

# DIGITAL TWINS

## Overview

**DIGITAL TWINS** is a sophisticated web application designed to create, simulate, and analyze virtual replicas of physical assets. It provides a comprehensive suite of tools for monitoring asset performance, running complex simulations, identifying operational risks, and generating insightful reports. At its core, the application leverages the power of the **Google Gemini API** to deliver AI-driven predictive maintenance analysis and actionable optimization suggestions, embodying a passion for innovation and a commitment to engineering excellence.

## Key Features

**Interactive Dashboard:** A central command center providing a high-level overview of your assets. It features key performance indicators (KPIs) like total asset count, system status (Online, Warning, Offline), average performance (OEE), and a bar chart visualizing the performance of each asset.

**Comprehensive Asset Management:** A detailed inventory of all assets. Users can view a list of assets, see their current status and performance, and click to open a detailed modal view for more in-depth information.

**Detailed Asset View:** The modal provides a deep dive into a specific asset, showing:

**Live Data Streaming:** A real-time chart simulating a key operational parameter (e.g., temperature).

**Full Specifications:** A complete list of operational parameters, technical specifications, and physical dimensions.

**AI-Powered Predictive Maintenance:** For assets in a 'Warning' state, users can trigger an AI analysis. The application sends asset data to the Gemini API to

predict the most likely failure mode, estimate the timeframe for failure, and recommend specific preventative actions.

**AI Optimization Analysis:** In the "Analysis" view, users can select any asset to receive AI-generated optimization suggestions. The application uses the Gemini API to analyze the asset's data and provide three concise, actionable recommendations to improve performance, efficiency, or longevity.

**Multi-Scenario Simulation:** The "Simulations" view allows users to run "what-if" scenarios. You can select an asset, define multiple scenarios with varying stress levels, and run the simulation to see a comparative line chart of the asset's predicted performance under each condition.

**Risk Assessment Matrix:** A dedicated view to manage and assess operational risks. It displays a clear table of identified risks, the associated asset, the probability and impact of the risk, and the predefined mitigation strategy.

**Reporting:** Generate and preview downloadable (mock) reports, including a Monthly Performance Report summarizing asset OEE and an Active Risks Summary.

**Secure Authentication:** A mock login and logout flow ensures that the application is accessed securely.

**Dedicated Support & FAQ:** A support section provides answers to frequently asked questions and links to contact support or access additional resources like blogs and video tutorials.

Tech Stack

**Frontend:** React, TypeScript

**AI Integration:** Google Gemini API (@google/genai) for predictive analysis and optimization.

**Styling:** Tailwind CSS for a modern, responsive, and utility-first design.

**Charting:** Recharts for creating beautiful and interactive data visualizations.

**Module System:** Modern JavaScript modules (ESM) loaded via esm.sh for a buildless development experience.

## AI Integration with Gemini

The application's intelligence is powered by the Google Gemini API. We utilize advanced prompt engineering techniques to get structured, reliable JSON data from the model.

**Predictive Maintenance (`getPredictiveMaintenanceAnalysis`):** When an asset is in a 'Warning' state, we send its details (name, type, status, performance, and all operational parameters) to Gemini. The prompt explicitly instructs the AI to act as a "predictive maintenance specialist" and return a JSON object containing the failureMode, timeframe, and recommendation.

**Optimization Suggestions (`getOptimizationSuggestions`):** For any asset, we send its data to Gemini with a prompt asking for three concise, actionable optimization suggestions. The prompt specifies the exact JSON output format required—an array of objects, each with a title and suggestion—ensuring the response can be directly rendered in the UI.

This integration showcases how Gemini can be used not just for conversational tasks, but as a powerful analytical engine to drive business logic and provide data-driven insights.

Developed by the **HERE AND NOW AI** product engineering team.