



Mechanimix

Condition Monitoring Service

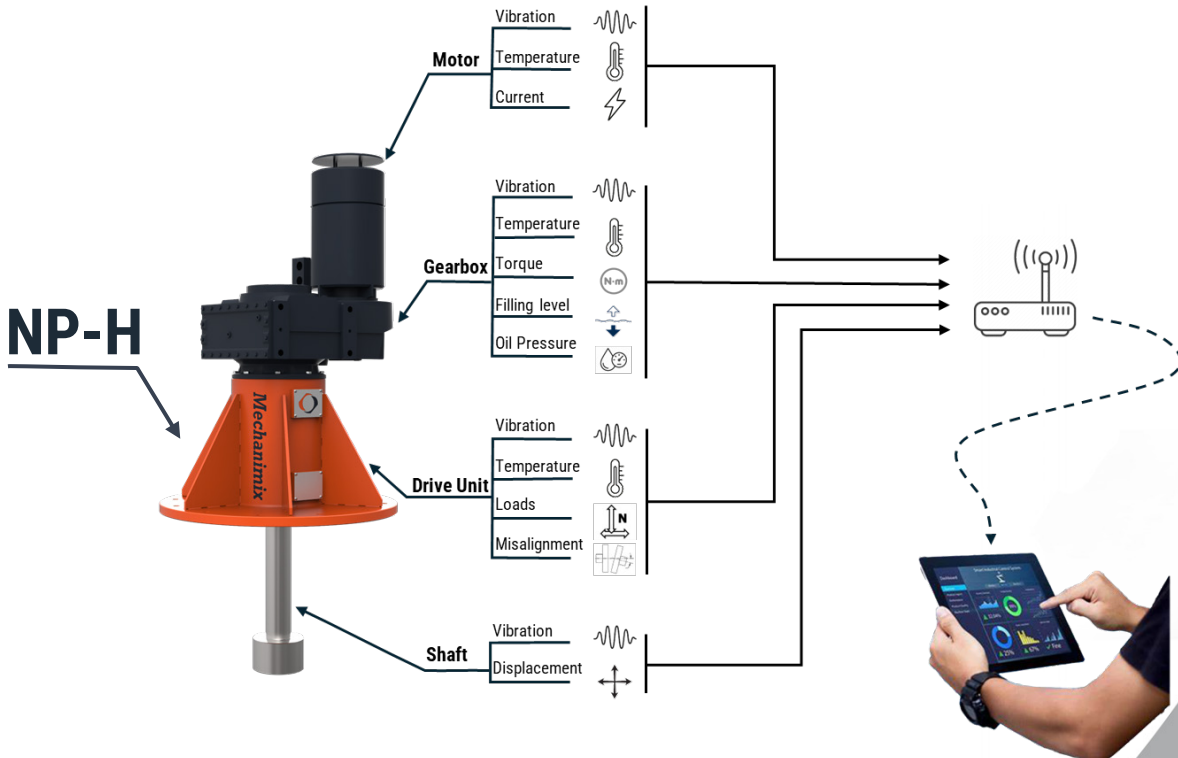
Professional Mixing Technologies

Traditional maintenance strategies can no longer meet the demands of modern industry, where efficiency and cost control are critical. Time-based interventions often result in either unnecessary early actions or delayed responses—both leading to unplanned downtimes, resource losses, and safety risks.

In this context, **Condition Monitoring** emerges as an innovative and advanced solution at the foundation of modern industrial maintenance. The system continuously monitors critical machine performance parameters in real time. Thanks to this data-driven approach, maintenance and control decisions are made based on actual equipment performance.



Backed by strong engineering expertise, extensive technical knowledge of rotating and process equipment, and the integration of cutting-edge technologies such as smart sensors, advanced data analytics, and Industrial IoT (IIoT), our company delivers scalable, reliable, and customizable condition monitoring services for a wide range of industrial asset



Advantages

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Key Benefits of Condition Monitoring

- **Increased Reliability**

Early detection of faults and reduction of unexpected breakdowns.

