Real-Time Production Line Sensor Dashboard

Si-Ware Systems Assessment Project
Product Engineer

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Systems

Solution

Live Monitoring: Real-time sensor tracking with configurable frequency updates

Key Features

Live Monitoring Dashboard

- 5+ sensors tracked simultaneously
- Live data tables with color coding
- Real-time analytics visualizer (pyqtgraph)
- Sliding 20-second window
- Live Alarm Logs
- Global Status Indicator

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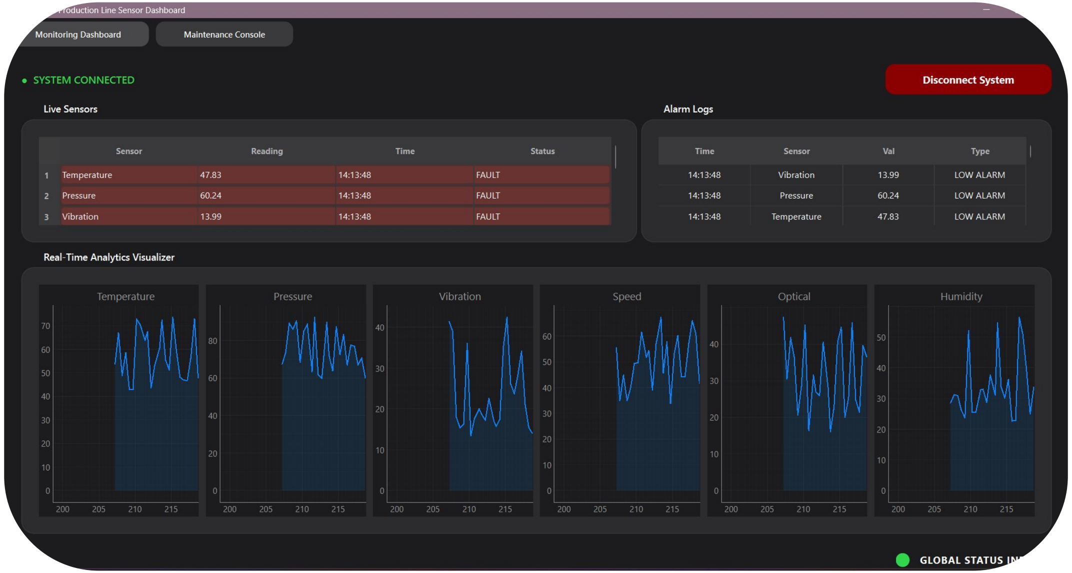
Key Features

Live Monitoring Dashboard



● SYSTEM CONNECTED

Live Sensors

	Sensor	Reading	Time	Status
1	Temperature	47.83	14:13:48	FAULT
2	Pressure	60.24	14:13:48	FAULT
3	Vibration	13.99	14:13:48	FAULT

Alarm Logs

Time	Sensor	Val	Type
14:13:48	Vibration	13.99	LOW ALARM
14:13:48	Pressure	60.24	LOW ALARM
14:13:48	Temperature	47.83	LOW ALARM

Real-Time Analytics Visualizer

● GLOBAL STATUS IN

Key Features

Maintenance Console

- Secure admin console (token-based)
- Full system reset & alarm clearing
- Session export (JSON format)
- Offline data replay mode
- Live Log Viewer
- Desktop Alerts Preference

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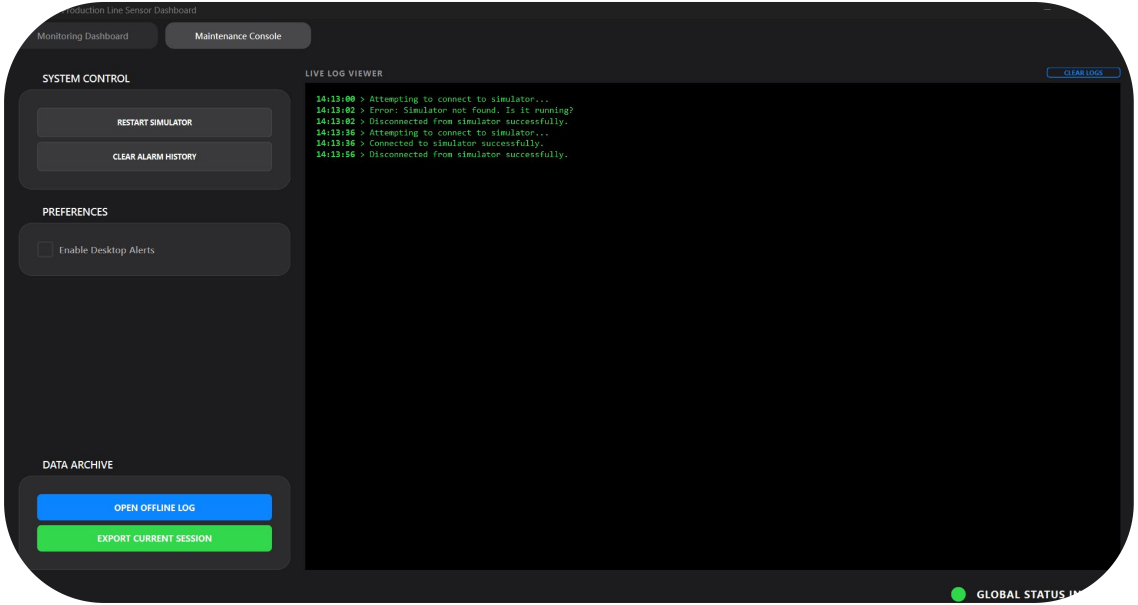
Problem Statement

