SIEMENS

Industrial Edge

App
Anomaly Detection for Industrial Edge

Application Manual

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Digital Industries
Postfach 48 48
90026 NÜRNBERG
GERMANY

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Introduction 1

1.1 Security information

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement - and continuously maintain - a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit:

https://www.siemens.com/industrialsecurity (https://new.siemens.com/global/en/company/topic-areas/future-of-manufacturing/industrial-security.html)

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under:

https://www.siemens.com/industrialsecurity (https://new.siemens.com/global/en/company/topic-areas/future-of-manufacturing/industrial-security.html)

1.2 Note on EU General Data Protection Regulation

Data protection

Siemens observes the principles of data protection, in particular the principle of data minimization (privacy by design). For the Anomaly Detection product, this means: the product processes / stores the following personal data: User name (first name and last name), email address, user role, user language, user-specific settings, smart device information and app usage data (number of users; number of KPI instances).

No private or intimate data is processed or stored.

The above data are required for the login, the billing function and for the internal user administration (administrator can see the role and the status of other users). The storage of data

is appropriate and limited to what is necessary, as it is essential to identify the authorized operators. The data needs to be maintained manually by you and if necessary, these can also be deleted. If you need support, please contact customer support.

The above data will not be stored anonymously or pseudonymized, because the purpose (identification of the operating personnel) cannot be achieved otherwise.

The above data is protected against loss of integrity and confidentiality by state-of-the-art security measures.

1.3 Security Information for Industrial Edge Apps

Security information (assumptions/constraints) for Industrial Edge Apps is as follows:

- Only authorized internal operators will have access to Industrial Edge Device within a secure network using VPN connection.
- Perimeter firewall configuration responsibility lies with the end customer.
- The security guidelines for usage of USB Flash Drives in the shop floor area are applied accordingly.
- Creating users with appropriate access rights upon commissioning is the responsibility of the operator.
- The customer is responsible for configuring the application on the basis of the system requirements and technical capabilities of the documented App according to the Installation / User Manual such that the automation system performance is not impacted.
- The system is installed in an environment ensuring that physical access is limited to authorized maintenance personnel only. Managing unauthorized attachment of removable devices is the responsibility of the operator.
- The platform including hardware, firmware and operating system is securely configured and maintained by the operator.
- The operator is capable of protecting the environment from malware infection.
- Centralized IT security components (Active Directory, Centralized IT Logging Server) are provided and well secured by the operator and are trustworthy.
- The operator personnel accessing the system is well trained in the usage of the system and general information security aspects like password handling, removable media, etc.
- The operator is responsible for the CIA (Confidentiality, Integrity and Availability) of data stored outside the Industrial Edge Device.
- The operator is responsible for configuring the CPUs with appropriate read/write access levels (legitimization), and for configuring the Industrial Edge Apps using appropriate passwords for data collection from CPUs.
- The customer takes care about the time synchronization of Industrial Edge Management and Industrial Edge Device.

1.4 Overview of Industrial Edge

Siemens Industrial Edge is the next generation of digital automation. With Industrial Edge, you use intelligence and scalability of the cloud directly in your manufacturing - in a simple, high-performance manner and without your data leaving the manufacturing process. Industrial Edge combines local and high-performance data processing directly in automation with the advantages of the cloud: app-based data analysis, data processing and Infrastructure-as-a-Service concepts with central update functionality. In this way, you can quickly integrate apps into manufacturing and manage them with a high degree of automation.

Industrial Edge gives you the opportunity to continuously make changes to your automation components and plants, analyze large volumes of data in automation to realize innovative functions, such as preventive maintenance, and to obtain maximum flexibility and thus productivity over the entire machine life cycle.