- **Cost Reduction**

Lower emergency repair costs through predictive maintenance strategies.

- **Performance Optimization**

Improved mixing efficiency and enhanced product quality.

- **Enhanced Safety**

Prevention of hazardous material leaks and industrial accidents.

- **Minimized Downtime**

Reduced unplanned stoppages via scheduled and condition-based interventions.

- **Extended Equipment Lifespan**

Protection of critical components such as shafts, impellers, and gearboxes.

- **Energy Efficiency**

Reduced energy consumption through optimal equipment operation.

- **Remote Monitoring**

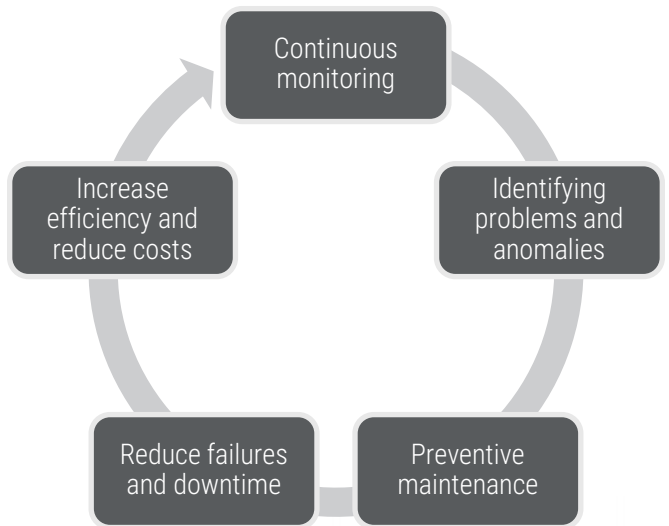
Real-time tracking enabled by IoT technologies, even in hard-to-access locations.

- **Compliance with Standards**

Alignment with industrial safety, environmental, and operational regulations.

- **Informed Decision-Making**

Data-driven insights enable smarter, condition-based maintenance decisions.



TESTING **PREDICTIVE** MAINTENANCE **PREVENT**
SCHEDULING **MAINTENANCE** **IN-SERVICE**
ACTUAL **PREDICT** EVALUATION
SYSTEM **EQUIPMENT** **MONITORING** **RELIABILITY**
COST SAVING **FAILURES**