- Industrial Challenges
  - Production lines generate continuous sensor data
  - Critical need for real-time monitoring
  - Immediate alarm detection prevents equipment damage
  - Historical data analysis for predictive maintenance

Key Features

Bonus Feature

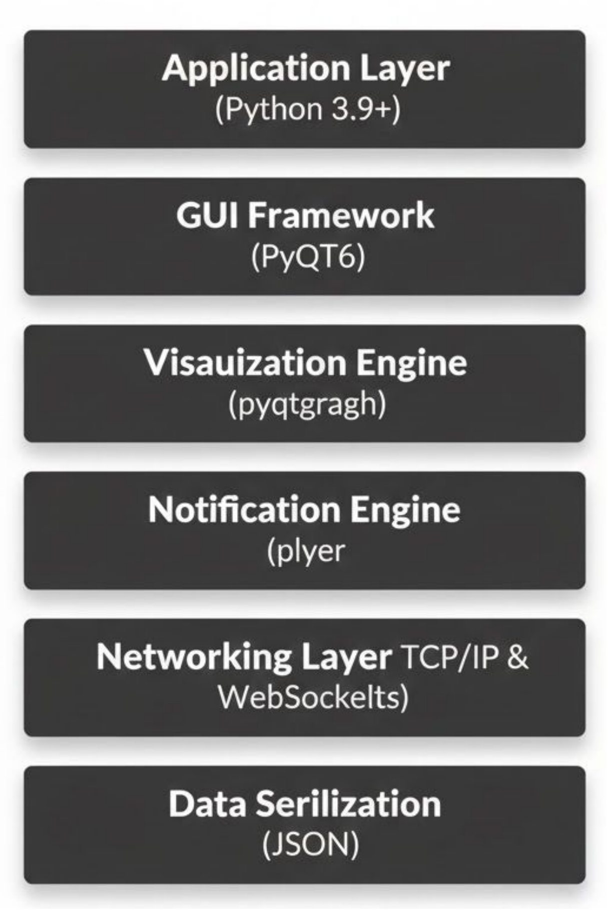
Maintenance Console



□ Enable Desktop Alerts

```
14:13:00 > Attempting to connect to simulator...
14:13:02 > Error: Simulator not found. Is it running?
14:13:02 > Disconnected from simulator successfully.
14:13:36 > Attempting to connect to simulator...
14:13:36 > Connected to simulator successfully.
14:13:56 > Disconnected from simulator successfully.
```

Technology Stack



Application Layer
(Python 3.9+)

GUI Framework
(PyQT6)

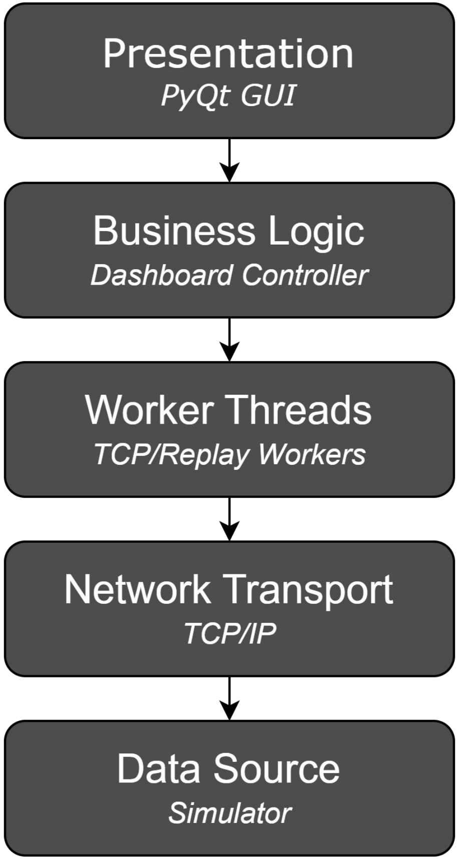
Visauization Engine
(pyqtgragh)

