Project fact sheet

Water infrastructure critical component anomaly detection and health prediction prototype

Key points

- The project focuses on understanding and mitigating failures in gravity-fed irrigation systems within the Murray–Darling Basin.
- New tools are being developed to predict and diagnose failures in key components, such as water level sensors and battery systems.
- These advancements aim to enhance water delivery reliability, reduce operational costs, and improve data quality.
- Workshops and collaborations with industry partners ensure practical application and alignment with real-world needs.

The challenge

Efficient water management is critical in the Murray–Darling Basin, where two-thirds of Australia's irrigation water is used.

Gravity-fed irrigation systems, integral to this region, are being modernised with automated control supported by solar-powered instruments and measurement devices. These components improve water delivery precision and system efficiency but require proactive management of failures, including sensor malfunctions, battery degradation, and communication issues.

Failures in these components can:

- lead to unmetered or lost water
- cause delays in water delivery to end-users
- increase maintenance costs and operational inefficiencies.

Additionally, failures may cause data quality issues resulting in challenges like false alarms.

The opportunity

The digital transformation of water infrastructure is revolutionising irrigation practices.

Investments in modernising the Murray–Darling Basin's irrigation networks have introduced advanced monitoring systems capable of real-time data collection.

Harnessing this data offers opportunities to:

1. detect and diagnose imminent failures before they disrupt operations
2. develop predictive maintenance protocols to extend the lifespan of critical components
3. enhance decision-making processes through better integration of data science tools into existing IT systems.

These advancements promise not only improved operational reliability but also reduced costs and greater environmental sustainability.

Our research

The project employs a Failure Mode and Effects Analysis (FMEA) to systematically investigate potential failure modes of critical components and their impacts. Key

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activities include:

1. **Understanding failures:**

- Examining how individual components—like water level sensors and battery systems—interact within the larger irrigation network
- Identifying common failure patterns and their root causes
- Leveraging historical and real-time data to inform failure predictions.

2. **Developing diagnostic tools:**

- Creating prototype tools using classical methods and advanced techniques, such as Bayesian networks
- Designing anomaly detection algorithms to minimise false positives and ensure timely fault detection

3. **Engaging stakeholders:**

- Conducting workshops with industry partners, researchers, and technical experts to validate findings and refine tool designs
- Exploring pathways for integrating these tools into operational workflows.

Outcomes

Several promising outcomes have emerged from the project:

- **Enhanced fault detection:** Prototype tools have demonstrated improved accuracy in identifying and diagnosing faults, reducing false alarms.
- **Cost savings:** Proactive maintenance strategies lower repair costs and extend the operational life of critical components.
- **Improved data quality:** Enhanced hydrometric data supports broader initiatives, such as leak detection and seepage estimation.
- **Capacity building:** Workshops and trials have fostered a culture of innovation, equipping organisations with the skills and infrastructure needed for digital transformation.

Next steps

Next steps include tool refinement through field testing and expanding diagnostic capabilities; workforce adaptation via training and workflows; collaboration with partner organisation to integrate tools into existing systems, and exploring opportunities to scale solutions across the basin.

One Basin CRC

Since our inception in mid-2022, the **One Basin Cooperative Research Centre** has brought together 85 partners across the Murray–Darling Basin.

Our purpose is to work together to grow value from water in a changing world.

From Queensland to South Australia, we are finding practical solutions to complex challenges, training the next generation of scientists, and nurturing regional communities.

Our collective goal is a productive, resilient and sustainable Murray–Darling Basin.

Key personnel

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