Equipment Monitoring and Preventive Maintenance

WebAccess/MCM – a Comprehensive Solution for the Predictive and Preventive Maintenance of Intelligent Machines

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Condition Monitoring

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ADVANTECH

Enabling an Intelligent Planet

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Equipment Monitoring and Preventive Maintenance

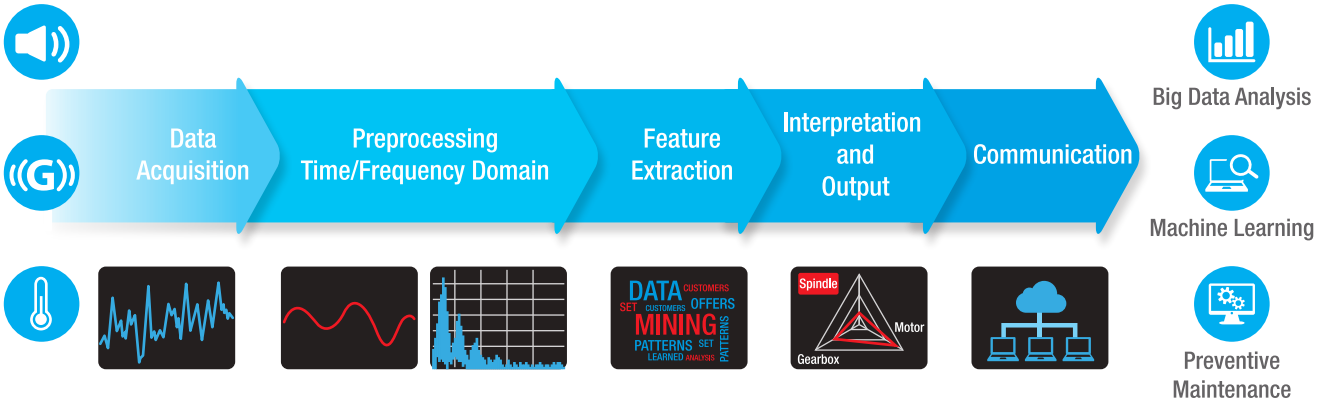
Predictive and preventive machine maintenance have become indispensable parts of Industry 4.0. Machine condition monitoring (MCM) systems upgrade consumable and damage replacement practices, as well as periodic maintenance activities, to preventive maintenance, or even predictive maintenance. This prevents situations in which machines are halted without warning for parts replacement, which causes additional overhead.

The MCM system visualizes machine status, enabling instantaneous monitor over the life of key components in the machine. Massive volumes of data are recorded to analyze and optimize the production line and minimize machine shutdowns, hence maximizing production efficiency and simultaneously increasing machine safety and reducing the cost of equipment maintenance.

Machine Condition Monitoring

To enable preventive maintenance for machines, a series of processes and analyses must be carried out that convert collected sensor data to useful information that predicts the health condition of machines and crucial elements.

Sensor generated signals undergo the following processes in the machine condition monitoring (MCM) system:



Data Acquisition: defines trigger-capture conditions, number of channels, amplification, sampling rate, and conversion of physical phenomena.

Time Domain Processing: processes the captured raw data and optimizes signal qualities using low computation methods.

Frequency Domain Processing: an optional processing step that converts time domain data to frequency domain data for fine optimization of signal qualities.

Feature Extraction: extracts meaningful feature messages from a large segment of continuous time or frequency domain data through default processing functions.