Notification Engine
(plyer

Networking Layer TCP/IP &
WebSockelts)

Data Serilization
(JSON)

System Architecture



Presentation
PyQt GUI

Business Logic
Dashboard Controller

Worker Threads
TCP/Replay Workers

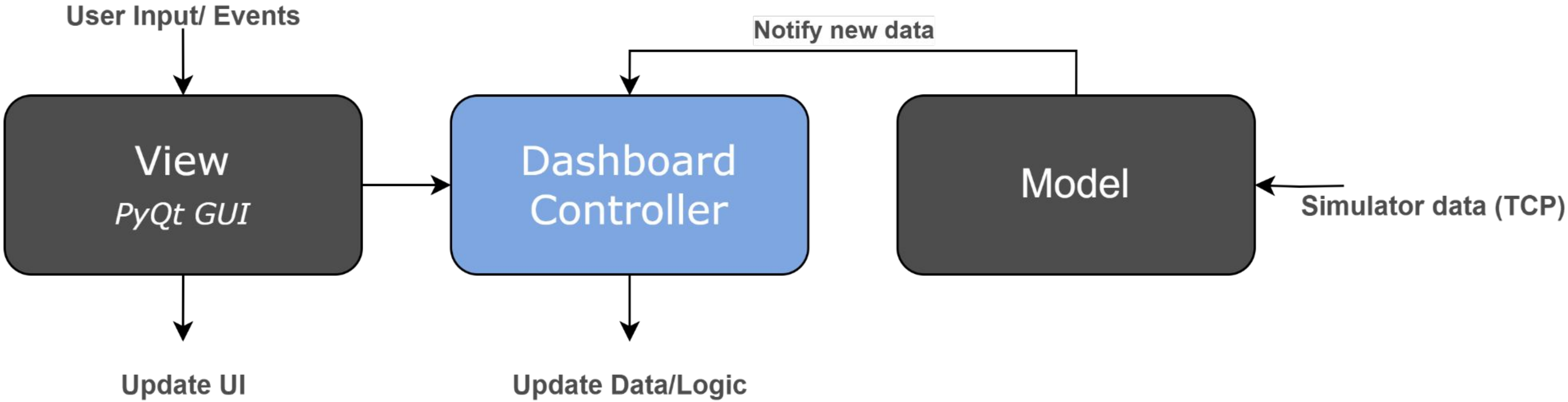
Network Transport
TCP/IP

Data Source
Simulator

Design Patterns

MVC model-view-controller Pattern

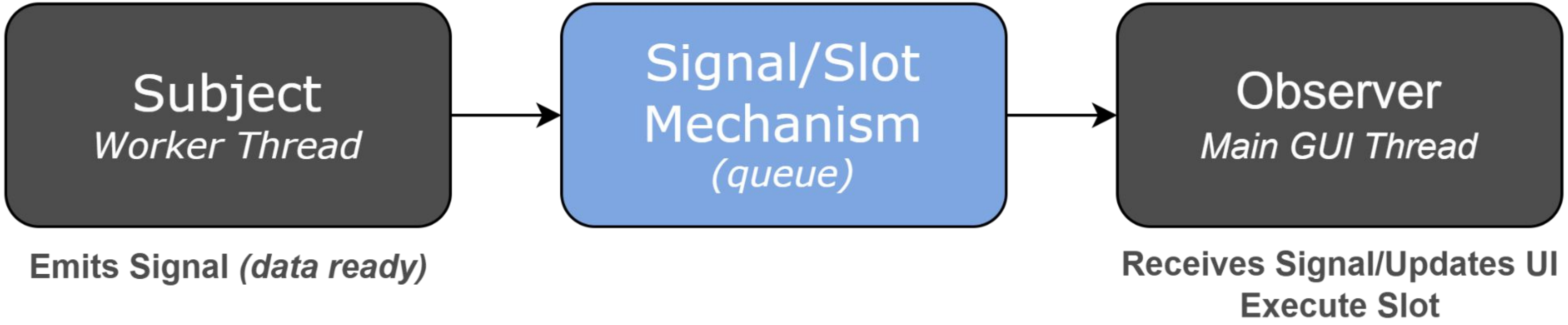
Separation of UI, Logic and Controller



Design Patterns

Thread-safe Observer Pattern

Signal/slot for thread-safe communication



Subject
Worker Thread

Signal/Slot
Mechanism
(queue)

