



Product Engineering & Digital Twin

Real-Time Multi-Line Robot Visualization & Predictive Diagnostics via Digital Twin

Client: A leading industrial robotics integrator and automation solution provider.



At a Glance

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Automated cells modernized (Welding, Robo Finish)

4-layer

Digital Twin & IoT platform architecture

4

Operational KPI dimensions improved (visibility, MTTR, analytics, maintenance)



The Client

The client is an industrial automation provider operating automated robotic assembly lines, including welding and finishing cells that combine multi-vendor industrial robots and PLC controllers.



The Business Challenge

The client needed a scalable digital platform to improve visibility and efficiency across its automated assembly operations. Teams lacked a centralised way to remotely monitor robotic production lines, while equipment downtime was extended by alarms that

provided little actionable diagnostic guidance. Performance metrics such as OEE, OLE, and cycle times were tracked through manual processes, limiting real-time insight. At the same time, rigid controller architectures made it difficult to integrate new PLCs and multi-vendor robotic systems, reducing operational flexibility.



Our Approach



We architected an end-to-end Digital Twin platform combining NVIDIA Isaac Sim 3D physics modeling with a lightweight web management dashboard:

- **Isaac Sim 3D Modeling:** Built high-fidelity 3D kinematic cell models compatible with diverse industrial robots.
- **Data Ingestion Engine:** Standardized Python-based REST API microservices for rapid payload validation and processing.
- **Hardware Controller Bridging:** Directly interfaced Fanuc R50iA (Ethernet/IP Soft PLC) and Mitsubishi PLCs (OPC UA Client).
- **Operational Dashboard UI:** Delivered live web views for shift KPIs, cycle-time trends, and configurable fault remedies.



Solution Overview

In business terms, the platform gives the client a single, real-time digital mirror of its physical production lines, so operators can see, diagnose, and act on line performance remotely instead of relying on localized, manual monitoring.



Solution Architecture & Technical Stack

The platform relies on a decoupled microservices architecture designed for sub-second synchronization between physical equipment and virtual models:

Architecture Layer	Technical Specifications & Integration Details
Simulation Engine	NVIDIA Isaac Sim with multi-robot kinematics support across automated lines.
Controller Connectivity	Fanuc R50iA via Ethernet/IP (Soft PLC); Mitsubishi PLC via OPC UA Client (ns=2;s=Address Space.Dev000.M103).
Data Ingestion API	Python REST API service handling real-time data validation, order tracking, and fault streaming.
Dashboard & Analytics	Chromium web application displaying real-time OEE/OLE, Quality Yield, cycle-time graphs, and preventive maintenance alerts.



Cell Implementation Highlights

Implementation focused on core automated production cells:

- **Welding Cell:** Complete 3D kinematic model; Fanuc R50iA Ethernet/IP and Mitsubishi OPC UA integrations active.
- **Robo Finish Cell:** Complete 3D kinematic model with Automatic Tool Change (ATC); Fanuc R50iA Soft PLC integration completed.
- **Operational Baseline:** Configured with 45s ideal cycle time target, 345 unit daily target, and Asia/Kolkata timezone baseline.



Business Outcomes & Results

Dimension	Before (Status Quo)	After (Digital Twin)	Business Impact
Remote Line Visibility	Localized physical monitoring	Live 3D Isaac Sim kinematic tracking	Enables global multi-line remote oversight.
Fault Resolution (MTTR)	Manual error diagnosis	Alarms linked to step-by-step remedies	Accelerates troubleshooting & lowers downtime.
Production Analytics	End-of-shift manual calculation	Real-time OEE, OLE & cycle time graphs	Instant insight into production bottlenecks.
Maintenance Scheduling	Reactive post-failure repairs	Automated battery & arm wear alerts	Prevents unexpected line stoppages.
Status	Delivered: reflects completed implementation across the Welding and Robo Finish cells.		



Why It Matters

Deploying Isaac Sim Digital Twins with open PLC integration establishes a repeatable Industry 4.0 benchmark. By uniting 3D kinematic visualization with automated diagnostic workflows, industrial manufacturers can scale line automation, reduce mean time to repair (MTTR), and ensure peak equipment performance across global production facilities.

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