CRC for
Water Sensitive Cities

Program C: Future Technologies | Project C5.1 | Project duration: July 2012 – December 2016

Intelligent urban water systems

Overview

Intelligent urban water systems use state-of-the-art sensors, telemetry as well as decision-making and optimisation software for various components of an urban water system. These elements are applied all the way from the catchment via water treatment facilities to households. This means sensor information can be continuously monitored and analysed, for example, smart water meter readings being reported in real-time. This results in detailed information such as water consumption by hour, day or season, total volumes consumed, or minimum hourly flow per day. An extensive computerised data-mining process can reveal some unexpected or interesting patterns of consumption such as periods of peak use, periods of continuous supply of water and possible leak locations in networks. This knowledge, in turn, can greatly enhance decision-making around urban water management.

The project aims to develop innovative analysis techniques for smart water data to optimise the efficiency and safety of urban water systems and to learn more about water consumption behaviours of customers. The project will focus on smart household water meters and water pumping in pipe delivery systems that manage water from alternative sources.

Key insights into water use behaviours through smart water meter data-mining

The project analysed information from smart meters, which were installed in households and businesses in Kalgoorlie-Boulder by Western Australia's Water Corporation utility to provide a clearer and more detailed picture of water use. Kalgoorlie-Boulder, Australia's largest outback city, experiences little rain throughout the year and completely relies on drinking-quality water piped 600 kilometres from Perth. The analysis made some interesting discoveries:

- Continuous flow patterns, for instance, where at least two litres of water are metered for every hour in a 24-hour period, may be evidence of leakage in appliances or pipes. In Kalgoorlie, 84% of households showed at least one day of continuous flow in the study period, accounting for 10% of total water use among the sampled households.
- The Water Corporation was able to apply this information derived from the data-mining exercise and followed up affected households to determine the cause of the water loss. Data from the smart meters helped show the cost of leaks relative to normal water consumption and provided a convincing argument for fixing leaks where they existed. Over 90% of customers affected took appropriate action within thirty days. Properties are now monitored continuously, enabling the detection of small leaks before water loss becomes costly.
- Data from smart meters also revealed householders who, over time, had lapsed into watering their gardens outside the days designated by the Western Australian statewide water efficiency regulations. Armed with this evidence, the Water Corporation was able to monitor customers' use better and help change the behaviour of those non-compliant households.

The figure below shows a summary of programmed patterns of a city's population. Each bubble represents one household water meter. The size of a bubble represents the number of day-hour combinations for which a programmed pattern was observed, ranging from 1 to 25 programmed hours per week (168 hours) for active meters. The green colour represents the number of days per week on which regular patterns were detected. The orange and red bubbles show the lapse into illegal watering on non-designated days.

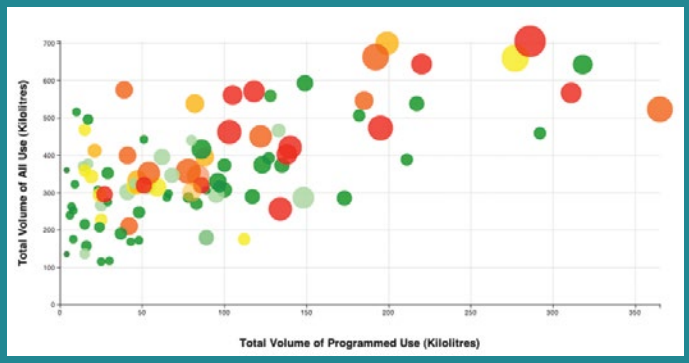

Figure 1. Population summary of programmed patterns (© The University of Western Australia).

An Australian Government Initiative

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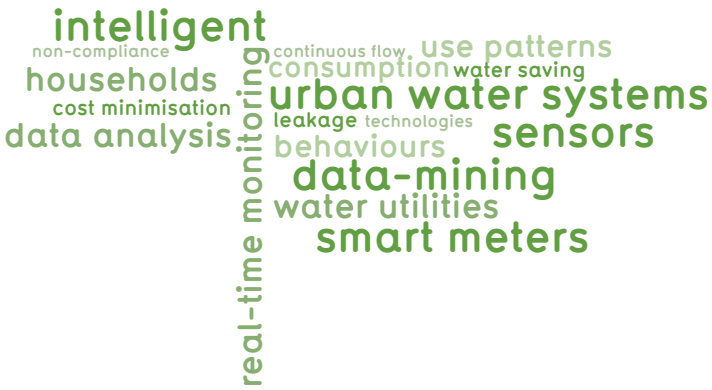
Key outcomes

The project will deliver new techniques for automated large-scale, real-time data collection and analysis. One of the techniques developed is the Water Use Signature Patterns model. It combines cyclic daily and seasonal patterns of water use with peaks in consumption to arrive at an in-depth understanding of consumption over time. This will generate a better understanding of water consumption behaviours and patterns and enhance water utilities' decision-making on water supply, control and management. The information, fed back to customers, will contribute to long-term behavioural and lifestyle changes in terms of using water more wisely.



Project design

The project will develop and evaluate a number of real-time analysis techniques and software tools to support effective decision-making for smart urban water systems. Western Australia's Water Corporation is providing data for this project from their ongoing smart meter trials of more than 13,000 residential, commercial and industrial properties in Kalgoorlie-Boulder and 500 customers in Karratha. Another project component looks into optimising pumping systems applied across a range of alternative types of water delivery systems in terms of minimising operational cost, energy use and green house gas emissions.

A case study with the Orange City Council, New South Wales aims to develop optimal operating rules for pumping with multiple alternative water sources. The goals are to minimise cost, spill from the main reservoir and environmental impacts while maximising water quality. A third component brings together all project outcomes to deliver practical solutions for the design of sensing and analysis systems for urban water, aiming to minimise their cost and complexity.

Outlook

Smart meter data-mining as a tool for water management has a promising future, in particular for an envisioned roll-out across Australia. The project anticipates even greater potential for additional significant water savings in the future as information yielded by the data leads to better targeted management responses.

Beyond the obvious benefits of conserving water, other environmental and social benefits include lower energy consumption with lower greenhouse gas emissions from pumping water into the region, and continued availability of water for recreational use. Additional benefits for the water utilities are cost savings in infrastructure augmentation, operation and maintenance, and the ability to adjust their internal processes to consumption patterns such as peak flows.

About the Cooperative Research Centre for Water Sensitive Cities

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) brings together interdisciplinary research expertise and thought-leadership from Australia and the world to address current urban water management challenges facing our cities and regions. In collaboration with over 80 research, government and industry partners, it develops and synthesises knowledge into powerful tools and influences key players aiming to achieve sustainable, resilient and liveable water sensitive cities.

Further information

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