Observer
Main GUI Thread

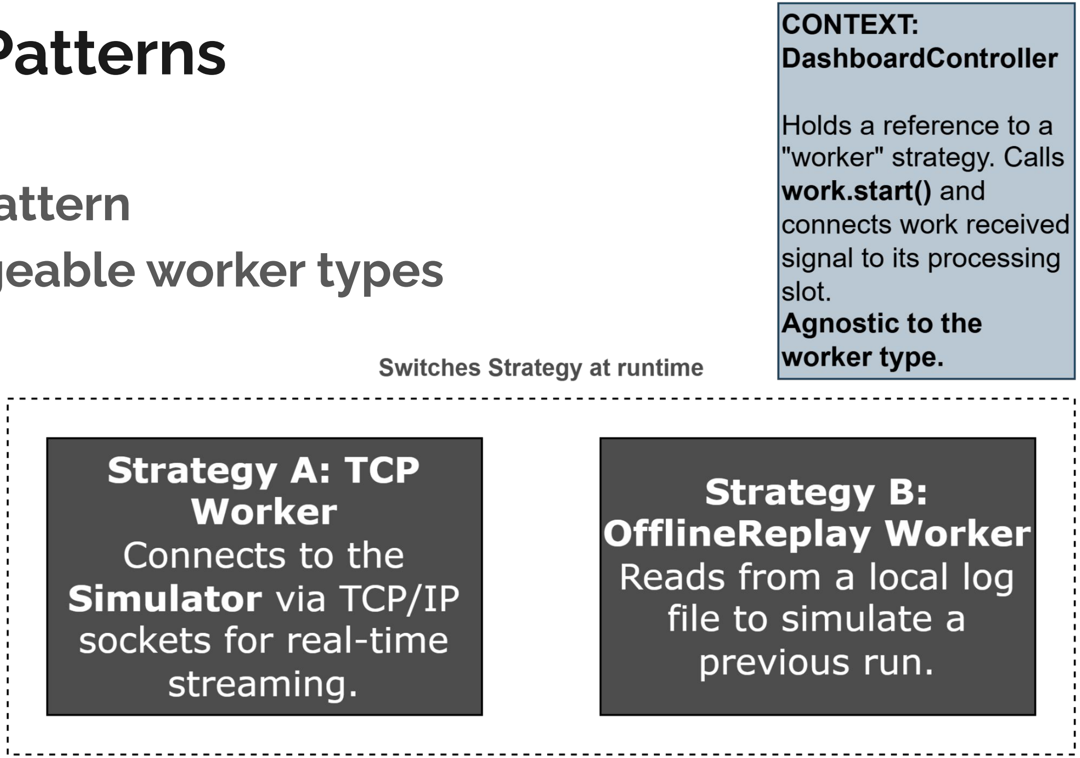
Emits Signal *(data ready)*

Receives Signal/Updates UI
Execute Slot

Design Patterns

Strategy Pattern

Interchangeable worker types



CONTEXT: DashboardController

Holds a reference to a "worker" strategy. Calls **work.start()** and connects work received signal to its processing slot.
Agnostic to the worker type.

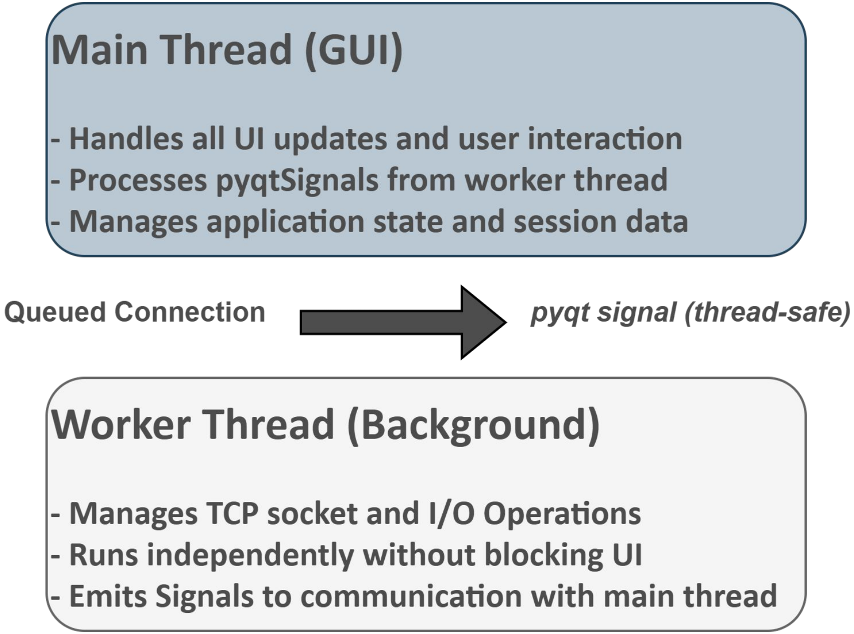
Switches Strategy at runtime

Strategy A: TCP Worker
Connects to the **Simulator** via TCP/IP sockets for real-time streaming.

Strategy B: OfflineReplay Worker
Reads from a local log file to simulate a previous run.

