Mitchell has developed a way of identifying water leaks in farm reticulation systems far earlier than in the past.

Taking tech to the trough

Long hours spent trying to find leaks in the water system inspired Mitchell Coleman to find a better way to identify problems quickly. **Jackie Harrigan** took a look at this trial system.

Growing up on a dairy farm gave Mitchell Coleman a great understanding of how frustrating random and elusive water leaks are to find on a farm with thirsty cows and old, or unrecorded, piping and pumping infrastructure.

The Manawatu 21-year-old student chose to develop a fault detection system for farm water flow as a final year project during his four-year Massey mechatronics degree and the concept is about to be prototyped and commercialised by Palmerston North fuel, milk and water monitoring company Levno.

"For my individual research project I started to think about what problems farmers have that I could help out with," Mitchell said.

Relating that to his childhood, he remembered his parents Debbie and Darryl Coleman trying to find water leaks on the farm. If a cow had damaged a trough, no one knew until the water had leaked out all night, draining the tank, tripping the pump into constant use and wasting expensive minerals or bloat oil that had been added to the water.

"It used to be a process of elimination – running around turning off taps, searching for puddles and trying to identify where the leak occurred."

"It struck me as not a very smart way of finding leaks."

The question Mitchell asked himself was whether he could teach a computer to identify when the system sprung a water leak.

Mitchell quotes a DairyNZ statistic of 26% of all water used on a farm being lost to leakage, and when that is factored with loss of minerals and bloat oil and pumping expenses, innocuous water leaks become very expensive and compromise cow health.

Mitchell investigated existing water monitoring systems but found they mainly look for maximum flow where it exceeds a defined threshold and are usually aimed at monitoring water usage for irrigation resource consent compliance. Triggering an alert when the threshold is breached could be because the pump is tapped out at a busy time of day, Mitchell found, not because of a leak.

Some products also monitor tank levels, he says, but once the tank falls below a safe level and alerts the farmers, it is often too late for the stock drinking supply to be safe. He thought the first improvement could be looking at the consistent overnight consumption, identifying slower leaks which may be hidden during the daytime demand.

No current system on the market can intelligently analyse water usage over time and use it to identify faults in the system, he said.

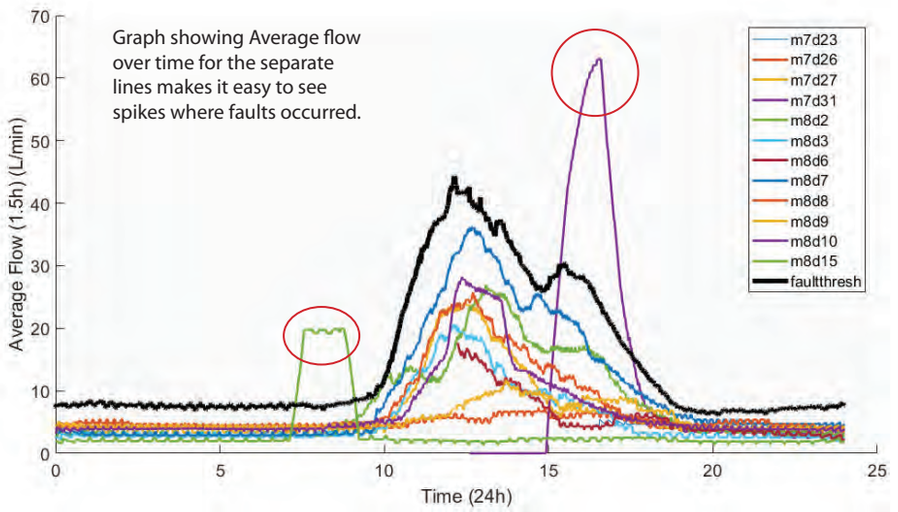
To prove the concept he installed flowmeter sensors across all the different waterlines across his parents' Kimbolton dairy farm, where Debbie and Darryl Coleman farm a dairy platform milking 550 cows made of four amalgamated blocks, with 200 water troughs, 21km of water lines and just six taps for turning off parts of the farm.

"The only way to find a leak here is by isolating 1/6th of the farm and going out to look – it's very difficult and frustrating," Mitchell said.

"And with 550 cows drinking up to 70 litres each per day, a trough can be drained in an hour if a leak is affecting the recharging time."

Mitchell says the whole point of the research was to understand if a computer could analyse the water consumption on a farm and identify the presence of a fault before it caused an issue for the farmer. The farm had a consistent overnight flow but variable flow during the day, so he had to teach the computer to figure out what was normal before expecting it to recognise abnormal flows that could be a leak.

Mitchell has always been a keen problem-solver and was drawn to mechatronics – a mixture of mechanics, electronics and computer programming.




Engineering and agriculture is where Mitchell sees his future.

The flowmeters he installed in mid-July collected data over winter through calving (which finished in late September) when two herds were milked twice daily. This provided an ideal scenario for data collection because both winter and summer consumption (and the transition over calving) were recorded from mid-July to mid-October. The pulse data from the sensors is processed into an average flow rate by a microcontroller running custom firmware, then sent to a PC in the farm dairy office. Mitchell wrote software to convert the 250,000 data points he collected into basic graphs, presenting a curve of daily usage once it had been smoothed to account for the cycling nature of the pump.

