A low-cost solution to making "smart cities" even smarter…and safer

The Active Reactor Company has teamed up with leading tech innovators to develop a solar-powered sensor that measures anything from people movement to air pollution.

BY LEO D'ANGELO FISHER

An Australian company has placed itself at the forefront of "smart city" technology with a low-cost sensor device that measures and communicates asset utilisation and environmental conditions.

Melbourne-based The Active Reactor Company has brought to market the arcHUB solar-powered device which, when fixed to a pole or other structure, can measure light, noise levels, people traffic, asset usage, weather indicators and water levels.

The breakthrough application for arcHUB is the measurement of air quality in real time. The device is capable of measuring particle quantities and smoke effects (in the case of bushfires and structure fires) which enables users to monitor pollution levels and if necessary take precautions in the event of harmful exposure to unhealthy levels of pollution.

Active Reactor director Dr Brian Oldland says arcHUB devices can be used to "enhance decision making" by environmental agencies, councils, schools and local communities.

"Environmental and asset-utilisation measurement capabilities have been available previously but these are generally expensive and often require integration with communications and data-presentation systems," Dr Oldland says.

"arcHUB is designed to be low-cost, self-powering, easy to install and able to provide networking connectivity so that devices can be located in multiple locations to gather and disseminate the measured data in a user-friendly dashboard display and downloadable format."

arcHUB units can be GPS-enabled to enable easy positioning of assets thus maximising the benefits of a unit's portability.

The typical unit, which is half the size of a football, is self-powered by using solar cells, rechargeable batteries and battery management hardware. It is easily fixed to a pole or other structure using two straps.

The global "smart cities" movement has seen local governments leverage "intelligent infrastructure management" technology to better manage, co-ordinate and maintain public assets and to improve service delivery to residents.

Dr Oldland says that by utilising fully integrated air quality, carbon monoxide detection and weather measuring sensors arcHUB will advance the move to smarter cities by making sensor technology more affordable and accessible for a variety of applications. These include the measurement of:

- People-traffic movement to be used to better plan the maintenance and location of public assets such as park barbeques or to detect unauthorised activity.

- Light levels to detect under-performance of LED streetlights due to non-compliance with manufacturers' claims, LED failures or the need to clean the light. Daytime light levels can also be measured.

- Temperature and wind monitoring that indicates the local ambient temperature and wind strength in the vicinity of the arcHUB.

- Water levels in drains and water retention tanks to better protect residents and businesses against impending flooding.

arcHUB's on-board hardware and software supports narrow-band wireless communications mobile technology. Data is reported back to a central web service and can also be forwarded to a customer's web platform.

Subscription-based access is provided via a customer's mobile device, computer or programmatic means using an Applications Programming Interface (API). Data can be extracted from the web portal and put into specific internal systems or databases with no restrictions on data accessibility.

> # "arcHUB is designed to be low-cost, self-powering, easy to install and able to provide networking connectivity."
>
> **– Dr Brian Oldland,** *The Active Reactor Company*

PHOTO: *Drs Richard Dluzniak and Brian Oldland, Directors of The Active Reactor Company, and Mr Ray Keefe, Managing Director of tech partner Successful Endeavours.*

Active Reactor director Dr Richard Dluzniak says the arcHUB unit and peripherals are based on the latest sensor and cellular communications technologies that perform better, at a lower cost and with more efficient power requirements than has previously been possible.

Dr Dluzniak says the advent of a locally manufactured product with the flexibility to calibrate it to required applications has provided potential users with the ability to utilise arcHUB in diverse and innovative ways specific to their needs.

"We are not going to the market and saying 'this is how you should use our technology', the market is coming to us and saying 'this is what our needs are can you help?' and the answer is usually yes," Dr Dluzniak explains.

"When the Environment Protection Authority of Victoria came to us seeking a cost-effective way to monitor and communicate air-quality data in multiple locations in an easy to use format we were able to provide the platform upon which that could be achieved with appropriate sensors."