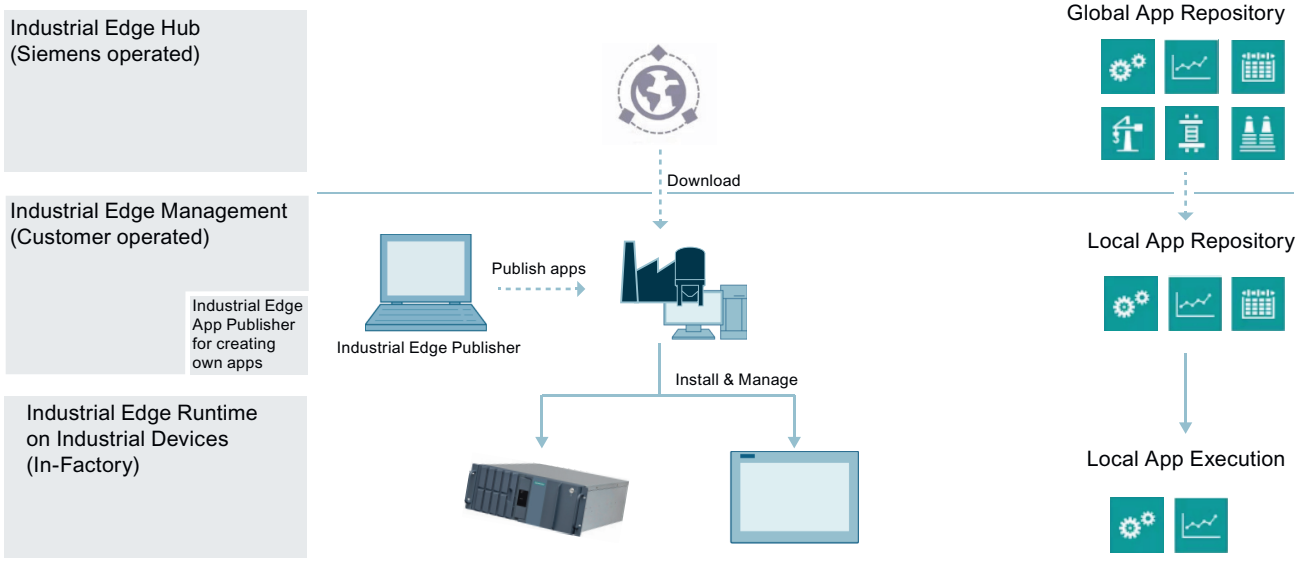
With the Industrial Edge Hub, an App Store is available to you where you can find all Siemens apps and 3rd-party apps. From here, you can manage all licenses for your apps and devices centrally and install updates for security issues, device firmware, apps and Industrial Edge Management.

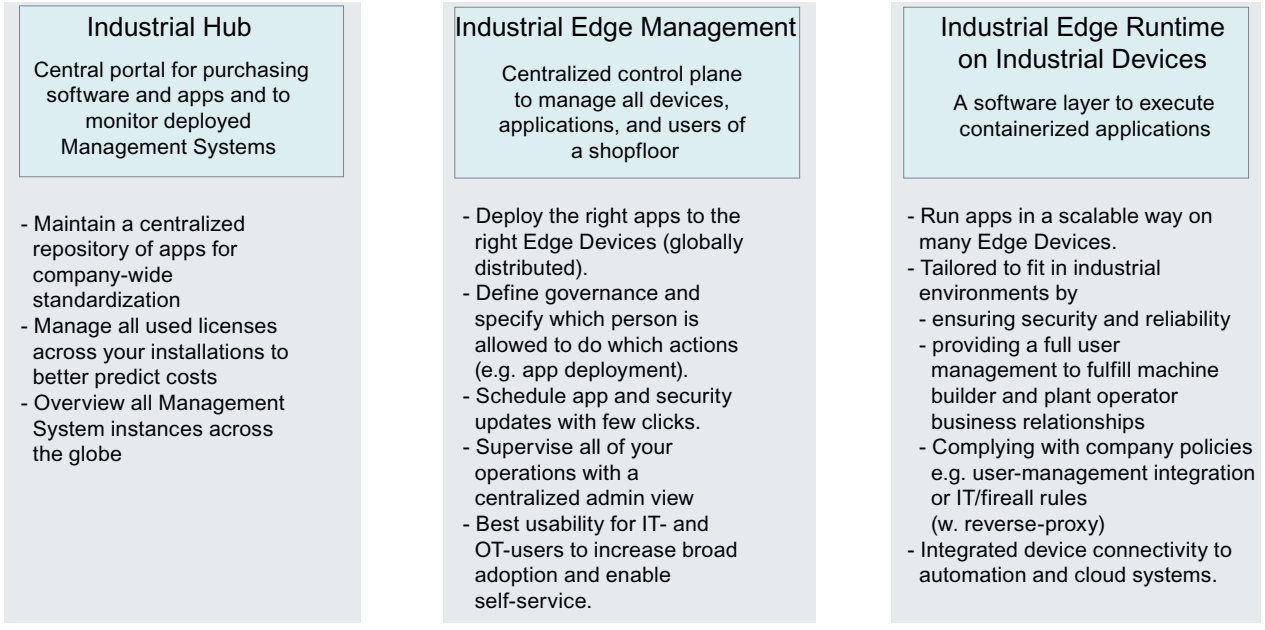
You can monitor and manage distributed Edge devices centrally in the Industrial Edge Management. In this way, new apps and software functions, for example, can be installed on all connected Edge devices company-wide. Central software management thus minimizes the workload for performing maintenance and updates on individual devices.