Smart Sensors

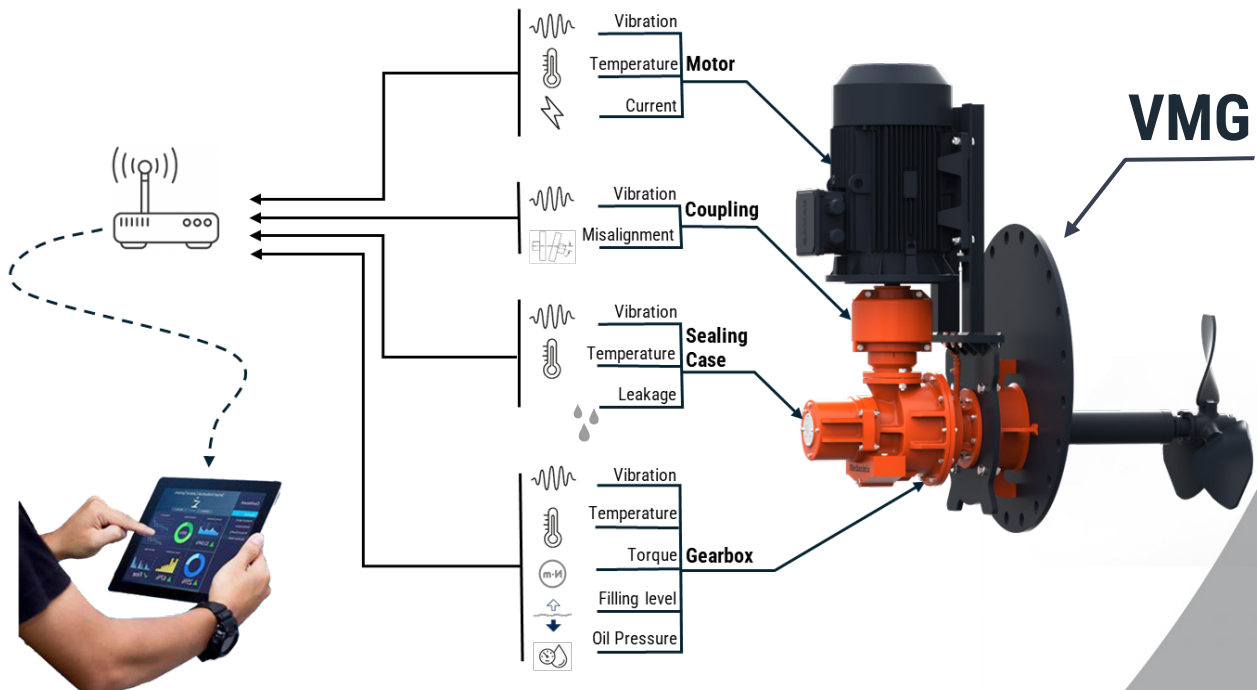
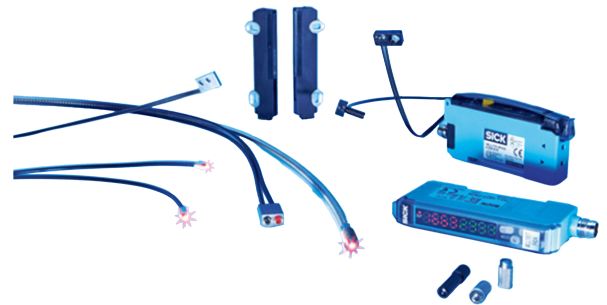
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Smart Sensor Technologies for Enhanced Condition Monitoring

The condition monitoring system provided by our company supports not only standard industrial sensors but also a wide range of advanced and specialized sensors tailored to specific process conditions, environments, and technical requirements. These include:

- **Wireless sensors**
Ideal for hard-to-access or hazardous locations.
- **Fiber-optic sensors**
Immune to electromagnetic interference; suitable for high-temperature or explosive environments.
- **MEMS sensors (Micro-Electro-Mechanical Systems)**
Extremely compact, low power consumption, and suitable for integration in rotating machinery.
- **NIR sensors (Near-Infrared)**
Used to monitor moisture, material composition, and surface properties in vacuum dryers and similar applications.
- **Non-contact or laser-based sensors**
For high-precision measurement of displacement, speed, or vibration in sensitive rotating equipment.
- **Smart sensors with onboard analytics**
Capable of performing data analysis locally and transmitting processed insights.

The use of these sensor technologies significantly enhances measurement precision, early fault detection, and system adaptability across a wide range of products.



Condition Monitoring Infrastructure

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Mechanimix goes beyond providing specialized solutions for the selection and supply of precise sensors tailored to industrial needs, leveraging advanced technologies to deliver comprehensive and intelligent solutions across all layers of the condition monitoring system.

From the design and implementation of high-precision, sensor-compatible Data Acquisition (DAQ) infrastructures to the development of real-time data processing and analysis systems powered by advanced Machine Learning and Artificial Intelligence algorithms, Mechanimix ensures that every stage of equipment condition monitoring is executed in a fully integrated, reliable, and optimized manner.

1. Sensor Network & Signal Acquisition

Types of Sensors	Vibration (accelerometers), temperature (RTD, thermocouples), pressure, torque, acoustic emission, current/voltage sensors, and specialized condition indicators (e.g., LVDT, strain gauges).	
Signal Conditioning Modules	Include isolation, amplification, filtering (low/high-pass), and analog-to-digital conversion to prepare raw signals for processing.	
DAQ Modules	Analog DAQ	For continuous signals (e.g., vibration, temperature)
	Digital DAQ	For discrete events (e.g., switch status, encoder pulses)
	Smart DAQ	With built-in diagnostics, self-calibration, and edge analytics
Wireless Nodes	LoRa, ZigBee, NB-IoT or BLE for hard-to-wire environments	

2. Edge Computing & Local Processing

Edge Devices

Industrial PCs or controllers that host lightweight analytics (e.g., RMS, peak detection, FFT) near the equipment.

