Data Mining Software

AI Controller Data Mining Software

Operation Manual

SYSMAC-AICSTENGE□□L
NOTE

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Microsoft product screen shots reprinted with permission from Microsoft Corporation.
Introduction

Thank you for purchasing the AI Controller Data Mining Software. This manual contains information that is necessary to use the AI Controller Data Mining Software. Please read this manual and make sure you fully understand the functionality and performance before you attempt to use it in a control system.

Keep this manual in a safe place where it will be available for reference during operation.

Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

• Personnel in charge of introducing FA systems.
• Personnel in charge of designing FA systems.
• Personnel in charge of installing and maintaining FA systems.
• Personnel in charge of managing FA systems and facilities.

Notice

This manual contains information that is necessary to use the AI Controller Data Mining Software. Please read and understand this manual before using the software. Keep this manual in a safe place where it will be available for reference during operation.
4-3 Mounting Units

1. Join the Units so that the connectors fit exactly.

2. The yellow sliders at the top and bottom of each Unit lock the Units together. Move the sliders toward the back of the Units as shown below until they click into place.

Precautions for Correct Use

- The sliders on the tops and bottoms of the Power Supply Unit, CPU Unit, I/O Units, Special I/O Units, and CPU Bus Units must be completely locked (until they click into place) after connecting the adjacent Unit connectors.

Special Information

Special information in this manual is classified as follows:

- **Precautions for Safe Use**
  Precautions on what to do and what not to do to ensure safe usage of the product.

- **Precautions for Correct Use**
  Precautions on what to do and what not to do to ensure proper operation and performance.

- **Additional Information**
  Additional information to read as required.
  This information is provided to increase understanding or make operation easier.
Version Information
Information on differences in specifications and functionality for Controller with different unit versions and for different versions of the Sysmac Studio is given.

Precaution on Terminology

• In this manual, the functions of a specific model of the NX-series CPU Units/Controllers may be described with its model specified, such as "NX701 CPU Unit/Controller".
• In this manual, the Controller functions that are integrated in the NY-series Industrial PC may be referred to as an "NY-series Controller".
• The AI Controller Data Mining Software supports the NX/NY-series Controllers. Unless another Controller series is specified, the operating procedures and screen captures used in the manual are examples of the NY-series AI Controllers.

Terminology
For descriptions of the Controller terms that are used in this manual, refer to information on terminology in the manuals that are listed in Related Manuals on page 16.
# AI Controller Data Mining Software Operation Manual (W612)

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WARRANTY

- The warranty period for the Software is one year from the date of purchase, unless otherwise specifically agreed.
- If the User discovers defect of the Software (substantial non-conformity with the manual), and return it to OMRON within the above warranty period, OMRON will replace the Software without charge by offering media or download from OMRON’s website. And if the User discovers defect of media which is attributable to OMRON and return it to OMRON within the above warranty period, OMRON will replace defective media without charge. If OMRON is unable to replace defective media or correct the Software, the liability of OMRON and the User’s remedy shall be limited to the refund of the license fee paid to OMRON for the Software.

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APPLICABLE CONDITIONS

USER SHALL NOT USE THE SOFTWARE FOR THE PURPOSE THAT IS NOT PROVIDED IN THE ATTACHED USER MANUAL.

CHANGE IN SPECIFICATION

The software specifications and accessories may be changed at any time based on improvements and other reasons.
ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.
Safety Precautions

Definition of Precautionary Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the AI Controller Mining Software and the Artificial Intelligence Machine Automation Controller. The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions. The following notation is used.

| WARNING | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. Additionally, there may be severe property damage. |
| Caution | Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage. |

Precautions for Safe Use
Indicates precautions on what to do and what not to do to ensure safe usage of the product.

Precautions for Correct Use
Indicates precautions on what to do and what not to do to ensure proper operation and performance.

Symbols

The ⊓ symbol indicates operations that you must not do. The specific operation is shown in the ⊓ symbol and explained in text. This example indicates prohibiting disassembly.

The △ symbol indicates precautions (including warnings). The specific operation is shown in the △ symbol and explained in text. This example indicates a precaution for electric shock.

The △ symbol indicates precautions (including warnings). The specific operation is shown in the △ symbol and explained in text. This example indicates a general precaution.

The ⋆ symbol indicates operations that you must do. The specific operation is shown in the ⋆ symbol and explained in text. This example shows a general precaution for something that you must do.
Precautions for Safe Use

Operation

- Confirm that the controlled system will not be adversely affected before you perform any of the following operations.
  a) Changing the operating mode of the CPU Unit (including changing the Startup Mode)
  b) Change the settings
- Before you use the system for the actual operation, make sure to verify that errors can be correctly detected by using the results analyzed by this tool. Upon verification, set the machine learning engine to start reading learning data and parameters. Inappropriate settings will result in misjudging errors.
- Before you start the operation, make sure to transfer parameters and data necessary for resuming the operation to the replaced CPU Unit.
- When you restore only part of the data that was backed up, confirm that no problems will occur if you do not restore all of the backup data. Otherwise, malfunction of the device may occur.