On the individual Industrial Edge devices, you can start and run apps and keep statistics on an Edge device, for example.

With the Industrial Edge Publisher, you can develop your own Edge apps and make them available to other users in Industrial Edge Management.

Another component of the Industrial Edge ecosystem is Industrial Edge Runtime, which is installed on Edge Devices (IED) or Unified Comfort Panels (UCP) and on which the system, including all applications, ultimately runs.





1.5 Function overview

Introduction

The app Anomaly Detection allows you to use a neural network to discover and analyze anomalies in the data of the assets created in the Data Service .

To do this, you first create an anomaly model based on asset time series data. Anomalies within the assigned asset are then discovered and visualized on the basis of this model.

Browser recommendation

We recommend the Google Chrome web browser. Internet Explorer is no longer supported as of version 11.

It is recommended to use 1920 x 1200 as resolution.

Installation 2

2.1 Validity of the documentation

Description

The Anomaly Detection documentation is valid for installing the app on an edge device.

2.2 Overview of additional documentation

Overview

The following table lists additional documents that supplement this description, some of which are available on the Internet.

Documentation	Most important contents
Industrial Edge Hub (https://iehub.eu1.edge.siemens.cloud)	This page describes the functions of the Siemens Industrial Edge platform and the functionalities of the Edge management system.
System overview (https://new.siemens.com/global/de/produkte/automatisierung/themenfelder/industrial-edge/simatic-edge.html)	This page provides an overview of all Edge solutions.

2.3 System requirements

Note the following system requirements for the installation of the Edge Apps.

Software requirements

The following Internet browsers are required:

- Google Chrome, Version ≥ 89
- Data Service ≥1.2
  You need to install the Data Service app. The app is available in the Industrial Edge Hub in the "Library" area. From there you can transfer the app to your Industrial Edge Management (IEM) and from there install it on your Industrial Edge Device (IED).
  With the Data Service app you model the structure of your industrial process using the assets and aspects that you then need for the plant structure of the Edge apps.

Hardware requirements

- A device on which the Industrial Edge Management (IEM) is running (VM - ISO: Version 1.1.0-48 or greater)
- An Edge device (IED) that is compatible with Industrial Edge Management:
  - IED Model: e.g. SIMATIC IPC 227E Nanobox and SIMATIC IPC 427E
  - IED Version: ied-os-1.1.0-19 or greater
  - Hard disk: At least 10 GB available
  - RAM: 2.4 GB available RAM
- The Edge device must be on board the Industrial Edge Management.

IEM, IED, and web browsers must be synchronous in the UTC time zone.

