Partner Institution:

CSIRO

70,000	**291**	**30**
core hours allocated	patients tested in clinical trials	GP clinics providing service

Project Leaders: *Professor Yogesan Kanagasingam and Professor Xiao* | **Systems**: *Zeus*
Areas of science: *Medical data analytics* | **Applications used**: *Tensorflow, Keras, optical coherence tomography*

AI Learning Helps Save Sight

Diabetic retinopathy is a condition where blood vessels in the back of the eye begin to leak or bleed. As the condition worsens, the leakage damages a patient's sight. In the long term, untreated diabetic retinopathy can lead to irreversible blindness. It is the world's leading cause of vision loss, with anyone with diabetes at risk.

Diabetes affects over 1.2 million Australians, and one third show signs of diabetic retinopathy. If it is detected early it can be treated, and diabetics are encouraged to take yearly eye exams.

Professor Yogesan Kanagasingam is Director of the CSIRO Australian e-Health Research Centre in WA. With Pawsey Supercomputing Centre's Zeus system, Professor Kanagasingam, and his team, including Ms Maryam Mehdizadeh and Professor Xiao, developed an Artificial Intelligence (AI) program called Dr Grader to allow general practitioners (GPs) and primary care providers to detect diabetic retinopathy simply by taking a photo of a patient's eye.

> " *Soon, this AI developed with Pawsey supercomputers may become a regular piece of equipment in every GP clinic, helping thousands of diabetes patients keep their sight.*

Professor Yogesan Kanagasingam & Professor Xiao
Project Leaders

THE CHALLENGE

Diabetic retinopathy cannot be diagnosed by a GP, but requires the expertise and equipment of an ophthalmologist. Professor Kanagasingam says many patients delay ophthalmologist visits due to long waiting lists and high cost, and put off these checks until their vision begins to deteriorate. Unfortunately, at this stage the diabetic retinopathy is already advanced and treatment becomes much more difficult.

To address this problem, Professor Kanagasingam and his team developed Dr Grader as a simpler way to detect diabetic retinopathy, allowing the check to be performed by GPs.

"There are a limited number of ophthalmologists, and they need to screen a large number of patients. But diabetics usually have to go to a GP as a first point of contact, so using AI there can make a big difference," says Professor Kanagasingam.

GPs will be able to take an image of a patient's eye, then Dr Grader can analyse the image to detect any signs of diabetic retinopathy. Having this detection system with GPs will decrease the load on ophthalmologists and encourage patients to get their eyes tested more regularly.

THE SOLUTION

Professor Kanagasingam and his team trained Dr Grader's AI using deep learning techniques, a form of machine learning for computer programs inspired by the human brain. The program is 'trained' to recognise diabetic retinopathy symptoms by giving it a large image data set of affected eyes to learn from.

Training the program requires a large amount of processing power, which is why Professor Kanagasingam needed to work with Pawsey Supercomputing Centre. "We can use the Pawsey systems to run these advanced learning techniques in a very short time. Timing is very important to process the images as each image is roughly 15-20 megabytes."

As well as recognising diabetic retinopathy, Dr Grader needs to be easy for busy GPs to use. Professor Kanagasingam has designed it to be fully integrated with GP medical databases, and include real-time image quality checking.

"We can't ask the patient to come back again if the image quality isn't high enough for Dr Grader, so we've included an AI quality control system which immediately checks the image and lets screeners know if they have to retake the photo. Now GPs can push the button, take the photo and everything is recorded, read and graded automatically."

THE OUTCOME

Dr Grader has already run a successful clinical trial at GP Superclinic @ Midland Railway Workshops in 2017 and 2018. There, Dr Grader successfully tested 291 patients for diabetic retinopathy. It is now being rolled out to 30 more GP clinics in Singapore and there are plans to implement Dr Grader at major hospitals in Western Australia.

"A major hospital may have 2,000–3,000 diabetes patients they scan annually. Ninety per cent of these patients are normal and test negatively with an ophthalmologist. With Dr Grader we can reduce strain on hospital resources. We're looking at setting up a server to process these hospital images now," says Professor Kanagasingam.

The Dr Grader technology has also been licenced by ophthalmology diagnostic imaging company, TeleMedC and is being rolled out in Singapore, Malaysia and South Asia. Its use is currently limited in Australia, but the technology is becoming cheaper and more portable. Soon, this AI developed with Pawsey supercomputers may become a regular piece of equipment in every GP clinic, helping thousands of diabetes patients keep their sight.