In the suburb of Brooklyn in Melbourne's inner west EPA Victoria turned to arcHUB in response to community concern about the levels of airborne dust associated with industry and other environmental factors. The EPA is using a series of distributed arcHUBs to monitor air-pollution levels to identify, manage and mitigate localised dust problems.

Another EPA-community partnership is the collaboration between the EPA, Active Reactor, the University of Melbourne's Lung Health Research Centre and St Joseph's Primary School in Hawthorn in Melbourne's east.

A member of the school community, Clare Walter, who is on the school's sustainability committee and whose daughter at the school has asthma, approached the EPA seeking advice on establishing "a modest air-quality monitoring program" at the school.

The result was the installation of three arcHUB particle monitoring sensors at St Joseph's to monitor airborne particle concentration and assess the levels of fine particle air pollution known as PM10 and PM2.5 at different locations within the school.

Assessing particle pollution levels in a school environment is important because young children are especially sensitive to elevated pollution levels.

Ms Walter says the program has three core aims: to minimise any potential adverse effects on children in the event that air quality is compromised; to raise awareness and drive good behaviour such as encouraging parents to turn off car engines when waiting out the front of the school; and to inform the school's sustainability education program.

A pharmacist by profession, Ms Walter is also a well-known public health advocate who works with academics, health professionals, government and community groups to translate air-pollution research into effective public health and environmental policy.

She believes the St Joseph's program provides a benchmark for other schools to follow.

"As a parent of a child with asthma it is reassuring for me that I can look at that data at any time and make decisions about my daughter's wellbeing. Teachers also have access to that data which means that while I am at work I know that my daughter is being taken care of," she says.

"I hope the St Joseph's program serves as an example for other schools and school communities. Ideally I would like all schools to take up this very simple and inexpensive measure to monitor air quality and ensure that students are safe at all times."

PHOTO: *Air quality measuring arcHUBs could be rapidly deployed at multiple locations around built environment fires and bushfires to enable better management of the health and safety of emergency workers and the local community.*

"**Keeping communities informed about what's going on in the environment, in a transparent way, is one of our most important roles.**"

– Gavin Fisher, EPA Victoria

EPA Victoria's Senior Applied Scientist in Air Emissions Management, Gavin Fisher, says the appeal of arcHUB is that it enables the authority to monitor the environment at a "much more reasonable cost" while also providing real-time access to environmental data that can be shared with local communities.

"The challenge with technology is how we can best utilise it to add value to the community of Victoria and improve lives. Keeping communities informed about what's going on in the environment, in a transparent way, is one of our most important roles," he says.

Mr Fisher says air-quality monitoring technology is "moving very, very rapidly" around the world and the EPA is abreast of the latest technologies in use internationally. He believes the locally developed arcHUB is at the cutting edge of environmental monitoring technology.

"We obviously look at what the overseas experience is with the latest in technology but Australia has moved faster in some areas of environmental monitoring than the United States," Mr Fisher says.

"Our aim is to ensure that Melbourne and Victoria are up with the latest technology and our experience is that we're smart enough in Australia to do a lot of it ourselves."

Active Reactor's Brian Oldland says because arcHUB sensors can be calibrated to measure air quality, sound and physical impact vibrations, temperature, wind speed and light-illumination the variety of applications for arcHUB is "boundless" as demonstrated by clients across Australia. These include:

- **Melbourne Urban Precinct Installation:** a multi-sensor network installed at the Community Learning and Education Centre precinct in Docklands. The arcHUB sensor network measures multiple aspects around the precinct, such as air quality, basketball court and table-tennis usage, phone charging, pedestrian movement; temperature and wind speed; and street light illumination levels. The Sensor Area Network uses the existing cellular network and does not require any external power supply or other network infrastructure. The readings are communicated to the City of Melbourne's nominated web services.

- **State trials:** the EPA of South Australia and the Department of Environment and Science in Queensland are trialling arcHUBs to monitor air quality in selected locations.