Unit Replacement

- The performance may be different if the hardware revisions are different. Before you transfer the user program, data, and parameter settings to the CPU Units with the different hardware revisions, check them for proper execution and then use them for actual operation.
Observe the following precautions before you start the AI Controller Data Mining Software or any of the Support Software that is provided with it.

• Exit all applications that are not necessary to use the AI Controller Data Mining Software. For virus checker or other software that could affect the startup and operations of the AI Controller Data Mining Software, take measures such as to remove the AI Controller Data Mining Software from the scope of virus checking.

• If any hard disks or printers that are connected to the computer are shared with other computers on a network, isolate them so that they are no longer shared.

• With some notebook computers, the default settings do not supply power to the USB port or Ethernet port to save energy. There are energy-saving settings in Windows, and also sometimes disable all energy-saving features. Refer to the user documentation for your computer and disable all energy-saving features.
Regulations and Standards

Software Licenses and Copyrights

This product incorporates certain third party software. The license and copyright information associated with this software is available at ThirdPartyLicenses.txt in DVD media.
Hardware revisions and unit versions are used to manage the hardware and software in NX/NY-series Units and EtherCAT slaves. The hardware revision or unit version is updated each time there is a change in hardware or software specifications. Even when two Units or EtherCAT slaves have the same model number, they will have functional or performance differences if they have different hardware revisions or unit versions.

### Checking Versions

You can check versions on the ID information indications or with the Sysmac Studio.

#### Checking Unit Versions on ID Information Indications

The unit version is given on the ID information indication on the side of the product.

- **Checking the Unit Version of an NX-series CPU Unit**
  The ID information on an NX-series NX701-Z CPU Unit is shown below.

![NX-series CPU Unit ID Information Indication](image)

- **Checking the Unit Version of an NY-series Controller**
  The ID information on an NY-series NY5 Controller is shown below.

![NY-series Controller ID Information Indication](image)
Checking Unit Versions with the Sysmac Studio

You can use the Sysmac Studio to check unit versions. The procedure is different for Units and for EtherCAT slaves.

- **Checking the Unit Version of an NX-series CPU Unit**
  You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can do this for the following Unit.

<table>
<thead>
<tr>
<th>Model</th>
<th>Unit for which version can be checked</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX701-□□□□</td>
<td>CPU Unit</td>
</tr>
</tbody>
</table>

1. Right-click CPU Rack under Configurations and Setup - CPU/Expansion Racks in the Multi-view Explorer and select Display Production Information. The Production Information Dialog Box is displayed.

- **Checking the Unit Version of an NY-series Controller**
  You can use the Production Information while the Sysmac Studio is online to check the unit version of a Unit. You can only do this for the Controller.

1. Right-click CPU Rack under Configurations and Setup - CPU/Expansion Racks in the Multi-view Explorer and select Display Production Information. The Production Information Dialog Box is displayed.

- **Changing Information Displayed in Production Information Dialog Box**

1. Click the Show Outline or Show Detail Button at the lower right of the Production Information Dialog Box. The view will change between the Production Information details and outline.

![Production Information Dialog Box](image)

Outline View  
Detail View

The information displayed is different for the Outline View and the Detail View. The Detail View displays both the unit version and the AI Controller version. The Outline View displays only the unit versions.

**Note** The hardware revision is separated by “/” and is displayed on the right of the hardware version. The hardware revision is not displayed for the Unit that the hardware revision is in blank.
Related Manuals

The following manuals are related. Use these manuals for reference.

<table>
<thead>
<tr>
<th>Manual name</th>
<th>Cat. No.</th>
<th>Model numbers</th>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
</table>
| NJ/NX-series CPU Unit Software User’s Manual | W501 | NX701-□□□□ △△△△ △△△△ △△△△ △△△△ △△△△ | Learning how to program and set up an NJ/NX-series CPU Unit. | The following information is provided on a Controller built with an NJ/NX-series CPU Unit.  
  • CPU Unit operation  
  • CPU Unit features  
  • Initial settings  
  • Programming based on IEC 61131-3 language specifications |
| Sysmac Studio Version 1 Operation Manual | W504 | SYSMAC-SE2□□□ | Learning about the operating procedures and functions of the Sysmac Studio. | Describes the operating procedures of the Sysmac Studio. |
| Sysmac Library AI Predictive Maintenance Library User’s Manual | W610 | SYSMAC-ZPA00□□□ | Learning about the specifications of the AI Predictive Maintenance Libraries and function blocks. | Information necessary to use AI predictive maintenance library is provided. |
| Al Controller Standard Software Operation Manual | W611 | SYSMAC-AICST□□□□□□L | Learning about the overview of the Al Controller Standard Software and how to use it. | This manual describes the overview of the Al Controller Standard Software (Al Operator, Al Viewer), how to install the software, basic operations, connections, and how to use the main functions. |
| NY-series IPC Machine Controller Industrial Panel PC / Industrial Box PC Software User’s Manual | W558 | NY532-1□□□□ △△△△ △△△△ △△△△ △△△△ | Learning how to program and set up the Controller functions of an NY-series Industrial PC. | The following information is provided on the NY-series Controller functions.  
  • Controller operation  
  • Controller features  
  • Controller settings  
  • Programming based on IEC 61131-3 language specifications |
Revision History