Threading Architecture

Responsive UI with QThreads and Signals



Main Thread (GUI)

- Handles all UI updates and user interaction
- Processes pyqtSignals from worker thread
- Manages application state and session data

Queued Connection

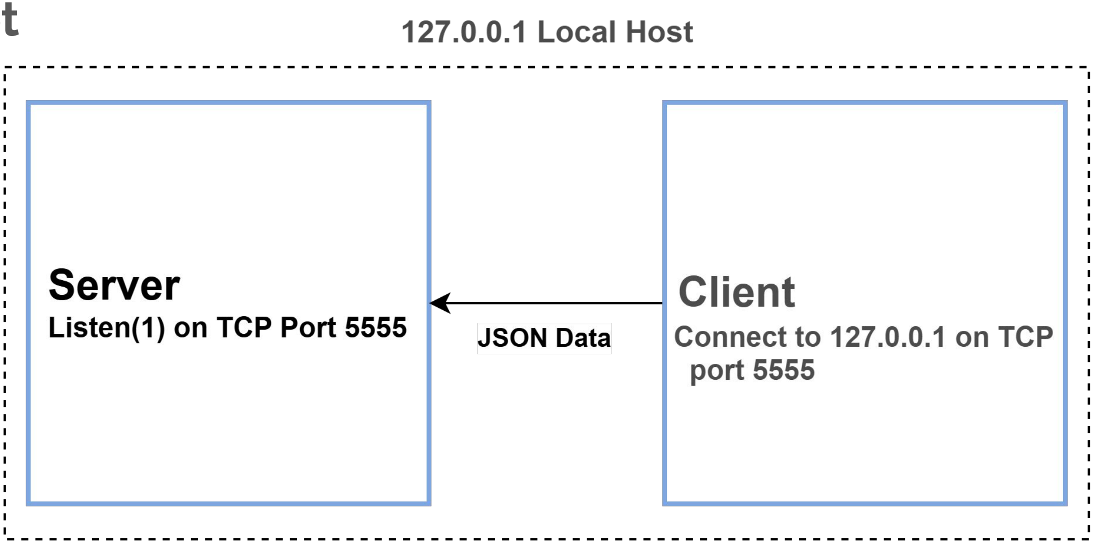
pyqt signal (thread-safe)

Worker Thread (Background)

- Manages TCP socket and I/O Operations
- Runs independently without blocking UI
- Emits Signals to communication with main thread

Communication Protocol

TCP Socket


127.0.0.1 Local Host

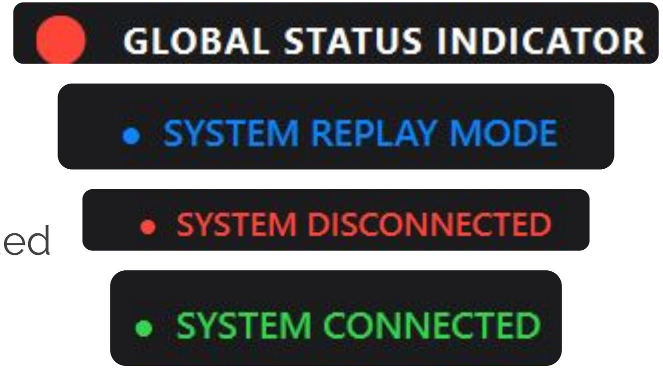
Server
Listen(1) on TCP Port 5555

JSON Data

Client
Connect to 127.0.0.1 on TCP port 5555

User Interface Highlights

- Color-coded status indicators for quick recognition
- Responsive graphs with smooth animations
- Card-based layout for logical grouping



Status Indicators:

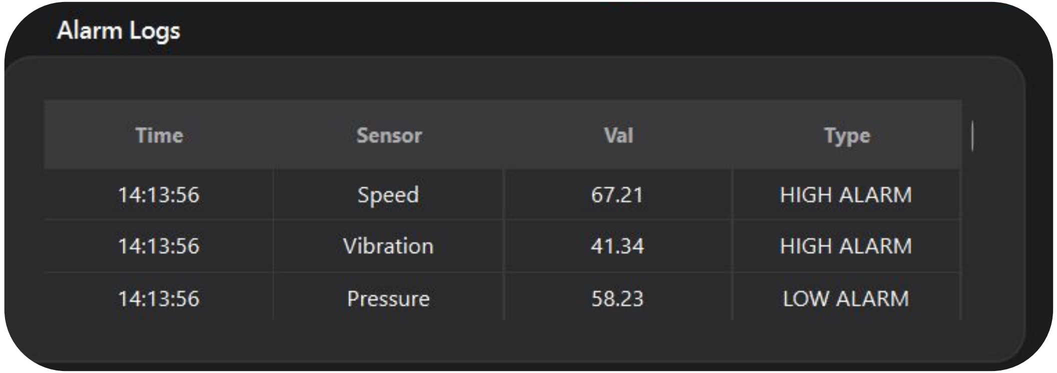
- Green: System connected, all sensors OK
- Red: Alarm detected, immediate attention needed
- Blue: Replay mode, historical data playback
- Grey: System offline, disconnected

