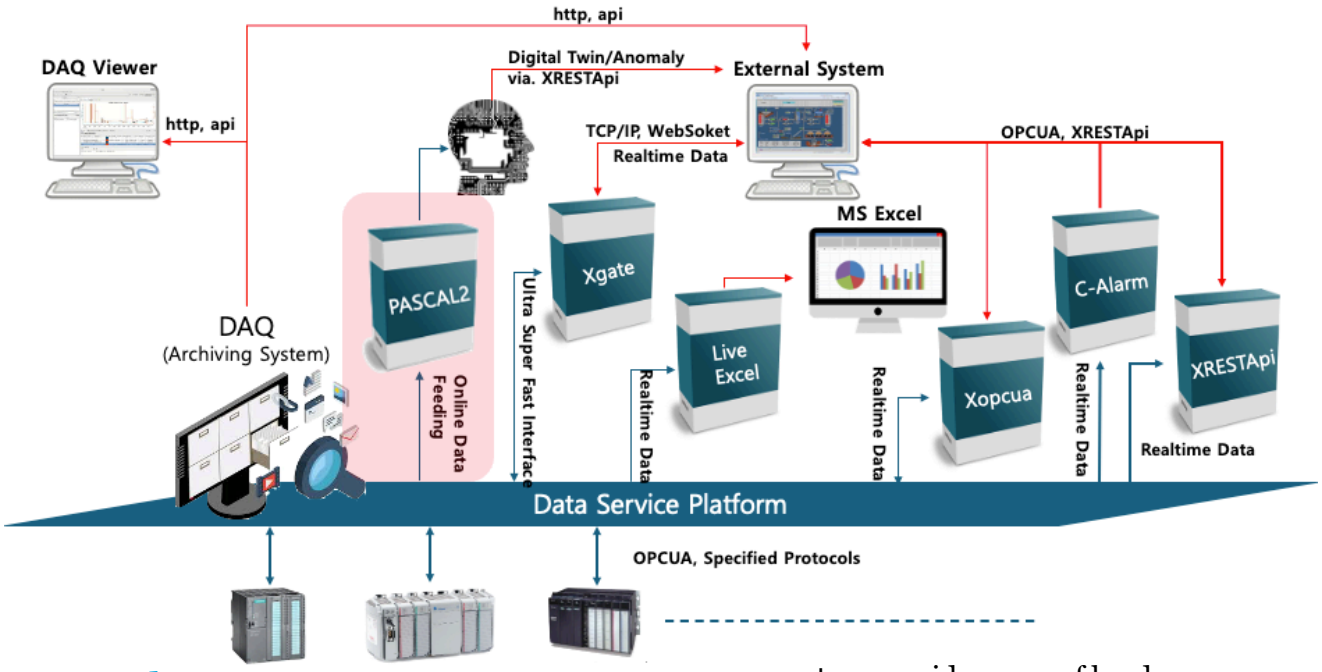
PASCAL 2



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.

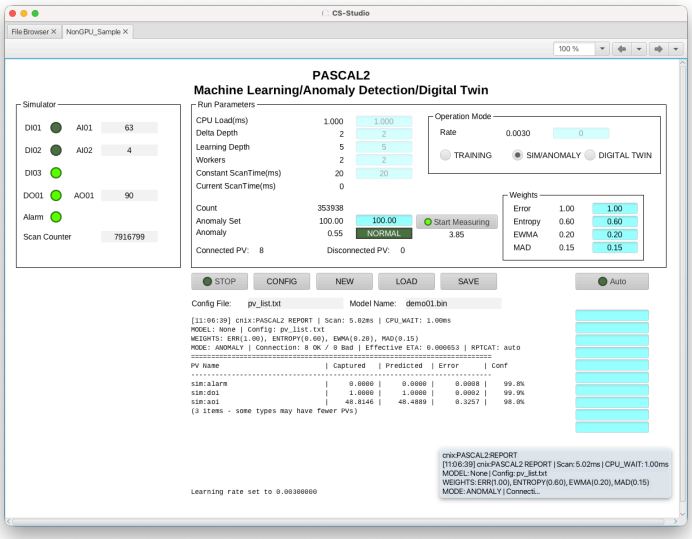
Unlike conventional traditional control systems, PASCAL2 incorporates a lightweight ML engine based on SGD (Stochastic Gradient Descent), enabling efficient operation even in edge computing environments. It realizes stable and intelligent monitoring directly at your industrial site.