A manual revision code appears as a suffix to the catalog number on the front and back covers of the manual.

<table>
<thead>
<tr>
<th>Revision code</th>
<th>Date</th>
<th>Revised content</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>October 2018</td>
<td>Original production</td>
</tr>
</tbody>
</table>
Overview of the AI Controller Data Mining Software

This section provides an overview and lists the specifications of the AI Controller Data Mining Software and describes its features and components.

1-1 The AI Controller Data Mining Software

1-2 Specifications
1-1 The AI Controller Data Mining Software

The AI Controller Data Mining Software is designed for the Artificial Intelligence Machine Automation Controller (abbreviation: AI Controller) to perform predictive maintenance on the system and is used in the data analysis phase.

Main Features

- Making Data Analysis Easier
  The AI Controller Data Mining Software consists of the AI Easy Modeler. The AI Easy Modeler is a tool designed to generate a necessary AI machine learning model for the AI Controller’s AI function. It works on Windows.

- Easy Operation
  The AI Easy Modeler makes data analysis easier for users with limited controller programming experiences and limited knowledge on statistics.
1-2 Specifications

Product Model Numbers

The product AI Controller Data Mining Software consists of a DVD media and a license, each of which is given a model number.

If you are purchasing the AI Controller Data Mining Software for the first time, purchase both a DVD and one or more licenses. The media is the same for all of the licenses. If you are purchasing the product for additional licenses, you can purchase only the licenses. You can also purchase the DVD separately.

The DVD is not included with the licenses.

- DVD

<table>
<thead>
<tr>
<th>Product</th>
<th>Media</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI Controller Data Mining Software Ver.1.□□</td>
<td>DVD</td>
</tr>
</tbody>
</table>

- Licenses

<table>
<thead>
<tr>
<th>Product</th>
<th>Number of licenses</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI Controller Data Mining Software Ver.1.□□</td>
<td>1 license</td>
<td>SYSMAC-AICSTENGEL01L</td>
</tr>
<tr>
<td></td>
<td>10 licenses</td>
<td>SYSMAC-AICSTENGEL01L</td>
</tr>
<tr>
<td></td>
<td>30 licenses</td>
<td>SYSMAC-AICSTENGEL030L</td>
</tr>
<tr>
<td></td>
<td>50 licenses</td>
<td>SYSMAC-AICSTENGEL050L</td>
</tr>
</tbody>
</table>

Support Software That You Can Install from the DVD media of AI Controller Data Mining Software and Enclosed Data

The following table lists the Support Software that you can install from the DVD media of AI Controller Data Mining Software and the data that is included in the DVD media.

<table>
<thead>
<tr>
<th>Installable Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI Easy Modeler</td>
<td>Ver.1.□□</td>
</tr>
</tbody>
</table>

Supported Languages

The AI Controller Data Mining Software supports the following languages.

Japanese, English

Applicable Models

The models that you can select when you create a project on the AI Controller Data Mining Software are given in the following tables.

Controllers
### Applicable Computers

The AI Controller Data Mining Software is a Microsoft Windows-based software. The supported operating systems are listed below.

- Windows 7 (32-bit or 64-bit edition)
- Windows 10 (32-bit or 64-bit edition)

Apply the latest updates to the OS installed on your computer to ensure that it is always up-to-date.

Installation of the following applications is a system requirement for the AI Controller Data Mining Software.

- .NET Framework 3.5
- .NET Framework 4.6.1

It is installed automatically if it is not already installed on the computer when the AI Controller Data Mining Software is installed.

### System Requirements

The system requirements for the AI Controller Data Mining Software are given in the following table.

<table>
<thead>
<tr>
<th>OS</th>
<th>CPU</th>
<th>RAM</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 7 (32-bit or 64-bit edition)</td>
<td>IBM AT or compatible with Intel® Celeron® processor 540 (1.8 GHz)</td>
<td>2 GB</td>
<td>XGA 1024 x 768 16 million colors</td>
</tr>
<tr>
<td>Windows 10 (32-bit or 64-bit edition)</td>
<td>IBM AT or compatible with Intel® Core™ i5 M520 processor (2.4 GHz) or the equivalent</td>
<td>4 GB or more</td>
<td>WXGA 1280 x 800 16 million colors</td>
</tr>
</tbody>
</table>

In addition, the following are also required.

