KEYSIGHT TECHNOLOGIES

IoT INNOVATION CHALLENGE

2019 SMART LAND FINALIST

CAIRNet

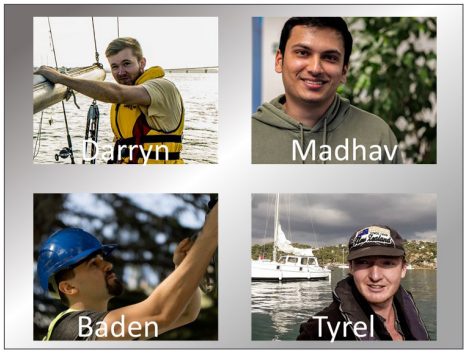
CAIRNet Climate Air Information Real-Time Network

Students get behind New Zealand's climate change bill with plans for a novel sensor network to monitor air quality

Globally, air pollution is one of the biggest environmental risks to health, with only one in 10 people living in a city that complies with the World Health Organization (WHO) guidelines for air quality. Unfortunately, poor air quality leads to about 8.8 million premature deaths around the world each year.

In May 2019, New Zealand's prime minister Jacinda Ardern announced a sweeping climate change bill that aims to make the nation mostly carbon neutral by 2050, requiring all greenhouse gases except methane from animals to be reduced to net zero. This inspired a group of engineering graduate students at Massey University in New Zealand—Tyrel Glass, Baden Parr, Darryn Wells and Madhav Kruthiventy—to think about ways they can contribute to this goal.

They developed the concept for CAIRNet (Climate Air Information Real-time Network) as a novel way to monitor air quality. "An earlier university project had highlighted the air pollution issues facing developing nations, and we began to wonder what the implications were for us here in New Zealand," Glass said. The students said they were startled to discover that despite having some of the cleanest air in the world, they still suffer health effects from the existing pollution. "We realized this was an area that was worth pursuing, and any progress made through our research would be amplified when applied to the global stage."



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Darryn Wells, Madhav Kruthiventy, Baden Parr, Tyrel Glass, of Massey University in New Zealand are the Asia-Pacific/Greater China finalist for the Smart Land challenge for their entry, CAIRNet (Climate Air Information Real-time Network).

CAIRNet was chosen as the Smart Land finalist for the Asia-Pacific/Greater China region in the Keysight IoT Innovation Challenge.

The students believed that if people could observe the quality of air that they and their loved ones were breathing in, they would be motivated to make a difference. “The issue of air pollution would evolve from a city problem into a street one,” Glass said. “They could minimize the health risks of air pollution by avoiding outdoor activities in polluted areas, reduce the usage of pollutant-creating vehicles and switch to cleaner, less pollutive heating methods.”

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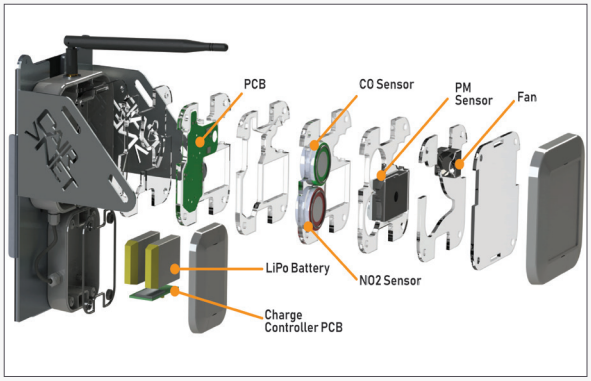
CAIRNet is solar-powered, weather-resistant and designed to be easily deployed at a large number of locations. The network utilizes cost-effective sensors to measure carbon monoxide and nitrogen dioxide, particulate matters, temperature and humidity. Each sensor is capable of long-range and low-power communication over IoT and short-range high data rate communication over Wi-Fi. The data collected from the sensor nodes is stored in a cloud-based server and is then displayed on a web page for end users.