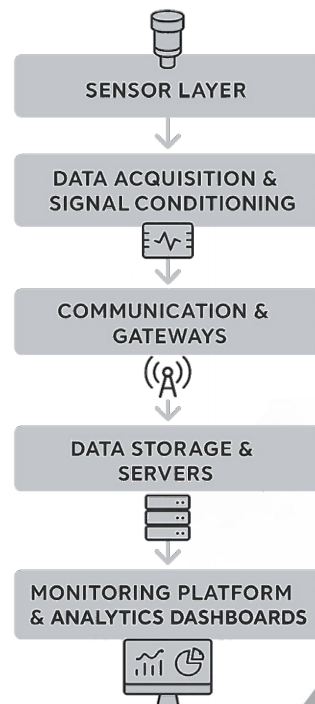
Embedded AI Modules

For local anomaly detection and rule-based logic.

Real-time Alerting

Enables decentralized decisions such as triggering alarms or shutdowns without delay.

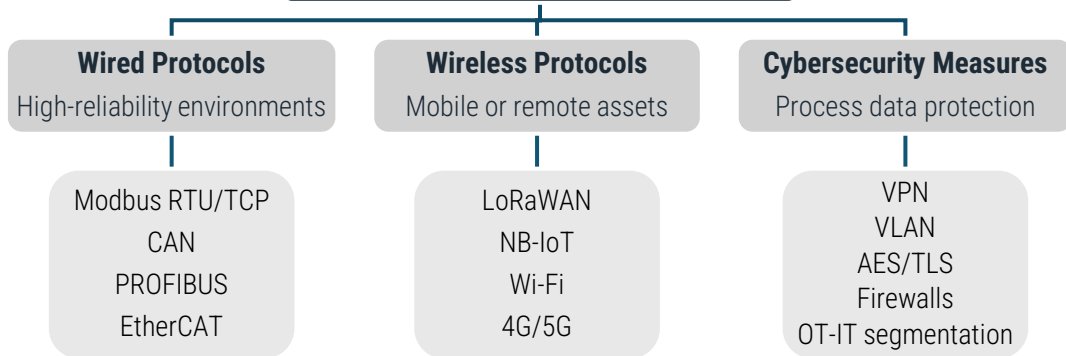
CONDITION MONITORING INFRASTRUCTURE



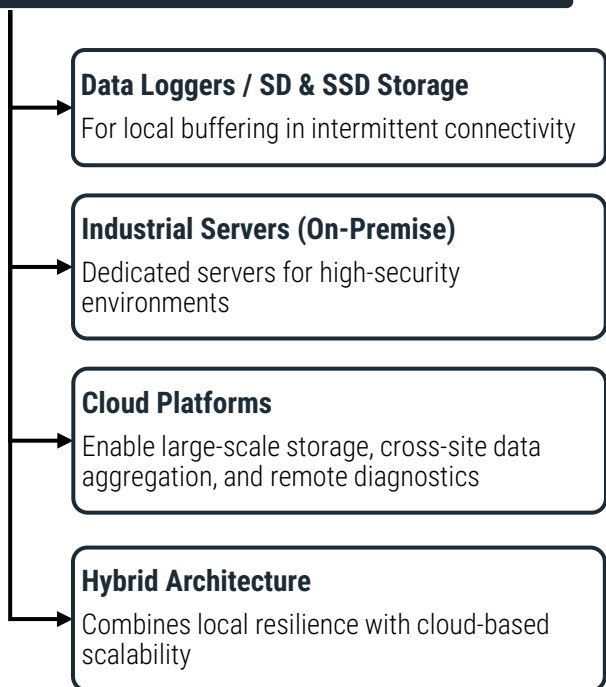
Condition Monitoring Infrastructure

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3. Communication Infrastructure



4. Centralized Storage & Cloud Integration



Design Considerations

- **Environmental Protection**
IP67/IP68, ATEX/IECEx certified hardware for hazardous locations.
- **Scalability**
Modular architecture supporting both small-scale setups and enterprise-wide deployments.
- **Interoperability**
OPC UA, MQTT, and REST APIs for seamless integration with existing infrastructure.