Intelligent Alarm System

Features

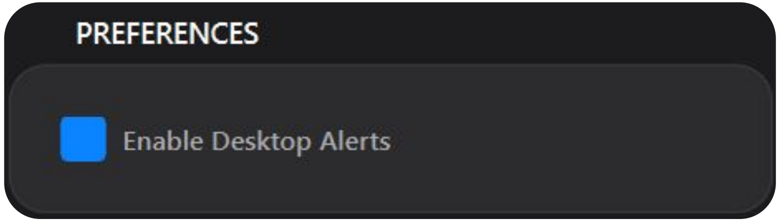
- Real-time threshold monitoring
- Visual highlighting (red background on affected rows)
- Chronological alarm history log
- Desktop notifications (optional, user-controlled)

Intelligent Alarm System



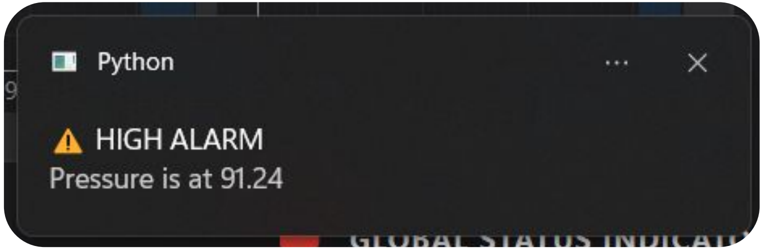
Alarm Logs

Time	Sensor	Val	Type
14:13:56	Speed	67.21	HIGH ALARM
14:13:56	Vibration	41.34	HIGH ALARM
14:13:56	Pressure	58.23	LOW ALARM



PREFERENCES

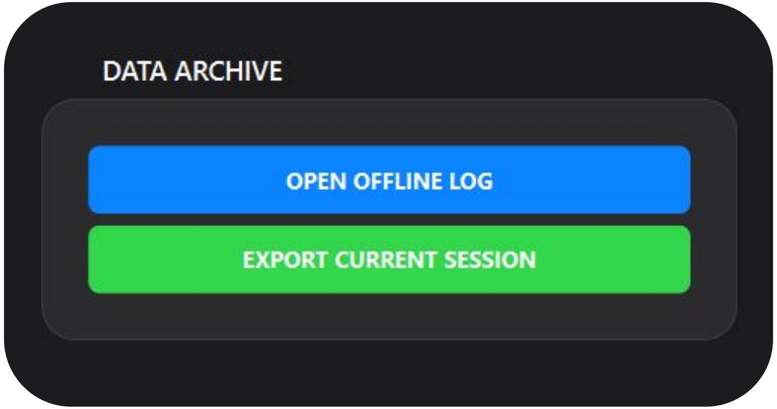
☑ Enable Desktop Alerts



⚠ HIGH ALARM
Pressure is at 91.24

Data Management

- **Session Export**
  - Automatic archiving during live sessions
  - JSON format with timestamps
  - Complete sensor state snapshots
  - One-click export to file
- **Offline Replay**
  - Load previously exported sessions
  - Replay at original 2Hz rate
  - Full UI functionality maintained
  - Blue status indicator for clarity



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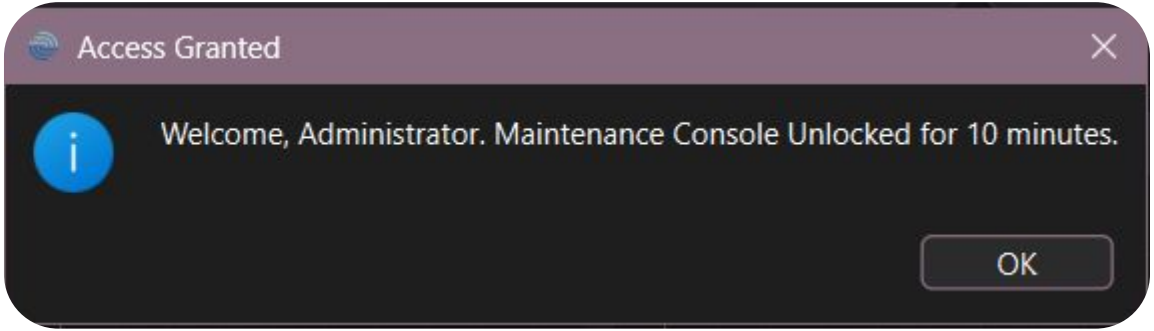
Security and Access Control