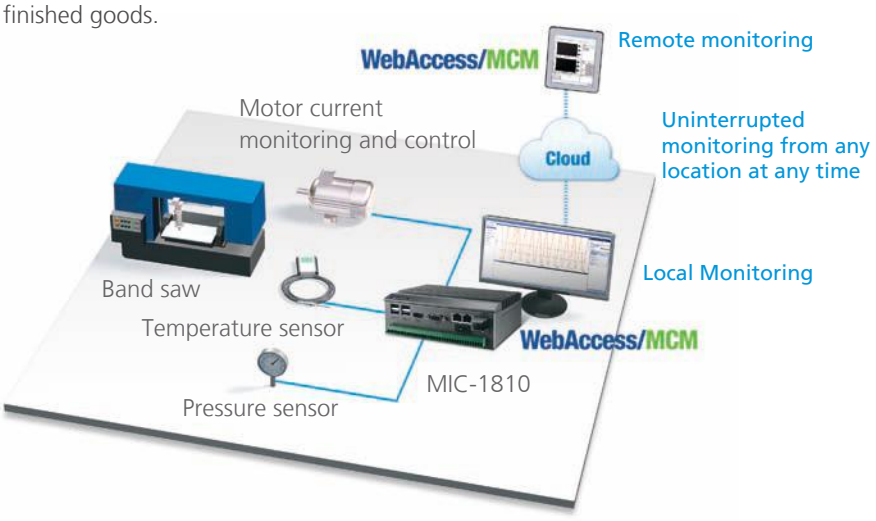
Interpretation and Output: interprets extracted features and makes decisions.

Communication: sends out feature and decision messages using network communication protocols or digital / analog output signals to connect with control desks or other control modules.

Case Study

Palm-sized Embedded Computer Provides Cost-effective Preventive Maintenance for Industrial Band Saws

Unlike traditional periodical maintenance or emergency break-down repair, preventive maintenance can detect and troubleshoot hidden faults in advance. Taking the metal-cutting band saw as an example, equipment manufacturers can perform preventative maintenance by collecting data that predict that saw blades or other components may wear out after performing thousands of cutting operations. Meanwhile, plant managers do not have to urgently call their suppliers to arrange for repairs on damaged machines, thus reducing equipment downtime and increasing overall plant productivity while also improving the quality of finished goods.



System Requirements:

- Machine monitoring and preventive maintenance
- Hardware must be compact and facilitate convenient wiring
- Rapid-sampling multichannel analog IO for retrieving machine information
- Multichannel digital IO for controlling machines
- Must support network port for uploading data to backend management systems
- Must provide software development tools to facilitate system development
- Must tolerate dust and vibration

Product Introduced:

Product	Description
MIC-1810	Embedded computer with built-in Intel® Core™ i3-3217UE processor and data acquisition module, equipped with 8-channel current input and 4-channel RTD
WebAccess/MCM	Browser-based machine condition monitoring software

Advantech Provides an Economical Automatic Spindle Calibration and Chatter Measurement Solution that Increases CNC Machining Accuracy

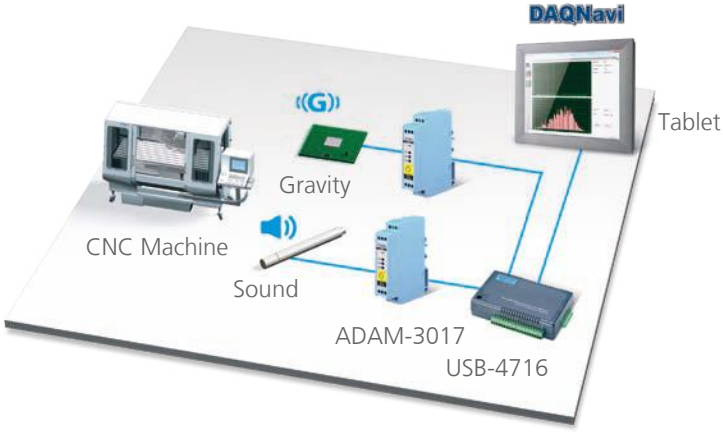
With equipment manufacturers actively improving machine performance and precision to better satisfy customer needs, the precision of machine calibration is a significant factor that influences processing accuracy. In traditional factories, all equipment must be checked and calibrated by an experienced mechanic before operation. To resolve calibration issues caused by human error and prevent machine chatter from affecting machining accuracy, the company implemented spindle calibration and chatter measurement functions at their existing machining centers in order to increase efficiency through consistent calibration and automated monitoring.