5. Visualization & Analytics Layer

User Interfaces	SCADA/HMI panels, web-based dashboards, mobile apps
Analytics Tools	<ul style="list-style-type: none"> – Real-time trending and historical comparisons – AI/ML models for predictive failure analysis – Health Index calculation and degradation scoring

Data Analysis

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Data Analysis & Dashboard

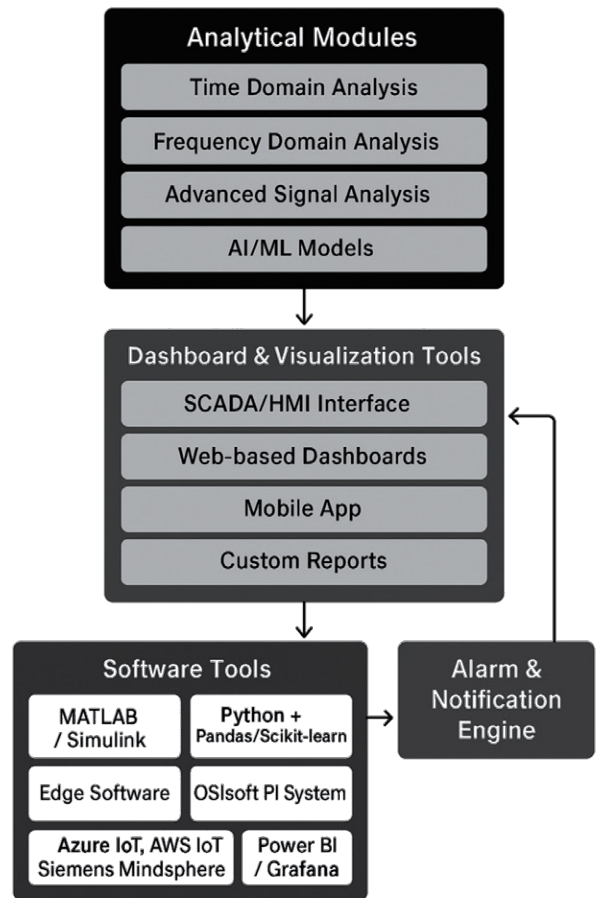
In the data analysis and dashboard layer, raw information collected from sensors and equipment is transformed into actionable insights through processing, evaluation, and intelligent decision-making. This layer serves as the critical bridge between operational data and informed action, enabling proactive maintenance strategies.

Key Analytical Capabilities

- Advanced Signal Processing**
 Application of digital filtering, time- and frequency-domain analysis, pattern recognition algorithms, and multivariate analytics to extract health indicators, trend rates, and anomalies
- Machine Learning & AI Models**
 Implementation of algorithms for anomaly detection, failure prediction, and estimation of Remaining Useful Life (RUL), based on historical trends and real-world equipment behavior
- Cross-Parameter Correlation Analysis**
 Combining multiple data streams to uncover hidden dependencies, detect nonlinear behavior, and achieve a deeper understanding of machine conditions
- Health & Performance Indices**
 Calculation of comprehensive Key Performance Indicators (KPIs) and health scores to provide a real-time overview of asset condition and operational efficiency

Software & Dashboard Features

- Web-Based Industrial Dashboards**
 Real-time visualization of equipment condition, trend comparison, critical alarm display, and intuitive graphical interfaces for operational clarity
- Automated Smart Reporting**
 Periodic generation of in-depth analytical reports, comparative graphs, and automated delivery to maintenance and operations teams
- Advanced Alarm Engine**
 Intelligent thresholding using adaptive models and statistical baselines rather than fixed limits, to reduce false positives and enhance reliability
- Role-Based & Multi-Level Access**
 Customizable dashboard views and access levels for managers, maintenance engineers, operators, and IT personnel, enabling targeted information delivery



Artificial Intelligence-AI

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Role of Artificial Intelligence in Condition Monitoring Infrastructure

Artificial Intelligence (AI) plays a critical role in enhancing the efficiency, precision, and predictive capabilities of modern condition monitoring systems. It empowers each layer of the infrastructure—from sensing to analytics—with intelligent insights and autonomous decision-making.

