

SOLUTION BRIEF



RED DOT ANALYTICS

Red Dot Analytics Pte. Ltd. (RDA) in collaboration with NTU Singapore, develops DCWiz, an industrial AI platform that digitalizes, optimizes and automates datacenter management and operations for business continuity and energy efficiency

This industrial AI platform system represents a "zero to one breakthrough in the application of AI for more stable and efficient data centre management

CHALLENGE

Electricity usage of data centres has skyrocketed in recent years, fueled by the increasing demand for this mission-critical CT infrastructure. There has been rising concern how to sustain this rapid growth without compromising the carbon footprint. At the same time, the complexity of data centre system management has increased exponentially, while the economic losses brought about by unplanned data centre outage (UDO) have grown in severity over the years. Against this backdrop, recent progress in AI technology has provided an unprecedented opportunity for data centres to enhance its energy efficiency and optimize its system management. Whilst the concept of using AI to improve the control policy of IT systems and facilities, as well as in automating system management is not new, data centres face two key challenges in implementing AI-based approaches:

- **Data Scarcity**

In order to develop an accurate model, all AI algorithms need to be trained by substantial data. In the context of physical infrastructures like data centres however, the collection from and access to large numbers of IoT sensors remains challenging due to high cost (e.g. costly sensors and meters), the long time period involved (e.g. peak/off-peak and seasonal attributes), as well as concerns over compliance and security (e.g. emergency faults and anomalies).

- **Risk averse Mindset**

Due to historical reasons (e.g. limited data and safety compliance), the management of data centres today still depend to a large extent on the decisions of human experts. This has rendered the data centre industry with a risk-averse mindset that hinders the adoption of AI technology.

INDUSTRY

Data Centres

SOLUTION

DCWiz couples an industry-grade digital twin with AI to create an intuitive yet high accuracy platform for data centre operators to digitalize, optimize and automate data centre operations without compromising on the safety standards required in this mission-critical infrastructure.

BENEFITS

- OPEX cost reduction
- Uptime improvement
- Human error reduction
- User-friendly interface

PARTNER

Alibaba Group



To tackle these challenges, a team at NTU and RDA, led by Professor Wen Yonggang from the School of Computer Science and Engineering has developed an integrated industrial AI solution combining an industry-grade digital twin and AIoT to optimize and automate data centre management and operations.

- **Industry-grade Digital Twin**

The industry-grade digital twin is able to achieve data quality within $\pm 0.5^{\circ}\text{C}$, providing an accurate yet intuitive 3D simulation platform that covers the layout, thermal dynamics, and airflow directions of the data centre. This allows human experts to better grasp the state information of the system, quickly pinpoint hot spots and anomalies as well as ascertain how any change introduced can affect the energy efficiency as well as safety of the data centre.

More than that, the high-fidelity digital twin is able to generate massive amounts of synthesized data with high quality and diversity (including “black swan” events such as emergencies and anomalies, peak/off-peak loads, and seasonal dynamics) within a relatively short time period. These can be used to augment existing available datasets for AI algorithms to solve the aforementioned data bottleneck issue.

***DIGITAL TWIN** is a virtual replica of a real-world entity. It starts as a multi-scale, multiphysics simulation tool can be extended to include neural network approximation, and is thus valuable for lifecycle management of complex industrial systems.*

AIoT

In DCWiz, AI is combined with IoT to offer 3 tiers of intelligence to the system:

1. Descriptive

Through the collection and analysis of historical and online data, the internal behaviors of the system can be accurately modeled.

2. Prescriptive

Actions to improve system management and efficiency can be proposed and then safely verified and validated on the cyber-system before actual implementation of the optimized control policies

3. Predictive

System behaviors under hypothetical inputs can be predicted to anticipate anomalies/failures in the data centre.

During actual operation, the digital twin works synergistically with the AIoT component, allowing the AI-recommended actions to be first validated in cyberspace before actual physical deployment, to assure and alleviate the risk-averse mindset prevalent in the data centre industry.

BENEFITS

DCWiz's integrated sandbox approach offers data centre operators a new paradigm for infrastructure management. Compared with the traditional system management in data centres, which relies solely on human expert knowledge and limited sensor readings from the data centre infrastructure management (DCiM) system, DCWiz offers the following benefits:

- **High precision with easy-to-understand user interface**

With its auto-calibration algorithm, calibration of the DCWiz digital twin requires only a small number of physical sensor readings, yet DCWiz is able to achieve a greater degree of accuracy (at least $\pm 0.5^{\circ}\text{C}$) compared to other commercial simulation software that are used for the same purpose. The fine-grained state predictions offered by DCWiz is coupled to an intuitive 3D graphical visualization interface, enabling one to for example, determine the temperature at any point within the data centre room space. This feature enables operators to accurately grasp the current state of the data centre using a much smaller number of physical sensors, without violating safety compliance.

- **High safety and efficient what-if analysis**

DCWiz allows data centre operators to conduct what-if analysis safely and efficiently to validate the effects of changes to the data centre (e.g. tolerance tests for peak hours). For instance, in order to estimate the effects of a proposed change to a data centre, operators can simply input an instruction to DCWiz and execute the simulation to visualize the outcome. Unlike testing on a physical data centre, such testing on the cyber digital twin requires no prior preparation (e.g. system maintenance), needs no consideration on time factors (e.g. peak versus off-peak hours), and does not pose any threat to the physical system.