<table>
<thead>
<tr>
<th>System requirement</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free HDD space required for software installation</td>
<td>4.6 GB or more</td>
</tr>
<tr>
<td>Optical drive type</td>
<td>DVD-ROM drive</td>
</tr>
<tr>
<td>Communications port</td>
<td>Ethernet</td>
</tr>
</tbody>
</table>
Basic Operation of the AI Controller Data Mining Software

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2-2 Basic Flow of Operation .................................................................. 2 - 3
2-1 Installation and Uninstallation

The installation and uninstallation procedures conform to those for the AI Controller Standard Software. Refer to 2-2 Installation Procedure or 2-3 Uninstallation Procedure in the AI Controller Standard Software Operation Manual (Cat. No. W611) for details.
2-2 Basic Flow of Operation

This section describes the basic operation flow for using the AI Easy Modeler. The following shows the basic operation flow.

**STEP 1 Read data**
Read analysis data that was output from AI Operator.

**STEP 2 Determine parameters**
The AI Easy Modeler automatically calculates the optimum parameters from the read analysis data. Parameters refer to the combination of variable data, a feature calculation method and subframe variables, as well as the threshold values.

**STEP 3 Reassign labels and redetermine parameters**
Reassign labels when you want to improve the index of Accuracy, Missed Rate, Over Detected Ratio, or Sigma Rate. This step is optional.

**STEP 4 Generate AI machine learning model**
The AI machine learning model is generated based on the calculated parameters in STEP 2 and STEP 3. The software exits when the generation completes.

- **STEP 1 Read Data**

  Start the AI Easy Modeler by reading data that was output from the AI Operator. Data to load varies depending on whether you use the AI predictive maintenance library or not.

<table>
<thead>
<tr>
<th>Usage of AI predictive maintenance library</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>Select <em>Reading from feature data (new)</em>. Feature data (FTR_DATA) is used as analysis data.</td>
</tr>
<tr>
<td>Do not use</td>
<td>Select <em>Reading from anl data (new)</em> or <em>Read from existing data</em>. ANL_DATA is used as analysis data.</td>
</tr>
</tbody>
</table>

- **STEP 2 Determine Parameters**

  Using analysis data as the input, the feature values are calculated by the combination of variable data, a feature value calculation method, and subframe variables.

  Among those values, the optimum combination for monitoring an equipment event is automatically selected by the AI Easy Modeler.

  Next, the threshold that is automatically calculated by the machine learning algorithm is displayed on the screen. The combination of variable data, a feature calculation method, and subframe variables varies depending on whether you use the AI predictive maintenance library or not.
### Usage of AI predictive maintenance library

<table>
<thead>
<tr>
<th>Usage of AI predictive maintenance library</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>They are selected automatically.</td>
</tr>
<tr>
<td>Do not use</td>
<td>Another combination can be reselected. Up to 16 variables can be selected.</td>
</tr>
</tbody>
</table>

Refer to 3-4-5 *Determine Parameters and AI Machine Learning Model* on page 3 - 9 for details on the procedure.

#### STEP 3 Reassign Labels and Redetermine Parameters

You can reassign labels after the parameters are determined. When you reassign labels, the parameters are recalculated. Refer to 3-4-1 *Labeling by Using the Feature Value* on page 3 - 6 and 3-4-4 *Labeling by Using the Feature Graph* on page 3 - 8 for details on the procedure.

#### STEP 4 Generate AI Machine Learning Model

When you click the Generate learned data button, the AI machine learning model outputs. This software terminates when the AI machine learning model has been created. Refer to 3-4-5 *Determine Parameters and AI Machine Learning Model* on page 3 - 9 for details on the procedure.
Functions of the AI Easy Modeler

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  3-4-5 Determine Parameters and AI Machine Learning Model ............................ 3 - 9
3-1 Start and Exit the AI Easy Modeler

Starting AI Controller Data Mining Software

From Windows Start Menu, select **OMRON - AI Controller Data Mining Software** and start the application.

Precautions for Correct Use

This software can not be activated in duplicate.