- **City of Melbourne:** the City is trialling arcHUB sensors to measure people movement in key locations. The generated data can be used to assist in planning for people-traffic requirements in urban locations.

PHOTO: *The arcHUB platform gathers and disseminates the measured data in a user-friendly dashboard display and downloadable format for further analysis.*

The arcHUB devices' ease of deployment and power self-reliance means they can be easily set up around emergency situations such as an industrial or bush fire at different distances and directions from the event to inform evacuation and other health advice strategies based on real-time data.

Dr Oldland stresses that it's not just government agencies that can utilise arcHUB sensors.

"Well organised citizen groups can use arcHUB devices to gather accurate and reliable data such as air quality or traffic movement. There is no restriction on who can use arcHUB and a unit cost of around $1000 for a sensor system means the technology is very accessible," he says.

Collaboration has been essential to identifying and refining potential "smart city" applications.

"Australia is a strong hub for innovation and forming long-term relationships with industry partners, such as The Active Reactor Company, is a critical part of the our business model."

*– **Mr Jason Meilhon,** Senior Business Development Manager in Australia for u-blox, SIX Swiss Exchange-listed positioning and wireless communication technologies company.*

A case in point is Active Reactor's participation in the Australian Integrated Multimodal Ecosystem (AIMES), a "transport test bed area" incorporating 100km of roads on the fringe of the Melbourne CBD. AIMES is a project of the University of Melbourne in conjunction with Cubic Transportation Systems, EPA Victoria and some 40 business and government partners.

Dr Behzad Rismanchi, a lecturer with Melbourne School of Engineering, describes AIMES as a "living urban laboratory" for the collection of data on "where and how we are moving" and the connectivity of all modes of transport.

"It will factor in developments that might influence mode of travel or time of departure, such as the addition of new public transport routes, the addition of discounted fares, the weather and road or public transport congestion or disruption," Dr Rismanchi says.

AIMES will also test highly integrated transport technology and its ability to deliver safer, cleaner and more sustainable urban transport outcomes.

PHOTO: *Smart cities leverage intelligent infrastructure management technology to better manage and maintain public assets and to improve public safety.*

"We wanted to make sure Melbourne enjoyed the benefits of adopting the new smart-city technologies appearing now," Dr Rismanchi says.

Up to 1000 environmental sensors will be installed over the next few years on roadsides and in selected cars, trucks and public transport vehicles. arcHUBs are being used to measure air quality in order to assess the localised impacts of different traffic-related strategies. Data is transmitted to investigators over the 4G network so that conditions can be tracked in real time.

Collaboration has also played a key role in developing and refining the arcHUB sensor technology.

SIX Swiss Exchange-listed positioning and wireless communication technologies company u-blox provides the cellular communication module that enables the delivery of arcHUB-to-server sensor data "within seconds, at the lowest power levels possible".

Brisbane-based senior business development manager for u-blox in Australia, Jason Meilhon, says Australia is a "strong hub for innovation" and forming long-term partnerships with industry partners is a critical part of the company's business model.

"It is important for us to participate in local projects not only to showcase the latest technologies but to help our customers become successful," he says.

"Smart cities have been an important focus for us and we see great potential in this market."

Active Reactor has also partnered with Melbourne electronics and embedded software design company Successful Endeavours. It was Successful Endeavours that identified arcHUB's potential as a "smart cities" device.

The result, says Successful Endeavours managing director Ray Keefe, is a product that supports councils, public utilities and government agencies by providing timely and cost-effective local sensing solutions for amenity, environment, utilisation, people counting and any other measurements they need to be able to assess the effectiveness of programs they run.

Mr Keefe says measurement of shock and vibration can be done more cost-effectively than ever before by using the latest solid state accelerometers (for measuring the acceleration of a moving or vibrating body) coupled with Digital Signal Processor-capable processors.

"Our focus is on developing complex electronics products for manufacture in Australia," Mr Keefe says.

"A lot of commercial opportunities go begging in Australia. While we are good at problem-solving, creative thinking and innovation Australian businesses often fall down when it comes to the commercialisation of that innovation because they are not very good at collaborating in order to realise market potential.