System Requirements:

- Consistent calibration and automated monitoring
- Hardware dimensions and installation methods for easy integration
- USB external module for replacing interface cards
- Prevent interference from environmental signals during data sampling processes
- Provide modules for connecting IEPE sensors
- Software development tools and customized service requirements

Product Introduced:

Product	Description
PPC-3100	10.4" industrial grade tablet computer with built-in Intel® Atom™ D2550 processor
USB-4716	200 kSs transfer rate, 16-bit resolution, 16-channel multifunction data acquisition USB module
ADAM-3017	IEPE signal processing module
DAQNavi	Software development tools for Advantech's DAQ products



Comprehensive Solution for Machine Condition Monitoring Management

Advantech's data acquisition card and suitable sensors are adopted and coupled with WebAccess/MCM software and Ethernet switches; they collect and transmit a machine's physical status variations. This enables machine manufactures to develop applications for production management, smart monitoring, and cutting tool management in open operating systems, thereby optimizing the processing efficiencies of CNC machines. Data from various machines on the production line is uploaded to a cloud platform to give clients real-time data access to machine conditions so they can improve production processes. This is smart production management in action.

WebAccess/MCM Features:

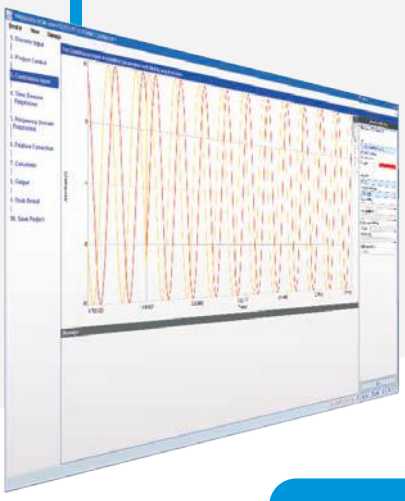
No Coding Required
This helps cut down investment in development resources and accelerates new project implementation.

Feature Extraction
Perform feature extraction for various functions such as Max, Mean, Median, Min, RMS, Pulse Width, Pulse frequency, Time of Max/Min, FFT frequency.

Data Pre-Processing
Pre-processing functions such as Moving average, Windows function, Linear filter, Frequency domain filter are provided.

Data Logger
Data storage, data searches, comparisons, and playback display functions are provided.

WebAccess/MCM Application Mode



Oscilloscope

Scope assists users to analyze signals, and provides oscilloscope-like functions, including cursor measurement tools, trigger capture functions, automatic measurements of amplitudes, frequencies, average values, and peak-to-peak values, as well as real-time display of time-domain data and spectrograms.

Intelligent Inspection

Wizard guides are provided for easy setup, feature extraction, and customized algorithm for identification and interpretation without coding. The system also outputs signals to link other equipment to the SCADA/PLC system as monitoring nodes, and generates quality inspection reports.

Condition Monitoring

Wizard guides are also provided for easy setup without coding; they provide multiple data pre-processing algorithms, such as FFT, IFFT, a variety of filters, smoothers, and mixers. Customized feature extraction algorithms are provided to convert large amounts of data into useful information. Through Ethernet communication protocols, data is uploaded to an IIoT cloud to facilitate remote equipment status monitoring, data analysis, and machine learning.

Big data analysis

Machine learning

Preventive maintenance

Connect to IIoT Cloud

Ethernet communication protocols, such as Modbus and MQTT are supported to upload data to an IIoT cloud.

Simultaneous Remote and Local Operations

Data analysis can be remotely or locally accessed.

Interpretation and Output

Simple configurations are provided for mathematical, bitwise, and logical operations; results are used to generate decision trees.

User and Equipment Authentication

The software comes with an authentication function, which can restrict users from viewing and/or changing system data and parameters, according to permission settings.

