one of the most cited papers in robotics ever.

Brooks and various colleagues worked their way through 14 failed business models before he founded iRobot with a couple of his students in 1990. The company produces the Roomba vacuum cleaning robot and the PackBot, which is used to defuse bombs in places like Iraq and Afghanistan. iRobot has sold over 14 million vacuum robots, earned revenue of US$556.8 million in 2014 and is listed on the NASDAQ stock exchange, with a market value of nearly US$1 billion.

The company manufactured its robots in China and around 2004 Brooks came to realise that the supply of

cheap labour wasn't going to last forever. "That led me to say, 'okay, we're not going to have this infinite supply of low-cost labour forever, so being a robot guy, the answer has to be robots'."

But the solution wasn't that easy. The majority of industrial robots at the time were used in the automotive industry and for safety reasons they couldn't work around people. Brooks set out to design industrial robots that could work with people, so they could be slotted into an existing manufacturing process and take on specific tasks, instead of being isolated behind a safety curtain. Traditional robots also require a redesign of a manufacturing process to accommodate them.

"What we're doing is we have robots that you can go up to and touch. They're safe because the robots have full sensors and full understanding of what's happening in the world around them," Brooks says. The sensors mean they can feel that they're near something soft – like a person – and stop.

Brooks also set out to build a robot that factory workers could program, rather than technicians with special training. "It becomes part of the arsenal for everyday use and not a scary, horrible thing," says Brooks.

Workers program this robot, known as Baxter, by outlining the task and "showing" it where things are. From there, the robot uses its own intelligence to fill in the gap. And unlike traditional robots which need precise coordinates to be able to locate objects, the Baxter uses its cameras to find them so only has to know roughly where they are. This is important, because in real factory environment things get moved around – tables get bumped a couple of centimetres out of place or a box of components isn't neatly aligned with the table it's sitting on.

The Baxter can adapt and overcome these problems because of Brook's behavioural approach to robotics – it focusses on the task it has to perform, rather than a pre-programmed series of motions required to complete the task.

The Baxter isn't for high volume manufacturing where millions of the same item roll off the production every month. Instead, their ease of programming makes them better suited for the vast majority of factories where they'll build a batch of something for a few days or weeks before moving on to something different.

The Baxter, with a starting cost of around US$25,000, has been selling worldwide for use in research at universities but only in Canada, Mexico and the US as a manufacturing robot. Brooks won't reveal sales figures, only saying fewer than 10,000 have been sold, though "w e'll be getting there before long".

The company's latest robot, the Sawyer, which can undertake more precise assembly operations, will be a global product.

China, Japan, and Korea in particular are potential markets for the new product, as well as North America, Europe and Australia. While Brooks won't reveal who the potential customers are, he says: "Everyone that you would imagine we would sell to, we have talked to at the CEO level."

Brooks has been settled in the US for about four decades, but maintains connections with Australia. He visits Adelaide twice a year and regularly attends conferences in Australia – in April he spoke at The Next Big Thing summit in Melbourne. Until recently he was on on an international advisory board of National Information and Communication Technology Australia, or NICTA, which is soon to be part of Australia's national science agency, the Commonwealth Science and Industry Research Organisation (CSIRO).

These days Brooks is more involved in the business aspects of Rethink Robotics than the technical problems, but is still passionate about the field. "To me, it's about changing what can happen in the world. That's still what I feel like I'm doing – changing the world and changing what people think is possible," he says.

- Rethink Robotics