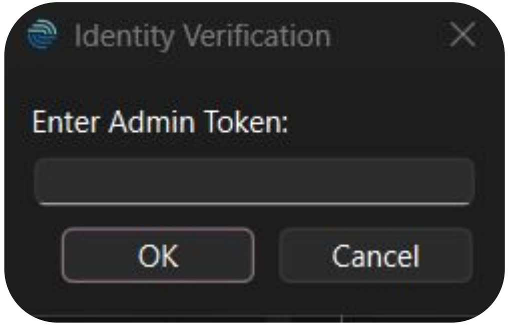
- **Authentication System**
  - Token-based authentication for maintenance console
  - Password-masked input dialog
  - Default token: **admin123** (customizable)
- **Session Management**
  - 10-minute automatic timeout for maintenance access
  - Activity monitoring (mouse, keyboard events)

Security and Access Control



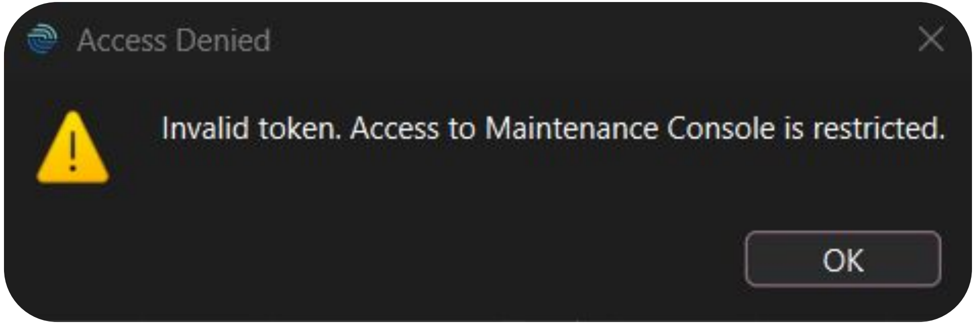
Access Granted

Welcome, Administrator. Maintenance Console Unlocked for 10 minutes.



Identity Verification

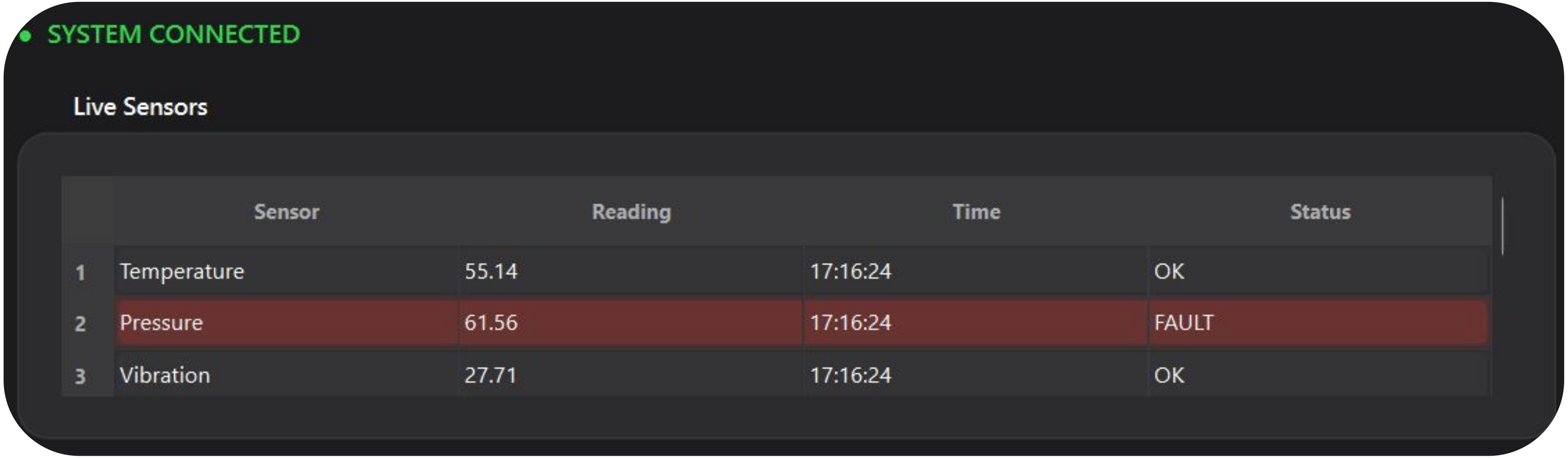
Enter Admin Token:



Access Denied

Invalid token. Access to Maintenance Console is restricted.