Exiting AI Controller Data Mining Software

The software closes in the following cases:

- The \* button in the upper-right corner of a window is clicked.
- The AI machine learning model has been generated.
This screen consists of State Transition Menus, Variable List Window that lists combinations of variable data, feature calculation method, and subframe variables selected by the software, Main Window that shows equipment event monitoring score as the result of data mining, and Log Window. The overview of the functions on each window is described below.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Area name</th>
<th>Outline of function</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>State Transition Menu</td>
<td>Displays the current status of the data mining processes. The status is available in the following six processes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1) Read data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2) Cleansing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3) Feature value generation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4) Visualization/Labeling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5) Determine parameters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6) Completed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The steps (1) through (3) are automatically completed when the software starts up.</td>
</tr>
<tr>
<td>(B)</td>
<td>Variable List Window</td>
<td>It is a list of combinations consisting of variable data, a feature calculation method, and subframe variables, which are used for calculating equipment event monitoring scores based on the machine learning algorithm (Isolation Forest).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The optimum combination for detecting anomaly is selected automatically.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Users cannot select this combination if the AI Predictive Maintenance Libraries are used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If the AI Predictive Maintenance Libraries are not used, users can select a combination.</td>
</tr>
</tbody>
</table>
### Symbol

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Area name</th>
<th>Outline of function</th>
</tr>
</thead>
</table>
| (C)    | Main Window     | Displays the data mining result. Data mining is performed by using a combination of variable data selected on the Variable List Window, a feature calculation method, and subframe variables. The following will appear:  
  • Equipment event monitoring score and threshold  
  • Feature value  
  • Variable data in the interval where feature values are calculated |
| (D)    | Log Window      | Displays the processing history.                                                                                                                                                                     |

### Precautions for Correct Use

In the state transition menu, the options users can use are (4) Visualization/Labeling and (5) Determine parameters only.
3-3 Reading Analysis Data

This section describes the procedure to read analysis data into the AI Easy Modeler. When you start the AI Easy Modeler, the file selection window shown below appears. On the file selection window, select a file used for reading analysis data in the procedure described below.

1 Select a file to read.

<table>
<thead>
<tr>
<th>Area name</th>
<th>Outline of function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading from anl data (new)</td>
<td>Select this option when you read new analysis data without using the AI Predictive Maintenance Library.</td>
</tr>
<tr>
<td>Read from existing data</td>
<td>Select this option when you reuse analysis data that was previously read to AI Easy Modeler without using the AI Predictive Maintenance Library.</td>
</tr>
<tr>
<td>Reading from feature data (new)</td>
<td>Select this option when you read new feature values from the AI Predictive Maintenance Library.</td>
</tr>
</tbody>
</table>

2 Click the File selection button and read data you want to analyze.

3 Click the **OK** button.

**Additional Information**

To create analysis data, open the **AI Machine Learning Model Creation** screen on the AI Operator and follow the steps described below:

(1) On the **AI Machine Learning Model Creation** screen, press Ctrl+Alt+o. This will display the Reference button, the Export button, and the Import button.

(2) Select an equipment event that will be used to generate analysis data.

(3) Press the Reference button and select an CSV file. When you use data from other than the AI Predictive Maintenance Libraries, select analysis data (ANL-****.csv). When you use data from the AI Predictive Maintenance Library, select feature data (FTR-****.csv).

(4) Press the Export button and select a folder to save the data. A new folder for the equipment event ID is created in the specified folder.

This folder contains analysis data. You will read this folder into the AI Easy Modeler.
3-4 Visualization and Labeling

3-4-1 Labeling by Using the Feature Value

Use the following procedure to assign labels (normal, anomaly, delete) to frame.

1. Click 4. Visualization/Labeling in the state transition menu.

2. In the table of extracted features, right-click on a frame you want to assign a label.

3. Select Normal (O), Anomaly (×), or Delete (■).

The labeling completes.

Click 5. Determine parameters in the status transition menu. The parameters are recalculated.

Additional Information

- The frame with the Delete (■) option selected are removed from the analysis target. The accuracy of the machine learning improves by eliminating data containing noise or that of unstable behavior.
- Labeling can be also specified from the feature data graph. Refer to 3-4-4 Labeling by Using the Feature Graph on page 3 - 8 for details.

3-4-2 Displaying the Feature Graph

When you select the Feature value button in the variable list, you can display a time-series graph for the feature value.

1. Click 4. Visualization/Labeling in the state transition menu.
2. Press any Feature value button from the Variable List Window. The time-series graph of the feature value you selected appears.

3. Press the Graph Operation button.

By clicking the following icons, you can move or zoom the graph.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>Move button</td>
<td>Allows you to move the graph.</td>
</tr>
<tr>
<td>(B)</td>
<td>Zoom button</td>
<td>Allows you to zoom the graph.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To zoom, drag the area you want to zoom.</td>
</tr>
<tr>
<td>(C)</td>
<td>Full-screen</td>
<td>Restores the initial view mode (full screen mode) of the graph.</td>
</tr>
</tbody>
</table>

3-4-3 Displaying Variable Data

You can display variable data for a frame that is used for calculating feature values.