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

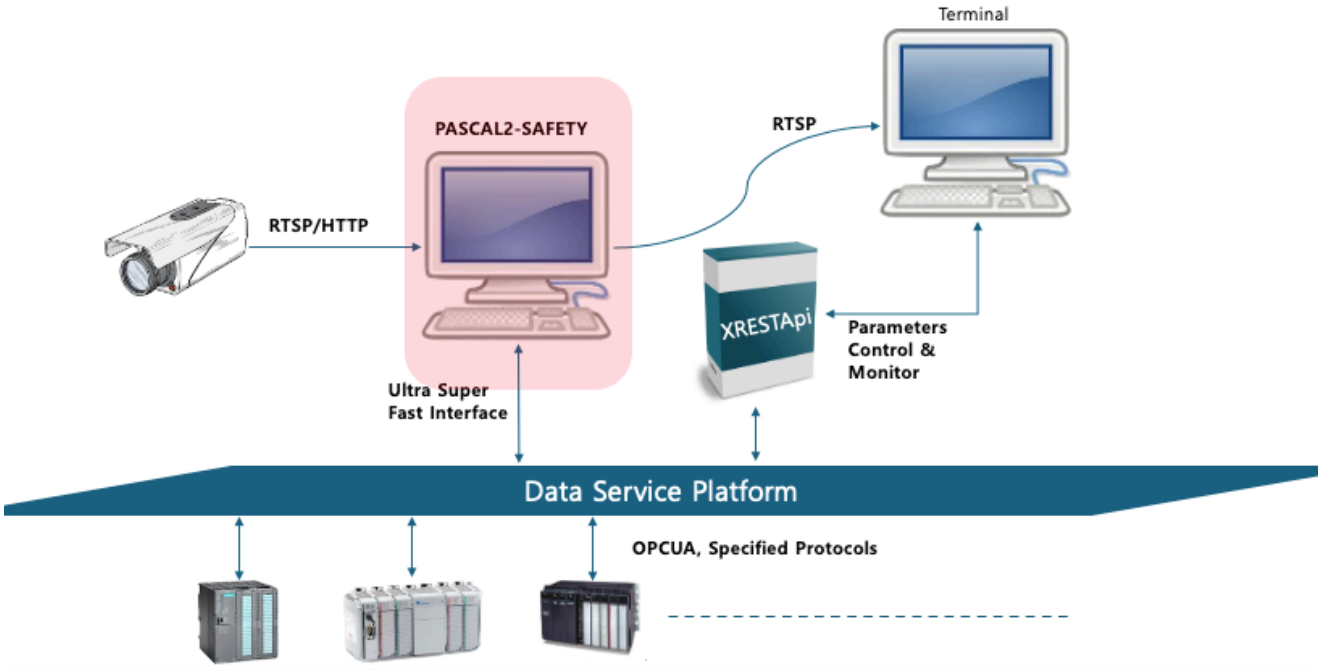
  - Online SGD training supported via SGDEngine → Learning rate decay, L2 regularization, type-specific optimization (DO / DI / AO / AI)
  - Parallel processing with OpenMP support → significantly improved training/ inference speed for large-scale models (up to 128 models simultaneously)
  - Prediction 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

PASCAL 2 - VISION



Pascal2-safety

Pascal2-Safety is a high-performance, CPU-based inference engine specifically engineered for object detection AI models within the **Data Service Platform** ecosystem. Designed for seamless integration, it bridges the gap between raw data and actionable intelligence.

- **Optimized Performance:** Tailored for the Data Service Platform to ensure reliable object detection without the need for specialized GPU hardware.
- **Seamless Integration:** Fully compatible with automated systems, enabling streamlined workflows and real-time operational efficiency.
- **System Synergy:** Works in direct coordination with the Data Service Platform to empower fully automated industrial environments.

Functions

Target Objects: Human (Optional: Customizable for additional object classes)

Detection Capabilities:

- **Fall Detection:** Advanced pose-estimation based on joint positioning.
- **Intrusion Detection:** Zone-based object detection.

Primary Application: Close-range industrial safety , monitoring and surface inspection.

Specifications

- Operating System: Debian Linux 12 or higherProcessor
- CPU: Intel Core i5 (4-Core) or higher
- Video InputRTSP / HTTP Stream Support
- Video OutputWebRTC for low-latency streaming
- External InterfaceXREST API for seamless system integration
- Zone Configuration: Support for multiple Restricted Zones and Exclusion Zones.

- Configuration: Text-based online configuration for rapid deployment.
  - Global Settings: Parameters applied across the entire video feed.
  - Local Overrides: Individual camera/ channel overrides for specific site requirements.
  - Configurable Parameters:
    - AI Engine: Object detection model selection (Global).
    - Performance: Analysis resolution, processing speed (FPS), and per-channel analysis rate.
    - Output Control: Stream resolution and output frame rate.
    - Accuracy Tuning: Detection thresholds for global and individual object classes.
    - Spatial Logic: Multi-zone restricted and exclusion area mapping.
    - Event Logic: Fine-tuning parameters for Fall Detection and Intrusion Detection.
    - Data Access: Publicly accessible parameters for API integration.
- System Parameters & Data Interface
  - Exposed Parameters: * Analysis Throughput: Configurable processing speed per channel (FPS).
  - Detection Alarms: * Human Detection: Real-time presence monitoring.
  - Fall Detection: Pose-based emergency alerts.
  - Zone Intrusion: Instant notification for unauthorized entry into restricted areas.
  - Metadata Output: * Event Logging: Precise timestamps for all detection triggers.
  - Visual Evidence: High-resolution event thumbnails for rapid verification.
  - Standard Interface: XREST API for robust system-to-system communication.
  -
- Optional Features
  - DAQ Integration & Storage: * Support for DAQ (Data Acquisition) system linkage.
  - Automated thumbnail archiving indexed by precise detection timestamps for comprehensive post-event analysis.