Product Offerings




DAQ Cards

Model		PCIE-1810	PCIE-1816 / H	PCIE-1812	PCIE-1802/L
General	OS Support	32-bit/64-bit Windows 7/8/10, and Linux	32-bit/64-bit Windows 7/8/10, and Linux	32-bit/64-bit Windows 7/8/10, and Linux	32-bit/64-bit Windows 7/8/10, and Linux
	Dimensions	167 x 100 mm	167 x 100 mm	167 x 100 mm	168 x 99 mm (6.6 x 3.9in.)
	Bus	PCIe x1	PCIe x1	PCIe x1	PCIe x1
	I/O Connectors	68-pin SCSI female connector	68-pin SCSI female connector	100-pin SCSI female connector	1 × 36-pin VHDCI (mini-SCSI), and 1 × HDMI
	Operating Temperature	0 ~ 60°C (32 ~ 140°F) (refer to IEC 60068-2-1, 2)	0 ~ 60°C (32 ~ 140°F)	0 ~ 60°C (32 ~ 140°F)	0 ~ 60° C (32 ~ 140° F)
	Programming Language	C#,C++,LabVIEW,VB.Net,BCB,MFC, VB6,Delphi,Java,Matlab,Qt	C#,C++,LabVIEW,VB.Net,BCB,MFC, VB6,Delphi,Java,Matlab,Qt	C#,C++,LabVIEW,VB.Net,BCB,MFC, VB6,Delphi,Java,Matlab,Qt	C#,C++,LabVIEW,VB.Net,BCB,MFC, VB6,Delphi,Java,Matlab,Qt
	Triggering	12 bits Analog x 2 / Digital x 2	16 bits Analog x 2 / Digital x 2	16 bits Analog x 2 / Digital x 2	24 bits Analog for any Analog Input / Digital x 2
Analog Input	Sampling Rates(S/s)	500 K	500 K / 1M	250 K	216 K
	Bipolar Inputs (V)	±10V, ±5, ±2.5, ±1.25, ±0.625	±10V, ±5, ±2.5, ±1.25, ±0.625	±10V, ±5, ±2.5, ±1.25, ±0.625	±10, 5, 2, 1, 0.5,0.2
	Channels	16	16	16	8/4
	Type	Scan	Scan	Simultaneous Sample	Simultaneous Sample
	Unipolar Input (V)	0~10, 0~5, 0~0.25, 0~1.25	0~10, 0~5, 0~0.25, 0~1.25	0~10, 0~5, 0~0.25, 0~1.25	-
	Resolution(Bits)	12	16	16	24
	Input Impedance	1 GΩ	1 GΩ	1 GΩ	-
	Trigger Mode	Start trigger, Delay to Start trigger, Stop trigger, Delay to Stop trigger	Start trigger, Delay to Start trigger, Stop trigger, Delay to Stop trigger	Start trigger, Delay to Start trigger, Stop trigger, Delay to Stop trigger	Start, delay to start, stop, or delay to stop trigger
	Overvoltage Protection	30 Vp-p	30 Vp-p	30 Vp-p	±24 V
Analog Output	Resolution(Bits)	12	16	16	-
	Channels	2	2	2	-
	Output Ranges	0 ~ +10 V, 0 ~ +5 V -5V ~ +5 V -10 V ~ +10 V	0 ~ +10 V, 0 ~ +5 V -5V ~ +5 V -10 V ~ +10 V	0 ~ +10 V, 0 ~ +5 V -5V ~ +5 V -10 V ~ +10 V	-
	Update Rate(S/s)	500 K	3 M	3 M	-
Timer/ Counter	Resolution	32 bits	32 bits	32 bits	-
	Channels	2	2	4	-
	Max. Input Frequency	10 MHz	10 MHz	10 MHz	-
TTL DI/O	Input / Output Channels	24 (shared)	24 (shared)	24 (shared)	1-ch DI / 2-ch DO