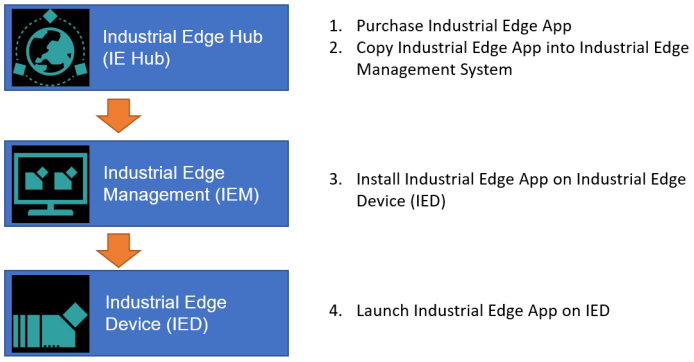
2.4 Installing Anomaly Detection on an IED

2.4.1 Overview of the installation process

Description

In the graphic below you can see the steps involved in the installation of an Industrial Edge app on an Industrial Edge device:

Installation process of an Industrial Edge App via Industrial Edge Hub



Additional information is available here:

1. Purchasing the Anomaly Detection app in the Industrial Edge Hub (Page 11)
2. Copying the Anomaly Detection app from the IE Hub to the IEM catalog (Page 11)
3. Copying Anomaly Detection into the IEM catalog (Page 12)
4. Installing Anomaly Detection on the IED (Page 12)

2.4.2 Purchasing the Anomaly Detection app in the Industrial Edge Hub

Description

The "Market" tab in the Industrial Edge Hub (IE Hub) contains the global app catalog which you can use to purchase the license for the Anomaly Detection app in the Siemens Industry Mall.

Procedure

To buy the license, follow these steps:

1. Click on the icon in the Energy Manager tile.
   The Siemens Industry Mall website is loaded.
2. Purchase the license for the app.
3. As soon as you have purchased the license, the icon for the license status turns green and the Anomaly Detection app is displayed in the "Library" tab of the IE Hub.

Result

You see all apps for which you have purchased licenses in the "Library" tab:

From the "Library" tab, you can now transfer the Anomaly Detection app to your Industrial Edge Management (IEM) instance.

2.4.3 Copying the Anomaly Detection app from the IE Hub to the IEM catalog

Description

An IEM instance and an Internet connection are required to copy an app to the Industrial Edge Management (IEM) catalog. With this functionality, you can copy the app directly into a catalog of one of your IEM instances.

Procedure

To copy an app into the IEM catalog, follow these steps:

1. Open the "Library" tab in the Industrial Edge Hub.
2. Click the icon in the desired app tile.
   The "Copy Application to IEM catalog" window opens. The layout of the window depends on whether the app contains links for open source software (OSS) and for the readme. The relevant file is downloaded when you click on one of the links. If the app does not support these links, the screen is shown without links.
3. In the drop-down list, select the IEM instance to which you want to copy the app.
4. Click "Copy".
   The app is copied, and a corresponding job is created. You can follow the status of the job in the status window of the corresponding IEM instance.

2.4.4 Copying Anomaly Detection into the IEM catalog

Description

An IEM instance and an Internet connection are required to copy an app into the Industrial Edge Management (IEM) catalog. You can import the app directly into the catalog of one of your IEM instances.

Procedure

To import an app into the IEM catalog, follow these steps:

1. Open the "Catalog" tab in the Industrial Edge Manager.
2. Click on "Import application".
   The "Import application" dialog appears.
3. In the ".app file" area, click on "Browse" and navigate to the storage location of the Anomaly Detection application files.
4. Click "Import".
   The application files are imported and the app icon is added to the catalog.

Note

The import process may take a few minutes. You can display the status of the import in the job overview of the Industrial Edge Managements. During the import, the status is displayed as "Executing" and changes to "Completed" after successful completion.

2.4.5 Installing Anomaly Detection on the IED

Description

You can install and start the Anomaly Detection app in the catalog of the Industrial Edge Management (IEM) instance. To be able to use the Anomaly Detection app on your corresponding Industrial Edge Device (IED), you must install the following apps on this IED:

- Data Service app
  With the Data Service app, you model the structure of your industrial process using assets and aspects and create the database for the Anomaly Detection app.
- Anomaly Detection

Note

Industrial Edge Device (IED)

Both apps must be installed on the same IED.

Requirement

- You must be logged onto the Industrial Edge Management (IEM).
- The two apps (Anomaly Detection and Data Service) have been copied into the catalog.