The theory was that faults in the water system (damaged ballcock, split pipe, faulty fitting or a tap left on) will affect this consistent curve, which are clearly shown on the graph and therefore should be able to be detected automatically.

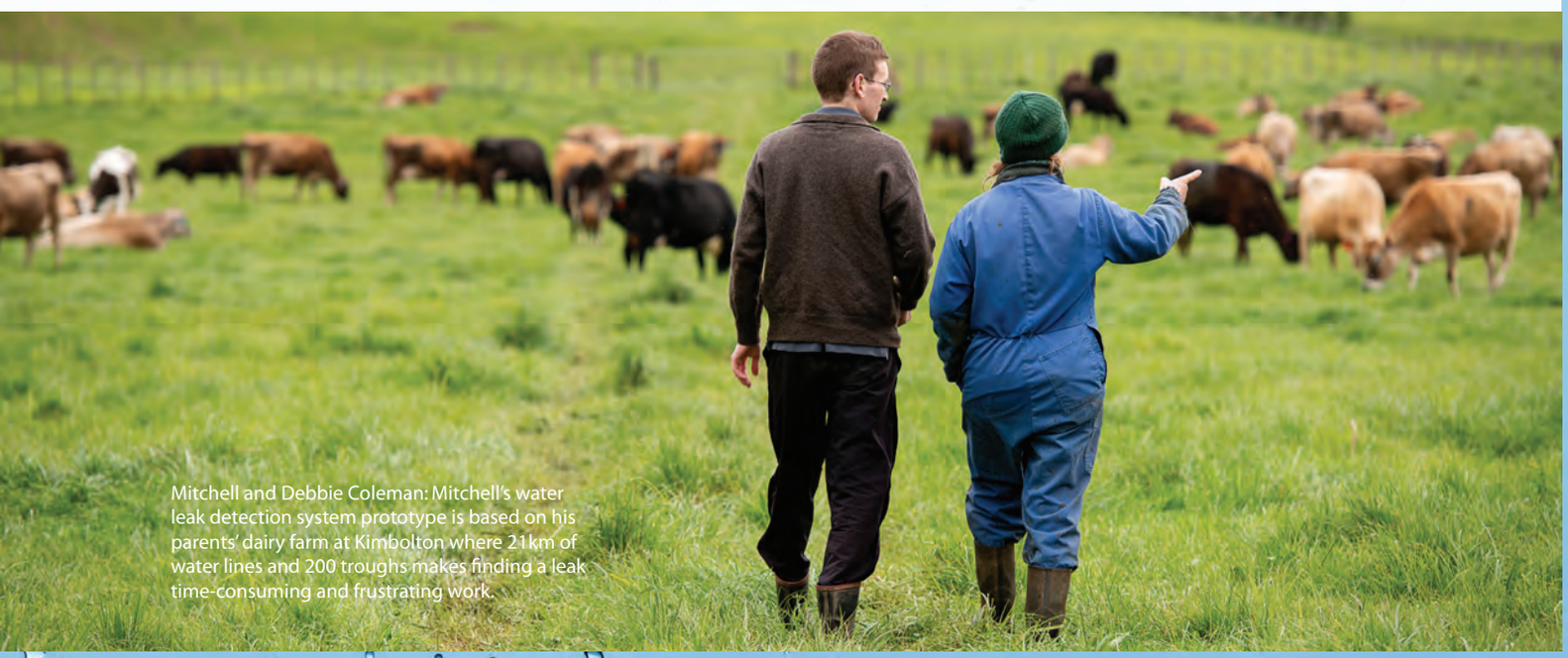
Two faults occurred during the period (red circles marked on the graph). In the first a trencher was driven through a main line, causing the pump to switch on, causing a spike. Later a calf stepped on a 20mm alkathene joiner causing a slower leak, which would be totally undetected by any of the existing limit-based fault detection systems on the market, Mitchell noted. However, they are immediately obvious as being abnormal on the flowmeter graph when compared to the surrounding days. Four later faults were also picked up quickly and successfully fixed.

Mitchell's next step was to develop an algorithm to track usage and to create dynamic trip thresholds as the season progresses. His algorithm is able to automatically generate a model from the latest data added, tracking seasonal changes.

Having proof of concept, Mitchell is keen to add in parameters like temperature and rainfall and work on incorporating automatic alerts for the farmer. Once he finishes his Massey degree he starts working at Levno in Palmerston North where, among other things, he will be working on a prototype and taking the water fault detection technology to commercialisation, improving Levno's existing water monitoring offering and joining their suite of other milk and fuel monitoring products.

"It combines engineering and where I have come from, my interests and what I love to do at the weekend," he said.

"It's exciting. Once we get this technology going, chasing slow leaks or waking up to empty water supply tanks should be a thing of the past."


Mitchell and Debbie Coleman: Mitchell's water leak detection system prototype is based on his parents' dairy farm at Kimbolton where 21km of water lines and 200 troughs makes finding a leak time-consuming and frustrating work.