The team believes this would be a welcome change from current air quality monitoring stations that are expensive and as a result, are limited to a small number of locations. Furthermore, these stations provide a low-fidelity picture of the air quality in the city and pockets with high densities of pollutants are sometimes overlooked, Glass said.

The idea is that with clearer data, policymakers would be better informed about the impact of the city planning decisions on pollution. Data would help to answer questions like, should traffic lights be installed instead of roundabouts?

Are cycle lanes far enough away from highway lanes? What types of parks best reduce pollution?

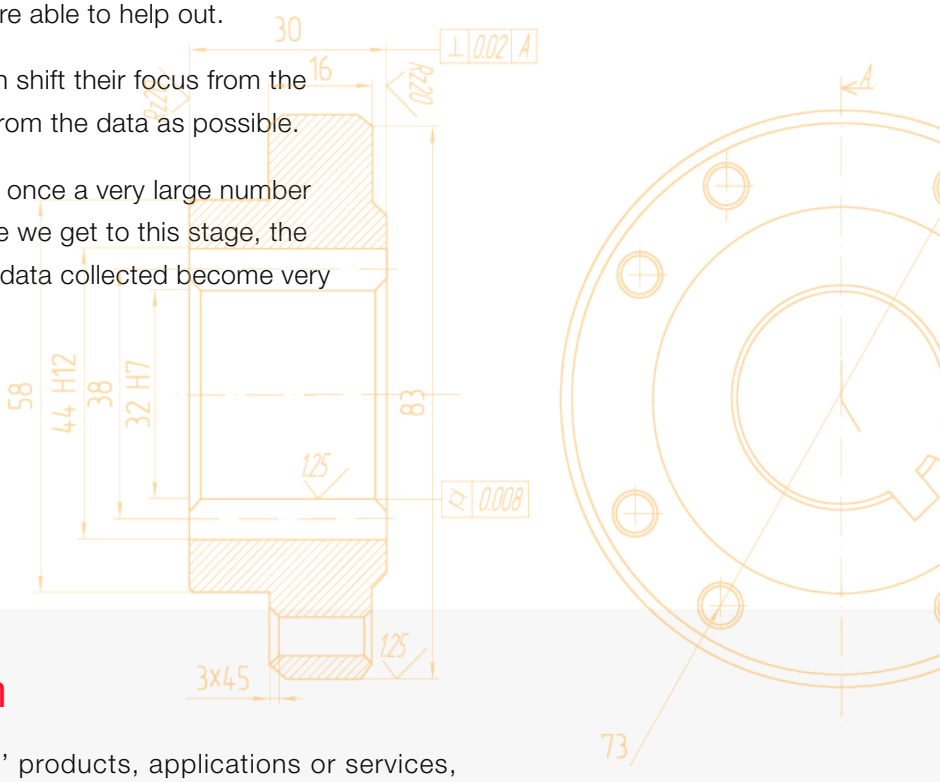
"Powerful predictive models would provide early warning alerts for dangerous pollution events, **allowing people to leave the area and pre-empting healthcare institutions for the possible influx of respiratory-related admissions** during such events," Glass said.

To date, the project—which was inspired and supported by Massey University's Dr. Fakhrul Alam—has impressed air quality scientists at New Zealand's National Institute of Water and Atmospheric Research (NIWA). "For the science, it was not long into the project before we realized the enormous complexity involved," Glass added. "Rather than bumble around in the dark trying to work at it ourselves, we decided to seek support from NIWA." This guidance was invaluable and reassured the team that the technical obstacles they were facing were solvable.

The team also faced the challenge of designing sensors that were capable of measuring a low concentration of pollutants typically found outdoors. Existing sensors weren't capable of detecting such a low concentration of pollutants. "This means we were operating at the very limit of these devices and needed to design some tricky electronics to operate the sensors," Glass said. Thankfully, electronic design experts at Massey University were able to help out.

The team hopes that five years from now, they can shift their focus from the hardware to extracting as many actional insights from the data as possible.

"The real impact of our idea would be observable once a very large number of CAIRNet units are operating," Glass said. "Once we get to this stage, the various possibilities of what can be done with the data collected become very exciting."



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