Procedure

To install the Anomaly Detection app, follow these steps:

1. Open the "Catalog" tab and click on the icon of the Anomaly Detection application.
2. Click on "Install".
   The "Install app" dialog box is displayed.
3. You can see a table with all associated IEDs. Select one or more IEDs on which you want to install the app.
4. You have two options to continue:
   - Click on "Install Later" to schedule the date and time of the installation.
   - Click "Install now" to install the app immediately.
5. Click on "Allow".
   The installation of the apps is started on the selected IEDs.

The Data Service App is installed in the same way.

Result

The Anomaly Detection app is displayed in the "My Installed Apps" tab.

Structure of the app

3

Views in the app

The Anomaly Detection app has the following tabs:

Tab		Description
	Home page	The "Home" tab is divided into the following areas: • Overview of the different areas of the Anomaly Detection app • Display of the number of all monitored assets • Display of the last anomalies per Asset
	Anomaly visualization	Detected anomalies are listed and displayed graphically in the "Anomaly visualization" tab.
	Model generation	In the "Model generation" tab you have the following options: • Model generation • Model management

Language switching

The Anomaly Detection app is available in the following languages:

- German
- English (US)

To switch the language of the user interface, enable the preferred language in your browser settings. After enabling the language, the user interface of the Anomaly Detection app is automatically displayed in the enabled language.

Feedback

You are welcome to provide feedback to our team of developers regarding use of the Anomaly Detection app. To do so, use the feedback button in the menu bar of the user interface.

Information on the application

For additional information on the Anomaly Detection app, click on the Information icon. The following information is displayed:

- Version number of the application
- Copyright information
- Link to the documentation

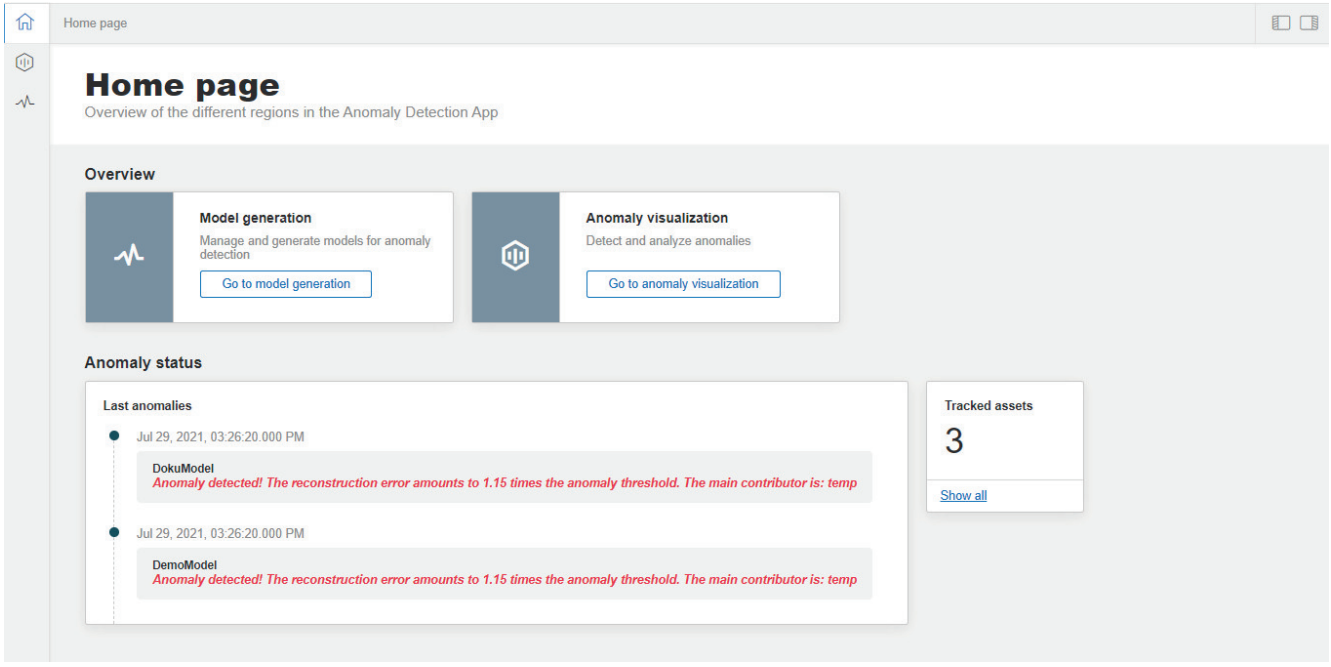
- Link to support and feedback
- Link to Product sheet and OSS Readme

Home page

4

From the home page of the Anomaly Detection app you can switch directly to the "Model generation" or "Anomaly visualization".