1. Follow the steps described in 3-4-2 Displaying the Feature Graph on page 3 - 6 and display the time-series graph of feature values.

2. Press the Anl data tab.
   On the time-series graph, select data for a frame you want to confirm.

3. Press the Variable data button.
   The variable data of the selected frame appears.
3-4-4 Labeling by Using the Feature Graph

Use the following procedure to assign labels (normal, anomaly, delete) to feature data on the Visualization/Labeling window.

1. Follow the steps described in 3-4-2 Displaying the Feature Graph on page 3-6 and display the time-series graph of feature values.

2. Press the Label operation tab.
   On the time-series graph, select data for a frame you want to confirm.

3. Click the Normal, Anomaly or Delete button to assign the label.
Symbol | Item name | Description
-------|---------|------------------
(A)    | Normal button | Assigns label information of Normal to the data for a frame selected by a user.
(B)    | Anomaly button | Assigns label information of Anomaly to the data for a frame selected by a user.
(C)    | Delete button | Assigns label information of Delete to the data for a frame selected by a user. Deleted frames are not used for mining.

### 3-4-5 Determine Parameters and AI Machine Learning Model

The equipment event monitoring score is calculated based on the label information specified in 3-4-1 Labeling by Using the Feature Value on page 3 - 6 and 3-4-4 Labeling by Using the Feature Graph on page 3 - 8.

1. Perform the steps described in 3-4-1 Labeling by Using the Feature Value on page 3 - 6 or 3-4-4 Labeling by Using the Feature Graph on page 3 - 8.

2. Click **5. Determine parameters** in the status transition menu.

3. Check the parameters of a selected combination of variable data, feature calculation method, and subframe variable, as well as Threshold 1 and 2 values. If you need to adjust the parameters, go back to the steps described in 3-4-1 Labeling by Using the Feature Value on page 3 - 6 or 3-4-4 Labeling by Using the Feature Graph on page 3 - 8 to assign labels.

4. If necessary, you can adjust the threshold by using the **Threshold 2** slide bar and specifying a difference between Threshold 1 and Threshold 2.

5. On the Variable List Window, select another combination of variable data, a feature calculation method and subframe variables as needed.
If there is no problem with the parameter values, click the **Generate learned data** button. This outputs the AI machine learning model and causes this software to exit.

The following table provides description of the figure. Refer to **A-1 Definition of Terms** on page A - 2 for details on the terms appearing in the table.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>Check item</td>
<td>This software adds a check automatically. Users can also select it manually. When the selection is modified, the equipment event monitoring score is recalculated.</td>
</tr>
<tr>
<td>(B)</td>
<td>Accuracy</td>
<td>Display the rate of normal labeled data that was judged as Alrt Lv1 or normal, and anomaly labeled data that was judged as Alrt Lv2. It is modified after each recalculation.</td>
</tr>
<tr>
<td>(C)</td>
<td>Threshold 2</td>
<td>Threshold 2 is displayed. It is modified after each recalculation.</td>
</tr>
<tr>
<td>(D)</td>
<td>Warning difference</td>
<td>Displays the difference between Threshold 1 and Threshold 2. Users can change this value.</td>
</tr>
<tr>
<td>(E)</td>
<td>Select valid variable</td>
<td>Displays the number of values selected on the Variable List Window.</td>
</tr>
<tr>
<td>(F)</td>
<td>Threshold 2 slide bar</td>
<td>Allows users to adjust Threshold 2. The accuracy, missed rate, over detected ratio, and sigma rate will be recalculated every time you adjust this value.</td>
</tr>
<tr>
<td>(G)</td>
<td>Monitoring index graph</td>
<td>Displays the graph of the equipment event monitoring scores. Red indicates Threshold 2 and yellow indicates Threshold 1.</td>
</tr>
<tr>
<td>(H)</td>
<td>Missed Rate</td>
<td>Displays the rate of anomaly labeled data that was judged as Alrt Lv1 or normal.</td>
</tr>
<tr>
<td>(I)</td>
<td>Over Detected Ratio</td>
<td>Displays the rate of normal labeled data that was judged as Alrt Lv2.</td>
</tr>
<tr>
<td>(J)</td>
<td>Sigma Rate</td>
<td>Displays the rate of data judged as Alrt Lv2. It is calculated based on the standard deviation in the statistical quality control. (e.g. 3σ)</td>
</tr>
<tr>
<td>(K)</td>
<td>Generate learned data</td>
<td>Extracts only the normal labels from the selected feature values and generates the AI machine learning model.</td>
</tr>
<tr>
<td>(L)</td>
<td>Reset button</td>
<td>Restores the parameters to the state right after 5. Determine parameters was pressed.</td>
</tr>
</tbody>
</table>
Precautions for Correct Use

The feature data variables cannot be changed for the AI predictive maintenance library.
3 Functions of the AI Easy Modeler
Appendices

