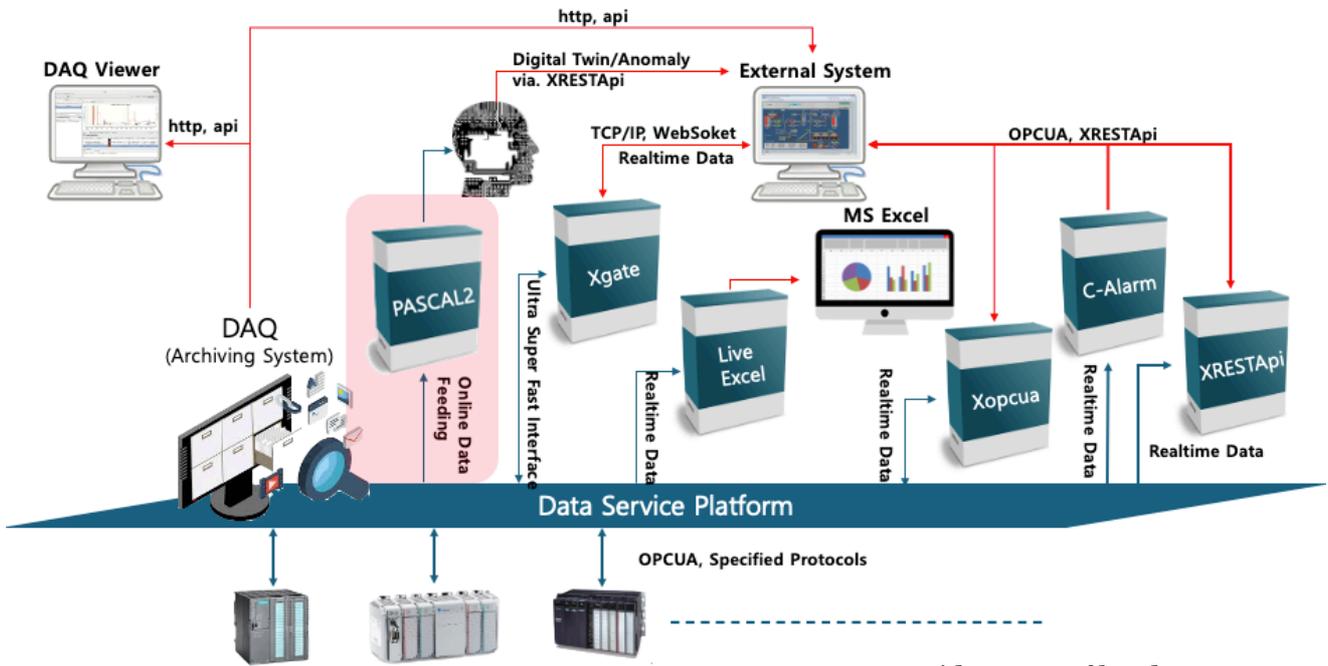# PASCAL 2

Pascal

Pascal2

Pascal2 is an artificial intelligence model designed exclusively for the Data Service Platform.

It is an advanced monitoring system equipped with a built-in SGDEngine that enables real-time machine learning training and anomaly detection.

PASCAL2 delivers exceptional performance in the domains of industrial control, data analysis, and anomaly detection. The system provides real-time data processing, on-the-fly model training, and highly flexible scalability — all seamlessly integrated with the Data Service Platform.

Unlike conventional traditional control systems, PASCAL2 incorporates a lightweight ML engine based on SGD (Stochastic Gradient Descent), enabling efficient operation even in edge computing environments. It realizes stable and intelligent monitoring directly at your industrial site.

Compared to existing AI systems, PASCAL2 eliminates the need for graphics cards, significantly minimizing deployment costs. It can operate on a wide range of hardware platforms—from embedded devices to enterprise servers. In particular, by utilizing real-time data supplied from the Data Service Platform directly as training data, it removes the need for a separate database system.

SPECIFICATION

- Operating Environments:

  - Hardware: Intel CPU i5 or higher, multi-core CPU (or compatible multi-core processors)

  - Operating System: Debian Linux

  - Required: Data Service Platform

- Real-time Data Acquisition & Processing

  - Maximum: 10,000 Tags

  - Time-series data change tracking

  - Input data normalization and statistical update

- Machine Learning-based Training & Prediction

- Online SGD training supported via SGDEngine → Learning rate decay, L2 regularization, type-specific optimization (DO / DI / AO / AI)

- Parallel processing with OpenMP support → significantly improved training/ inference speed for large-scale models (up to 128 models simultaneously)

- Prediction error calculation + anomaly detection based on EWMA (Exponential Weighted Moving Average) and MAD

- Multi-model operation supported

- Adaptive to seasonal pattern changes

- Anomaly Detection & Alarm System

  - Multi-metric anomaly score calculation combining: Error-norm, Entropy, EWMA, MAD (Median Absolute Deviation) with weighted integration

  - Alarm activation and log storage when threshold is exceeded

  - Long-term data pattern analysis using RollingBlock (rolling statistics)

- Digital Twin

  - Inference output based on user input

- Model Management & Scalability

  - Model save / load functionality

  - Multi-instance management (multi-core support)

  - Multiprocessing workers + shared memory for high-speed processing

  - CPU wait-time control and update-rate fine-tuning

- Training & Inference Performance

  - 10 features: ≤ 1 ms

  - 100 features: ≈ 1 ms

  - 1,000 features:≈ 50 ms
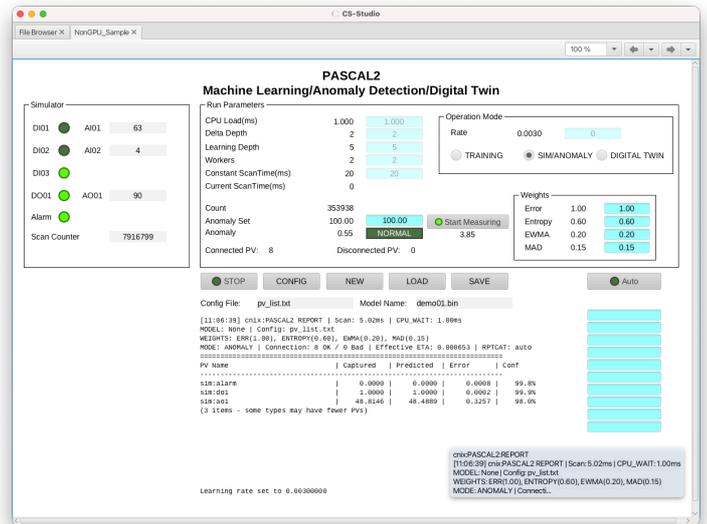

```
[13:50:18] PASCAL2 REPORT | Scan: 0.26ms | CPU_WAIT: 1.00ms
MODEL: None | Config: pv_list.txt
WEIGHTS: ERR(1.00), ENTROPY(0.60), EWMA(0.20), MAD(0.15)
MODE: ANOMALY | Connection: 8 OK / 0 Bad | ETA: 0.000000
==============================================================
PV Name | Captured | Predicted | Error | Conf
--------------------------------------------------------------
sim:alarm            |    1.0000 |    0.9999 |   0.0001 |   100.0%
sim:do1              |    1.0000 |    1.0000 |   0.0000 |   100.0%
sim:ao1              |   78.4475 |   78.3926 |   0.0549 |    99.8%
(3 items displayed - some types may have fewer PVs)
```

- Subject to change depending on hardware and network performance.

- Supported Interfaces

  - External sharing of system variables to support customer-developed custom UI

  - XRestApi