In the lower area of the home page you will find information about the anomaly status and the number of monitored assets.



Creating and managing Anomaly models

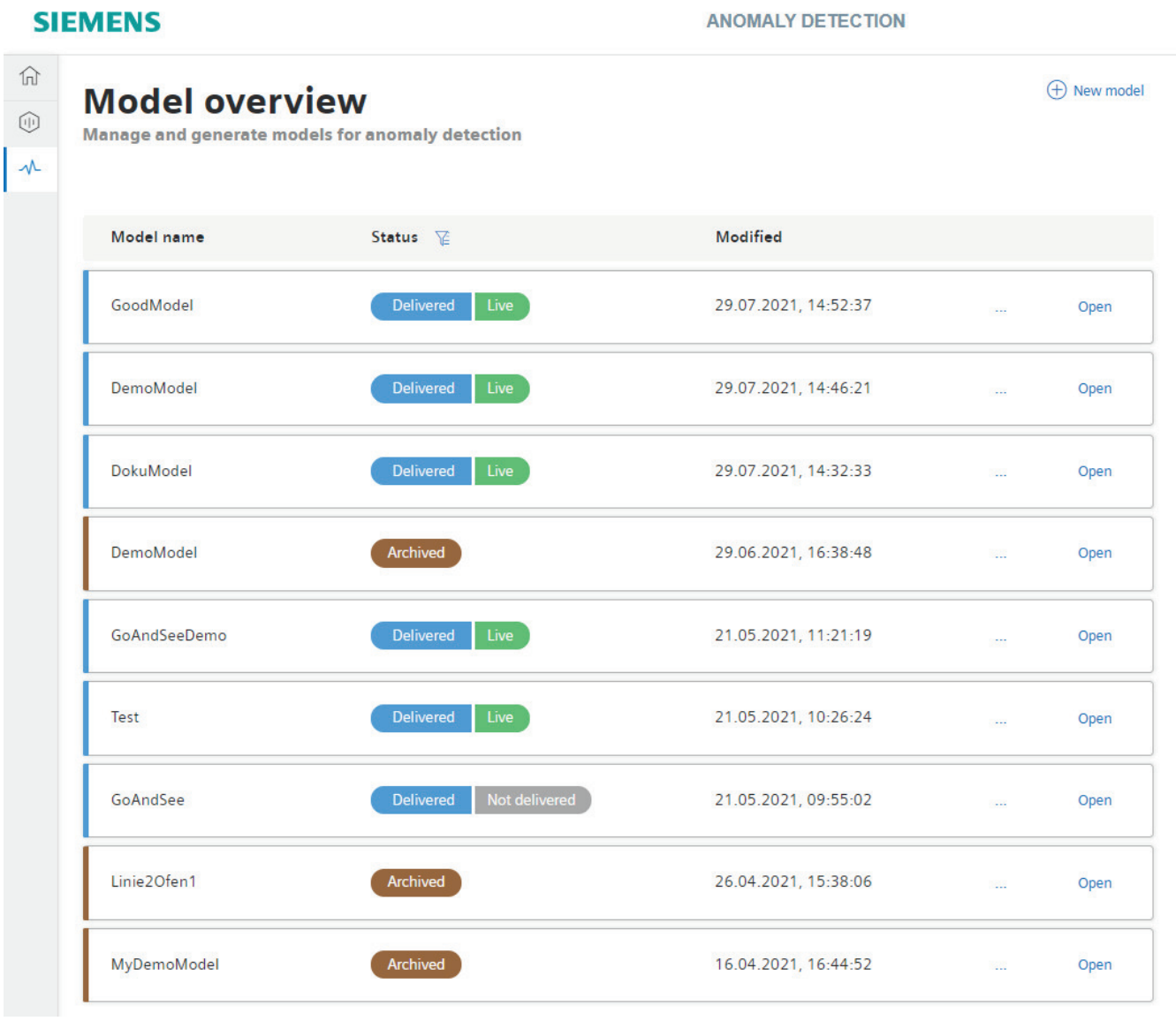
5

5.1 Overview

Description

The following options are available to you in the "Model generation":

