

TECH OFFER

Immersive Dashboard for Sustainability



KEY INFORMATION

TECHNOLOGY CATEGORY:

Sustainability - Sustainable Living

Green Building - Sensor, Network, Building Control & Optimisation

Infocomm - Smart Cities

TECHNOLOGY READINESS LEVEL (TRL): **TRL6**

COUNTRY: **SINGAPORE**

ID NUMBER: **TO175450**

OVERVIEW

This technology leveraged multiple advanced components to deliver an immersive, data-driven BI (Business Intelligence) dashboard for smart building management.

3D visualization and integration formed the dashboard's intuitive interface, utilizing a photorealistic 3D-scanned building. Technologies such as laser scanning and photogrammetry were used to create the digital twin. This 3D model was then integrated with real-time IoT data using Building Information Modeling (BIM) principles, enabling visualization of sensor data directly within the digital replica of the building.

An **IoT sensor network and data acquisition** system played a crucial role, with various sensors deployed to monitor building performance, energy usage (including non-invasive water and power monitoring), and environmental conditions. These sensors

transmitted data wirelessly, using protocols such as MQTT and LoRaWAN to an IoT platform.

For **data processing and storage**, an edge IoT platform served as the backbone for collecting, processing, and managing large volumes of real-time sensor data. Built-in rule engines enabled data enrichment and automated alerting.

Finally, **immersive dashboard development** frameworks were pivotal in creating interactive user experience. Web-based 3D visualization libraries rendered the building model and integrated dynamic data overlays.

While BI tools such as Tableau or Power BI may have supported traditional dashboard components, custom immersive development provided a more intuitive 3D environment for navigation and data exploration.

TECHNOLOGY FEATURES & SPECIFICATIONS

The dashboard's technical architecture adopted a multi-layered approach. The data acquisition layer leveraged diverse IoT sensors (e.g., environmental sensors and smart meters) communicating via protocols such as Modbus and LoRaWAN, connected through industrial IoT gateways. For **non-invasive water and power measurements**, ultrasonic or electromagnetic flow sensors and current transducers were integrated to minimize installation disruption.

The **data processing and storage layer** utilized an edge-based IoT platform for secure data ingestion, real-time stream processing, and scalable storage.

The **visualization and interaction layer** was built on a web-based Unity framework to render a photo-realistic 3D building model. This enabled immersive navigation and direct interaction with virtual representations of sensor locations. Drill-down capabilities supported granular data exploration from floor-level summaries to individual sensor readings, ensuring a comprehensive, data-driven operational overview.

The technology provider seeks partnerships with real estate developers, facility management firms, and building technology providers focused on smart, sustainable infrastructure. Collaboration may also involve hotel chains, mall operators, and data centre owners aiming to enhance operational efficiency and ESG performance.

POTENTIAL APPLICATIONS

Real Estate & Facility Management

- **Precision Utility Management:** Real-time data from smart power and water meters enables precise consumption control. Facility managers can detect leaks or identify energy-intensive equipment instantly, reducing utility costs, an important factor in Singapore's dense urban environment.
- **Resource Efficiency & Compliance:** The dashboard supports Singapore's Green Mark certification and national water conservation initiatives by providing verifiable data on consumption reduction, efficiency performance, and improvement opportunities.
- **Predictive Maintenance:** Continuous monitoring of flow rates, pressure, and power quality allows early detection of potential plumbing or electrical issues, enabling proactive maintenance that minimizes costly outages.
- **Occupant Engagement:** Personalized dashboards within the immersive 3D model display each tenant's consumption, fostering awareness and encouraging sustainable behavior aligned with national conservation drives.

Commercial & Hospitality

- **Operational Efficiency & Cost Savings:** Hotels, shopping malls, and data centres can cut utility expenditures by identifying inefficiencies in real time, improving profitability and operational performance.
- **ESG Reporting & Branding:** Detailed utility data strengthens Environmental, Social, and Governance (ESG) reporting and highlights a reduced environmental footprint, enhancing brand reputation and appeal among sustainability-minded customers and investors.
- **Enhanced Guest Experience (Hospitality):** Optimised utility systems ensure stable comfort conditions, such as consistent air conditioning and water pressure, while supporting eco-friendly operations that resonate with modern travellers.

UNIQUE VALUE PROPOSITION

The technology lies in its unprecedented integration of photorealistic 3D building visualization with granular, real-time IoT data on environmental conditions, power, and water utilities. It specifically leverages non-invasive measurement techniques, all delivered through an immersive and highly interactive dashboard.

Unlike traditional BI dashboards that present data in flat, abstract formats, or existing BIM solutions that lack real-time sensor integration, this project provides an intuitive, spatial understanding of utility consumption. Stakeholders can virtually “walk through” a digital twin of their building to pinpoint locations of high-power draw or water leakage through visual data overlays.

A key differentiator is the emphasis on non-invasive measurement, which enables seamless retrofitting into existing buildings with minimal disruption, significantly reducing adoption barriers for facility managers seeking immediate, data-driven insights into their utility footprint within Singapore's dense built environment.

This immersive experience transforms abstract data into actionable intelligence, fostering a deeper understanding of building performance. It drives resource conservation, enables rapid anomaly detection, and empowers more effective, data-driven decision-making for sustainability and operational efficiency, directly supporting Singapore's Smart Nation and environmental objectives.