He finds tech fix for neuroscience problem

Life sciences grad, 22, has come up with software that accelerates analysis

Jose Hong

Mr Aditya Nair has developed software that could massively help the research of Parkinson's disease around the world. His software also found a new type of nerve cell. And he is 22 years old.

Yet the life sciences graduate from the National University of Singapore (NUS) never imagined he would end up a developer of technology when he first began his studies here. As with all scientific endeavour, however, Mr Nair began with a problem.

A single cell is powered by up to 2,000 tiny engines called mitochondria. Besides fuelling the cell, mitochondria can also be used by biologists to tell if something has gone terribly wrong with the body.

For example, shrunken and broken-up mitochondria in nerve cells are a signature hallmark of neurodegenerative diseases, especially Parkinson's.

But it takes up to several hours for a trained scientist to analyse a scan of the cell. And the gold standard of accuracy demands that the analysis is performed at least thrice.

At the end of Mr Nair's first year at NUS, his then mentor, Associate Professor Lim Kah Leong, discovered that he had learnt some basic coding skills back in high school in Kerala, India.

Mr Nair said: "Prof Lim told me he wanted me to design a program to count the mitochondria... He has this habit of handing out challenges to students on a whim."

That he knew only the basics of coding did not matter much. The NUS scholarship holder was in Singapore for the first time in his life and hungry to learn – so he taught himself programming, spending hours per day studying coding.

And he would constantly go back to Prof Lim, who heads the Yong Loo Lin School of Medicine's Department of Physiology, for feedback on whether the results looked correct or whether the software was easy enough to use for the average biologist.
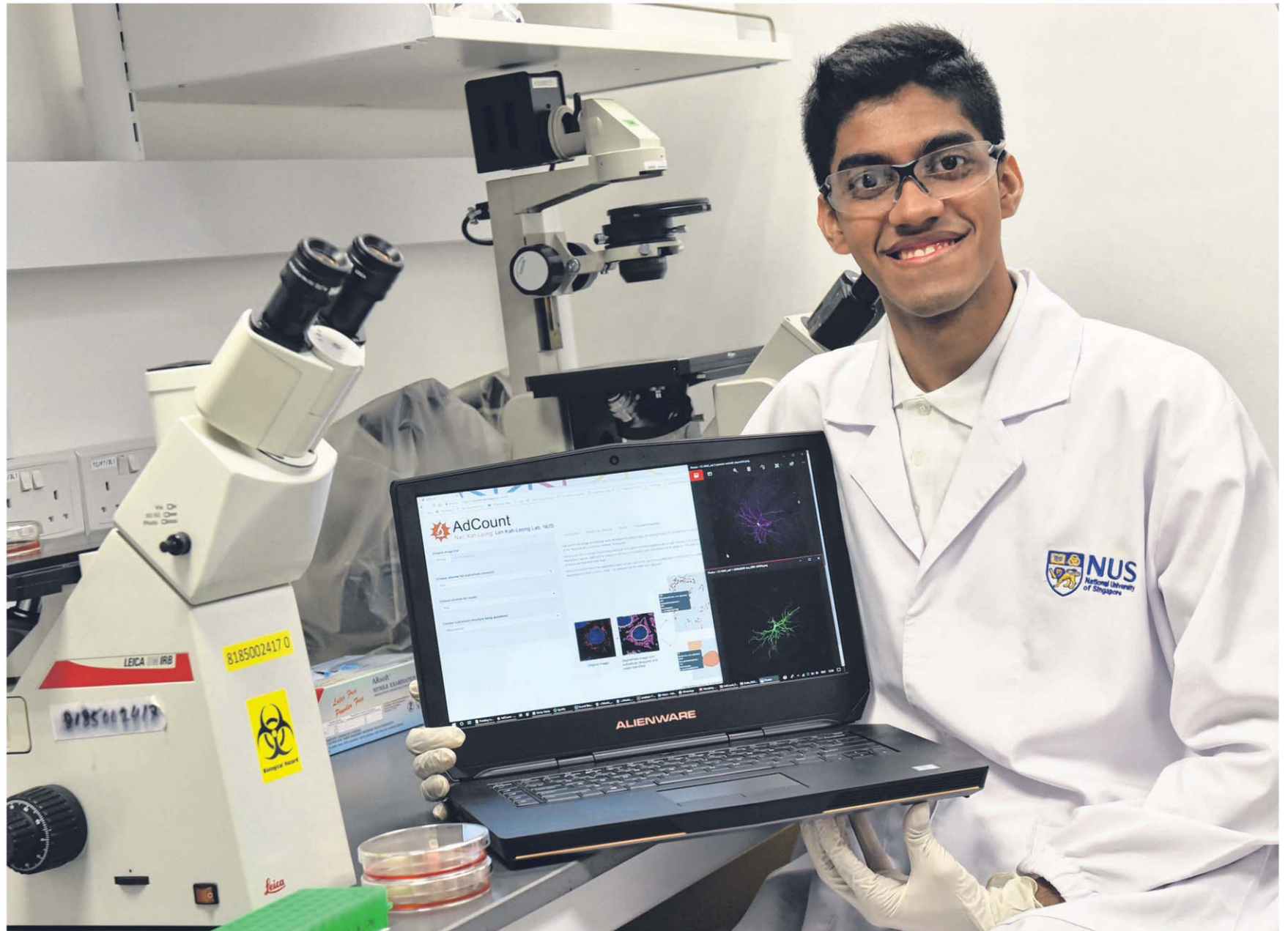
After 1½ years, Mr Nair unveiled AdCount. It could detect the shape, size and quantity of the cells' mitochondria, among other characteristics.