Live Sensor Monitoring

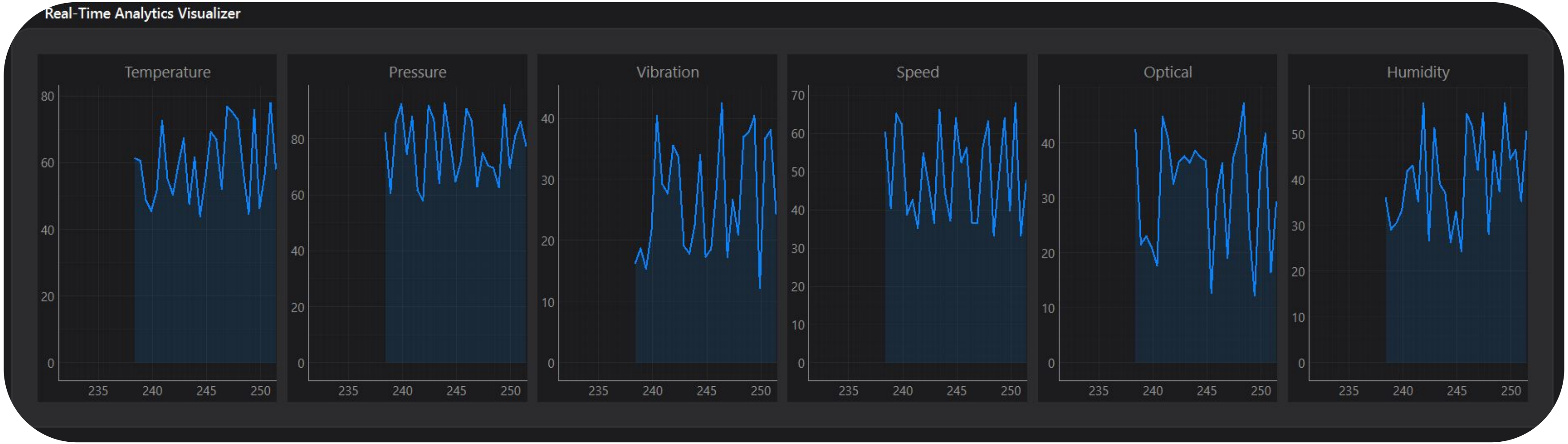


● SYSTEM CONNECTED

Live Sensors

	Sensor	Reading	Time	Status
1	Temperature	55.14	17:16:24	OK
2	Pressure	61.56	17:16:24	FAULT
3	Vibration	27.71	17:16:24	OK

Live Sensor Monitoring



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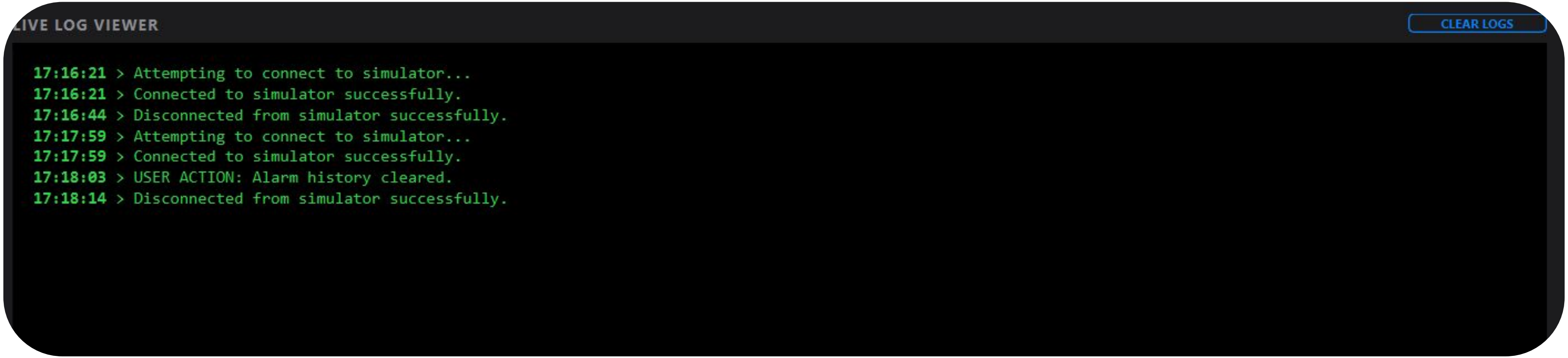
Live Log Viewer



```
17:16:21 > Attempting to connect to simulator...
17:16:21 > Connected to simulator successfully.
17:16:44 > Disconnected from simulator successfully.
17:17:59 > Attempting to connect to simulator...
17:17:59 > Connected to simulator successfully.
17:18:03 > USER ACTION: Alarm history cleared.
17:18:14 > Disconnected from simulator successfully.
```

Project Outcomes

✓ Production-ready industrial monitoring system

✓ Modern UI/UX

✓ Thread-safe architecture for reliable operation

✓ Flexible data management (export/replay)

✓ Extensible design for future enhancements

THANK YOU!

Questions and Discussion

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