Signal Condition Modules

ADAM-3011	ADAM-3013	ADAM-3016	ADAM-3017	ADAM-3112	ADAM-3114
Isolated Thermocouple Input Module	Isolated RTD Input Module	Isolated Strain Gauge Input Module	IEPE transducer	Isolated AC Voltage Input Module	Isolated AC Current Input Module

MCM Platforms

Model		MIC-1810	MIC-1816
General	Power Consumption	45W (Typical)	45W (Typical)
	OS Support	Windows 7	Windows 7
	Dimensions	165 x 130 x 59 mm	165 x 130 x 59 mm
	I/O Connectors	2 x RS-232 from COM1/COM2 2 x LAN: 10/100/1000 Mbps	2 x RS-232 from COM1/COM2 2 x LAN: 10/100/1000 Mbps
	Operating Temperature	0 ~ 50°C (14 ~140°F) @ 5 ~ 85% RH	0 ~ 50°C (14 ~140°F) @ 5 ~ 85% RH
	Programming Language	C#,C++,LabVIEW,VB.Net,BCB,MFC,VB6,Delphi,Java,Matlab,Qt	C#,C++,LabVIEW,VB.Net,BCB,MFC,VB6,Delphi,Java,Matlab,Qt
Analog Input	Sampling Rates(S/s)	500 K	500 K
	Bipolar Inputs (V)	±10V, ±5, ±2.5, ±1.25, ±0.625	±10V, ±5, ±2.5, ±1.25, ±0.625
	Channels	16	16
	Type	Scan	Scan
	Unipolar Input (V)	0~10, 0~5, 0~0.25, 0~1.25	0~10, 0~5, 0~0.25, 0~1.25
	Resolution(Bits)	12	16
	Trigger Mode	Start trigger, Delay to Start trigger, Stop trigger, Delay to Stop trigger	Start trigger, Delay to Start trigger, Stop trigger, Delay to Stop trigger
	Overvoltage Protection	30 Vp-p	30 Vp-p
Analog Output	Resolution(Bits)	12	16
	Channels	2	2
	Output Ranges	0 ~ +10 V, 0 ~ +5 V -5V ~ +5 V -10 V ~ +10 V	0 ~ +10 V, 0 ~ +5 V -5V ~ +5 V -10 V ~ +10 V
	Update Rate(S/s)	500 K	3 M
Timer/Counter	Resolution	32 bits	32 bits
	Channels	2	2
	Max. Input Frequency	10 MHz	10 MHz
TTL DI/O	Input / Output Channels	24 (shared)	24 (shared)

USB Modules

Model		USB-5801	USB-5817
General	OS Support	32-bit/64-bit Windows 7/8/10, and Linux	32-bit/64-bit Windows 7/8/10, and Linux
	Dimensions	168 mm x 120 mm x 40 mm (6.6" x 4.7" x 1.6")	120 x 120 x 40 mm (4.72" x 4.72" x 1.57")
	Bus	USB 3.0	USB 3.0
	Operating Temperature	0~60 °C (32~140°F)	0~60 °C (32~140°F)
	Programming Language	C#,C++,LabVIEW,VB.Net,BCB,MFC,VB6,Delphi,Java,Matlab,Qt	C#,C++,LabVIEW,VB.Net,BCB,MFC,VB6,Delphi,Java,Matlab,Qt
Analog Input	Sampling Rates(S/s)	192K	200 K
	Bipolar Inputs (V)	±1 V, ±10 V	±10 V , 0-20 mA
	Channels	4	8
	Type	Simultaneous Sample	Scan
	Unipolar Input (V)	-	0 ~ 10
	Resolution(Bits)	24	16
	IEPE Excitation	2mA	-
Analog Output	Resolution(Bits)	24	-
	Channels	2	-
	Output Ranges	±1 V, ±10 V	-
Tachometer	Resolution	32 bits	-
	Channels	2	-
	Max. Input Frequency	5kHz	-
Isolated DI/O	Input / Output Channels	4-ch DI / 4-ch DO	-