It was free and as accurate as much of existing software but, unlike that technology, which still needed the guiding hand of a human while analysing the image, AdCount was completely automated.

Also, it was fast. Very fast. Where manual analysis would take many hours, Mr Nair's program took less than four seconds.

AdCount can detect many things besides mitochondria and, according to Prof Lim, has positive implications for Parkinson's disease research around the world.

Prof Lim said Mr Nair's software can measure how fat droplets within cells change in people suffering from Parkinson's. Scientists still do not know the exact nature of the link between fat and the disease, except that it exists.

"Prior to Adi's software, there were no good methods to quantify the number and size of fat droplets accurately," Prof Lim said, adding that Mr Nair's technology provides "a significantly improved method to measure the changing landscape of fat droplets in cells" affected by Parkinson's.

After showing AdCount's capabilities at an international neuroscience conference in India in December 2016, Mr Nair received feedback from scientists who wanted to use his software to create three-dimensional images.

He flew to Sweden for an exchange programme a week after the conference, where he conducted research in a laboratory of the Karolinska Institute, the university that awards the Nobel Prize in physiology or medicine.

The lab was studying ways to automatically create three-dimensional images of neurons, cells that are the basic building blocks of the nervous system, typified by their many branches.

And the scientists there wanted Mr Nair to use the skills that went into making AdCount to help them. By March last year, he had created AdReconstructor.

He said: "Before, you would have a hundred images of a neuron, and on your computer you would navigate with your mouse and click on a thousand points per branch in the neuron...

"We call that manual neuron tracing, and we still have grad students who do this on a daily basis, taking four or five hours to map out a single neuron – it's insane."

It takes AdReconstructor around 30 minutes to complete the same task at the highest resolution. Just like AdCount, the software is free. It is now being used in Australia, Finland, Singapore and Sweden.

Through AdReconstructor, Mr Nair helped to discover the existence of a new type of neuron in the brain, and the findings have been submitted to a scientific journal.

He said that there will always be free versions of his software. "The two programs are our small contributions to the neuroscience community... Keeping them free means reaching as many researchers and creating as big an impact as we can."

Now he is working in the bioimaging consortium at the Agency for Science, Technology and Research (A*Star) for a year before he pursues his PhD at the California Institute of Technology with a scholarship from the statutory board.

And even though he lives alone in Singapore, he sees his future here, saying that he wants to contribute to the community and inspire students, much like his mentors did for him.

There is also a strong personal motivation behind his research. In his third year at NUS, his grandmother back in India was diagnosed with Alzheimer's disease, and she died in a few months.

"I spent the entire summer after that at a Parkinson's clinic where I would interact with those with the disease. When you talk to these patients about your work, you fill them with hope because they see there are people working on this disease."

He added: "It's quite uplifting to know that your work will have an impact not just in the future but in the present, because you're giving people hope now."

Ultimately, he hopes to use his programming knowledge to help map out the "programming code" that makes up the human brain.

"The idea is that there is some sort of computer code in the brain that people haven't figured out yet. I want to at least figure out a small part of the code, like emotions or thought, so that we can begin to treat things like schizophrenia, which is currently very opaque."

And those who know him do not doubt that he will achieve much.

A*Star's Professor George Augustine, who Mr Nair worked with as a student, said: "His intelligence is off the charts and he has a knack for improving everything that he touches."

Prof Augustine, a neuroscientist who is also based at Nanyang Technological University's Lee Kong Chian School of Medicine, said: "In my extensive experience in the neuroscience field, the best predictor of success is passion for this type of research and Adi has more of this than any young person I have met."

Prof Lim said: "I only have superlatives to describe Adi. He is by far the best student I have hosted in my laboratory. His talent reaches the sky but his feet are firmly grounded.

"I am confident that what we have seen in Adi thus far is just a tip of the iceberg. It is a mere glimpse of the greatness that he would undoubtedly achieve in the future."

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National University of Singapore life sciences graduate Aditya Nair developed AdCount – a data analytical software which could massively aid Parkinson's disease research that is now being used by scientists around the world – two years ago, after being challenged by his university mentor to come up with a program to solve a problem. ST PHOTO: LEE JIA WEN

BRAINY CHALLENGE

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> **MR ADITYA NAIR**