"Active Reactor understood the importance of partnering with our development team to create a new world-class product that has the potential to be a leader in key international markets."

Mr Keefe says the benefits of arcHUB's range of sensor options include lower cost to purchase, lower cost installation, lower cost data services and sensor accuracy at 70% of laboratory grade.

"I'm passionate about never missing an opportunity to manufacture a product in Australia," he says.

"With arcHUB we not only have a product that will be manufactured locally but we have a technology that can't be bought anywhere else in the world because it doesn't exist anywhere else in the world."

"I'm passionate about never missing an opportunity to manufacture a product in Australia,"

– Ray Keefe, Successful Endeavours

PHOTO: *A multi-device friendly platform means data can be accessed virtually anywhere.*
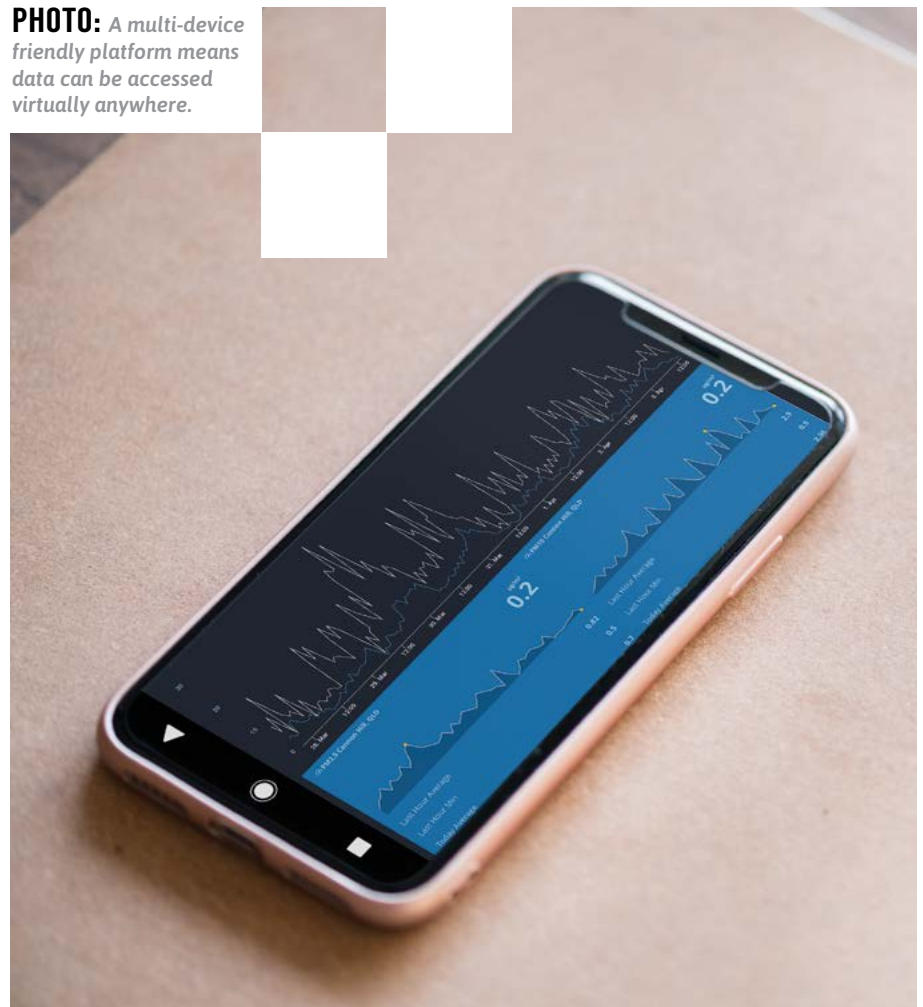
LEO D'ANGELO FISHER

is a Melbourne-based business writer. He was commissioned by The Active Reactor Company to write this article which can be reproduced in whole or part by interested parties.