1. Sensor Layer

Smart Noise Filtering

AI models distinguish useful signals from environmental noise, improving sensor accuracy.

Embedded Intelligence

Smart sensors perform edge-level data analysis, reducing the need for external processing.

2. Data Acquisition & Signal Conditioning

Automated Signal Correction

Machine learning identifies and corrects distorted or abnormal signal patterns.

Feature Extraction

AI extracts relevant indicators to streamline data transmission and reduce processing loads.

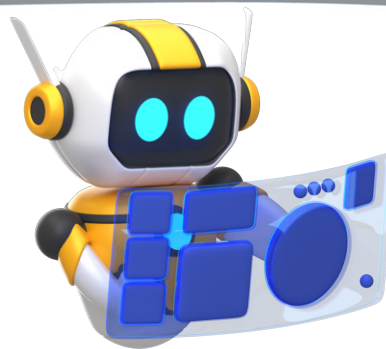
3. Communication & Gateways

Bandwidth Optimization

AI dynamically prioritizes and compresses sensor data for efficient transmission across industrial networks.

Edge AI Gateways

Real-time preprocessing and anomaly detection at the edge minimize latency and cloud dependency.



4. Data Storage & Servers

Anomaly Detection

AI algorithms continuously scan incoming data for unusual behavior and trigger early warnings.

Operational Clustering

Data is grouped into condition-based clusters for easier trend recognition and analysis.

5. Monitoring Platform & Analytics Dashboards

Predictive Maintenance

AI models forecast equipment failures and estimate Remaining Useful Life (RUL).

Root Cause Analysis

Correlates multisource data to identify underlying causes of system anomalies.

Smart Alerting

Adaptive thresholding and context-aware alarms reduce false positives and improve reliability.

Automated Decision Support

AI recommends optimal corrective actions based on real-time system behavior and historical data.



Industry Compatibility

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Comprehensive Industry Coverage and Broad Application of Condition Monitoring Service











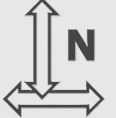
Our Condition Monitoring service is designed with a modular structure, scalable architecture, and the ability to adapt to operational and maintenance needs across various industries. Leveraging AI technologies, real-time processing tools, and a wide range of sensors, it enables intelligent monitoring, condition analysis, and failure prediction for a wide spectrum of industrial equipment and operational domains.



Covered Industries

Industry	Equipment
Chemical and Petrochemical	<ul style="list-style-type: none"> – Batch and continuous reactors – Pressure vessels with agitators – Top-entry and side-entry agitators – Vacuum dryers and crystallizers – High-temperature process pumps and lines
Pharmaceutical and Biotechnology	<ul style="list-style-type: none"> – Sterile reactors and fermenters – Precision mixers for sensitive formulations – Fluid transfer and filtration systems – Cleanroom-compatible equipment – CIP / SIP systems monitoring
Food and Beverage	<ul style="list-style-type: none"> – Sanitary agitators and pasteurizers – Homogenizers and mixing systems – Hygienic pumps, valves, and piping – Temperature and humidity control
Water Treatment and Environmental	<ul style="list-style-type: none"> – Agitators for coagulation and settling tanks – Chemical dosing systems – Sludge dryers and separation equipment – Filtration and membrane units
Mining and Material Processing	<ul style="list-style-type: none"> – Agitators in leaching and neutralization tanks – Slurry pumps and hydrocyclones – Rotary dryers and kilns
Oil and Gas	<ul style="list-style-type: none"> – High-temperature mixers and reactors – predictive maintenance for rotating machinery
Pulp and Paper	<ul style="list-style-type: none"> – Pulp agitators and storage tanks – Vacuum and roller dryers – Wear detection in rotating parts