A-1 Definition of Terms ........................................................................................................ A - 2
A-2 Error Messages .............................................................................................................. A - 3
   A-2-1 Error Messages and Corrections .............................................................................. A - 3
# Definition of Terms

The following table summarizes the description of terms that are related to the values displayed in 3-4-5 Determine Parameters and AI Machine Learning Model on page 3 - 9.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missed Rate</td>
<td>The rate of anomaly labeled data that was judged as Alrt Lv1 or normal. (Formula: FN/(TP + FN))</td>
</tr>
<tr>
<td>Over Detected Ratio</td>
<td>The rate of normal labeled data that was judged as Alrt Lv2. (Formula: FP/(FP + TN))</td>
</tr>
<tr>
<td>Accuracy</td>
<td>The rate of normal labeled data that was judged as Alrt Lv1 or normal, and anomaly labeled data that was judged as Alrt Lv2 out of the entire data. Formula: (TP + TN)/Number of data counts</td>
</tr>
<tr>
<td>Sigma Rate</td>
<td>The distribution of the area assumed to be Alrt Lv2 (= area equal to or greater than Threshold 2) out of the entire data distribution</td>
</tr>
<tr>
<td>True positive (TP: True Positive)</td>
<td>Number of anomaly labeled data judged as Alrt Lv 2.</td>
</tr>
<tr>
<td>True negative (TN: True Negative)</td>
<td>Number of normal labeled data judged as Alrt Lv1 or normal.</td>
</tr>
<tr>
<td>False positive (FP: False Positive)</td>
<td>Number of normal labeled data judged as Alrt Lv2</td>
</tr>
<tr>
<td>False negative (FN: False Negative)</td>
<td>Number of anomaly labeled data judged as Alrt Lv1 or normal</td>
</tr>
</tbody>
</table>
# A-2 Error Messages

## A-2-1 Error Messages and Corrections

The following table summarizes details of the error messages for this software along with the troubleshooting methods.

<table>
<thead>
<tr>
<th>Error message</th>
<th>Cause</th>
<th>Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>No file is selected. Exit the application.</td>
<td>File not selected</td>
<td>Select a file.</td>
</tr>
<tr>
<td>Failed to load the event setting file. Please check if the file exists in the selected folder. Exit the application.</td>
<td>You have specified a folder that does not contain the equipment event file.</td>
<td>During 3-3 Reading Analysis Data on page 3 - 5, specify a folder containing the equipment event file (Event.xml).</td>
</tr>
<tr>
<td>Feature amount calculation process failed. Please retrieve the data again. Exit the application.</td>
<td>Feature value calculation failed due to invalid data input.</td>
<td>Try retrieving the data again.</td>
</tr>
<tr>
<td>Cleansing process failed. Please retrieve the data again. Exit the application.</td>
<td>Failed in checking input data due to invalid data input.</td>
<td>Try retrieving the data again.</td>
</tr>
<tr>
<td>The parameter determination process failed. Please retrieve the data again. Exit the application.</td>
<td>Parameter definition failed due to invalid data input.</td>
<td>Try retrieving the data again. Contact the Engineering Department of OMRON for details on the error code.</td>
</tr>
<tr>
<td>Frame is not specified in Event.xml. Please specify the Frame variable. Exit the application.</td>
<td>No Frame variable specified in equipment event file.</td>
<td>Specify Frame variable using the AI Controller Standard Software. Contact the Engineering Department of OMRON for details.</td>
</tr>
<tr>
<td>EntryVariables is not specified in Event.xml. Please specify EntryVariables. Exit the application.</td>
<td>No EntryVariables specified in equipment event file.</td>
<td>Specify EntryVariables variable using the AI Controller Standard Software. Contact the Engineering Department of OMRON for details.</td>
</tr>
<tr>
<td>The variable of the feature quantity data exceeds the valid variable that can be specified. Please do not exceed effective variable. Exit the application.</td>
<td>The number of feature values exceeded the value specified in the application setting file.</td>
<td>Check the settings in the application setting file. Contact the Engineering Department of OMRON for details.</td>
</tr>
<tr>
<td>Failed to read ANL data. Select ANL data. Exit the application.</td>
<td>Cannot read ANL data.</td>
<td>Select ANL data.</td>
</tr>
<tr>
<td>Failed to read feature data. Please select feature data. Exit the application.</td>
<td>Cannot read feature data.</td>
<td>Select feature data.</td>
</tr>
<tr>
<td>Feature amount cannot be calculated because there is no ANL data. Please read ANL data. Exit the application.</td>
<td>Cannot read ANL data.</td>
<td>Check that specified ANL data exists.</td>
</tr>
<tr>
<td>Data of extracted features necessary to determine parameters does not exist. Please check the labeling.</td>
<td>Labeling information is invalid.</td>
<td>Check labeling.</td>
</tr>
<tr>
<td>Because there is no feature amount data, it cannot be cleansed. Please let me load feature data. Exit the application.</td>
<td>No feature data.</td>
<td>Select feature data.</td>
</tr>
<tr>
<td>Error message</td>
<td>Cause</td>
<td>Correction</td>
</tr>
<tr>
<td>---------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>There are no variables to output. The application will be terminated.</td>
<td>Invalid equipment event file content.</td>
<td>Check the AI Controller Standard Software settings. Contact the Engineering Department of OMRON for details.</td>
</tr>
<tr>
<td>Cleansing is not possible because there is no ANL data. Exit the application.</td>
<td>Cannot read ANL data.</td>
<td>Check that specified ANL data exists.</td>
</tr>
<tr>
<td>Variable specified in ANL data does not exist. Exit the application.</td>
<td>Variable not specified in ANL data.</td>
<td>Properly set variable to be analyzed using the AI Controller Standard Software.</td>
</tr>
<tr>
<td>There is no variable specified in the feature data. Exit the application.</td>
<td>No variable is specified in feature data.</td>
<td>Properly set variable to be analyzed using the AI Controller Standard Software.</td>
</tr>
<tr>
<td>FIX data does not exist. Exit the application.</td>
<td>FIX data does not exist.</td>
<td>Check whether FIX data exists. If FIX data does not exist, run application in Reading from ANL data or Reading from feature data mode.</td>
</tr>
<tr>
<td>Can not write to the following files. Please close it if it is open. &lt;file_name&gt;</td>
<td>&lt;file_name&gt; is opened by another application.</td>
<td>Close the application where &lt;file_name&gt; is open.</td>
</tr>
<tr>
<td>Learning data could not be written. Please close the application that opened the writing destination folder.</td>
<td>Cannot access a folder to write to.</td>
<td>Close the application that opened the writing destination folder.</td>
</tr>
<tr>
<td>Since there is no folder in the specified path &lt;path name&gt;, Exit the application.</td>
<td>Folder does not exist.</td>
<td>Create a folder.</td>
</tr>
<tr>
<td>You can not write to the selected folder. Please select another folder.</td>
<td>Cannot access a folder to write to.</td>
<td>Close the application that opened the writing destination folder.</td>
</tr>
<tr>
<td>The following file / folder does not exist in the project path. Quit the application. &lt;file_name&gt;</td>
<td>File or folder does not exist in project path.</td>
<td>Check to see that file or folder exists.</td>
</tr>
<tr>
<td>Specify a project path. Exit the application.</td>
<td>The project path is not specified.</td>
<td>Specify a project path.</td>
</tr>
<tr>
<td>It is illegal input data. Because processing can not continue, quit the application. Error code: *****</td>
<td>The error occurred due to the following causes: (1) Invalid input data was read. (2) The AI machine learning model cannot be created because invalid data was used in the feature value calculation, such as zero division or infinite divergence.</td>
<td>Cause 1. Correct the user program and try retrieving data again. Detailed causes are described below. • The header is not specified for the input data. • The variable name column specified in the equipment event file does not exist. Cause 2. It could be due to problems with the data retrieval environment. Check the system environment and try retrieving data again.</td>
</tr>
<tr>
<td>Multiple applications cannot run.</td>
<td>This application is already running.</td>
<td>Exit the application that is already running.</td>
</tr>
<tr>
<td>An unexpected error occurred. Please reinstall the application.</td>
<td>File necessary for application does not exist.</td>
<td>Reinstall the application. Contact the Engineering Department of OMRON for details.</td>
</tr>
</tbody>
</table>
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- Programmable Logic Controllers (PLC) • Temperature Controllers • Remote I/O

Robotics
- Industrial Robots • Mobile Robots

Operator Interfaces
- Human Machine Interface (HMI)

Motion & Drives
- Machine Automation Controllers (MAC) • Motion Controllers • Servo Systems
- Frequency Inverters

Vision, Measurement & Identification
- Vision Sensors & Systems • Measurement Sensors • Auto Identification Systems

Sensing
- Photoelectric Sensors • Fiber-Optic Sensors • Proximity Sensors
- Rotary Encoders • Ultrasonic Sensors

Safety
- Safety Light Curtains • Safety Laser Scanners • Programmable Safety Systems
- Safety Mats and Edges • Safety Door Switches • Emergency Stop Devices
- Safety Switches & Operator Controls • Safety Monitoring/Force-guided Relays

Control Components
- Power Supplies • Timers • Counters • Programmable Relays
- Digital Panel Meters • Monitoring Products

Switches & Relays
- Limit Switches • Pushbutton Switches • Electromechanical Relays
- Solid State Relays

Software
- Programming & Configuration • Runtime