Monitoring Parameters

Icon	Parameter	Description	Sensor type
	Vibrations Oscillations Accelerations	Detecting the health status of equipment. Abnormal changes can indicate failure or defects in machinery. Detect mechanical faults such as imbalance, misalignment, looseness, and bearing failure	<ul style="list-style-type: none"> – Accelerometers (Piezoelectric or MEMS) – Acoustic Emission (AE) Sensors – Triaxial Vibration Sensors – Velocity Sensors (Seismic or Electrodynamic)
	Temperature	Detection of abnormal thermal variations and heat transfer disturbances. From simple temperature readings to infrared thermography to catch temperature irregularities which can be caused by a part misalignment or belt issue	<ul style="list-style-type: none"> – Resistance Temperature Detectors (RTDs) – Thermocouples – Thermistors – Pyrometers – Embedded Temperature Sensors
	Pressure	Detect abnormal deviations from the operational range, enable early failure detection, and prevent mechanical stresses and critical conditions such as overpressure or vacuum collapse.	<ul style="list-style-type: none"> – Strain Gauge Pressure Sensors – Piezoelectric Pressure Sensor – Capacitive Pressure Sensor – Piezoresistive Pressure Sensor
	Flow rate	Detection of abnormal drops or fluctuations in flow behavior, identification of blockages, leakages, or reduced hydraulic performance, and assurance of uniformity in the operational process.	<ul style="list-style-type: none"> – DP Flow Sensors – Magmeters – Coriolis Flow Sensors – Ultrasonic Flow Sensors – Turbine Flow Sensors
	Humidity	Detection of unauthorized increases in humidity within the environment or inside the equipment, to prevent corrosion, insulation degradation, and reduced electrical or mechanical performance.	<ul style="list-style-type: none"> – Capacitive Humidity Sensors – MEMS-Based Humidity Sensors – Resistive Humidity Sensors – NIR (Near-Infrared) sensors
	Voltage Current	Detection of electrical fluctuations or deviations, early identification of power supply or motor performance issues, and prevention of equipment damage caused by overload, short circuit, or voltage drop.	<ul style="list-style-type: none"> – Voltage Transformers/PTs – Current Transformers /CTs – Hall Effect Current Sensors – Shunt Resistors
	Speed	Detection of deviations from nominal speed, early identification of mechanical issues such as slippage, seizure, or imbalance, and ensuring optimal and safe equipment operation.	<ul style="list-style-type: none"> – Rotary Encoders – Inductive Proximity Sensors – Reflective Optical Sensors – Tachogenerators
	Level	Detection of changes in material level (liquid or solid), prevention of overflow, dry-run conditions, or equipment performance degradation, and ensuring process safety and efficiency.	<ul style="list-style-type: none"> – Hydrostatic Pressure Sensors – Optical Level Sensors – Float Level Sensors – Ultrasonic Level Sensors – Capacitive Level Sensors – Magnetostrictive sensors
	Displacement	Detection of mechanical changes, identification of vibrations, misalignments, and component wear, prevention of potential failures, and enhancement of equipment durability.	<ul style="list-style-type: none"> – Linear Variable Differential Transformer – Inductive Displacement Sensors – Optical Displacement Sensors – Ultrasonic Displacement Sensors – Magnetic Displacement Sensors
	Torque	Measurement and control of the rotational force applied to the shaft or rotating components, detection of abnormal fluctuations, and prevention of overload and mechanical damage.	<ul style="list-style-type: none"> – Optical Torque Sensors – Magnetic Torque Sensors – Resonant Torque Sensors
	Loads	Monitoring dynamic and static load variations, detecting fluctuations and unauthorized loads, evaluating stress distribution in components, preventing fatigue, and estimating component lifespan for preventive maintenance planning.	<ul style="list-style-type: none"> – Load Cells – Accelerometers – Strain Gauges