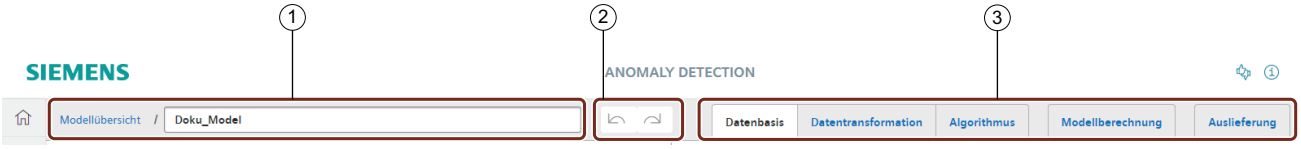
- Generate a new model
- Filter the displayed models by status:
  - Drafts
  - Deployed
  - Not deployed
  - Archived
- Actions for an existing model
  The actions available vary depending on the status of the selected model:
  - Archive
  - Deploy
  - Duplicate
  - Delete
  - Stopping
- Model comparison (for calculated models)
- CSV import


SIEMENS
ANOMALY DETECTION
Model overview
Manage and generate models for anomaly detection
New model
Model name
Status
Modified
GoodModel
Delivered
Live
29.07.2021, 14:52:37
...
Open
DemoModel
Delivered
Live
29.07.2021, 14:46:21
...
Open
DokuModel
Delivered
Live
29.07.2021, 14:32:33
...
Open
DemoModel
Archived
29.06.2021, 16:38:48
...
Open
GoAndSeeDemo
Delivered
Live
21.05.2021, 11:21:19
...
Open
Test
Delivered
Live
21.05.2021, 10:26:24
...
Open
GoAndSee
Delivered
Not delivered
21.05.2021, 09:55:02
...
Open
Linie2Ofen1
Archived
26.04.2021, 15:38:06
...
Open
MyDemoModel
Archived
16.04.2021, 16:44:52
...
Open

5.2 Generating a new model

5.2.1 Overview

The following functions are available on all the model generation tabs via the menu ribbon:



① Model name
② Undo / Redo
③ Tabs

(1) Model name

You enter a unique name for the model under ① Model name.

(2) Undo / Redo

You have the following options under ② Undo / Redo:

- You undo the last step by clicking the Undo button .
- You redo the last step by clicking the Redo button .

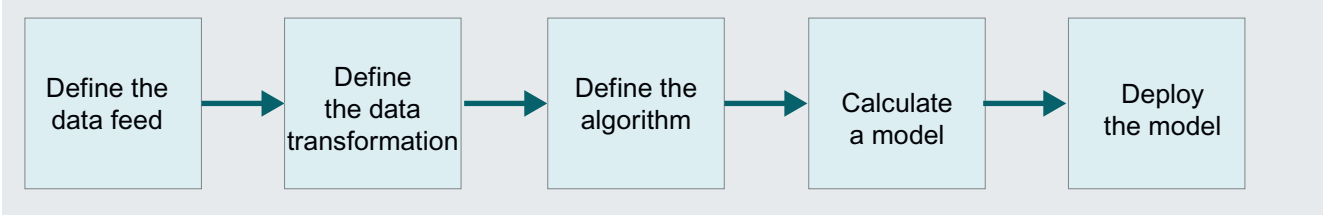
Note that the change takes effect on all tabs in both cases. If, for example, you deselect a variable in the Data feed tab, this variable is also removed in all other tabs in which it was referenced.

(3) Tabs

The tabs contain the steps for model generation and are completed in order. The following tabs are available:

- Data feed
- Data transformation
- Algorithm
- Model calculation
- Deploy

The model is generated in the same order and is described in the following sections:



See also

Deploying a model (Page 45)

Defining the data feed (Page 22)

Defining the data transformation (Page 26)

Calculate model (Page 41)

Defining the algorithm (Page 36)

5.2.2 Defining the data feed

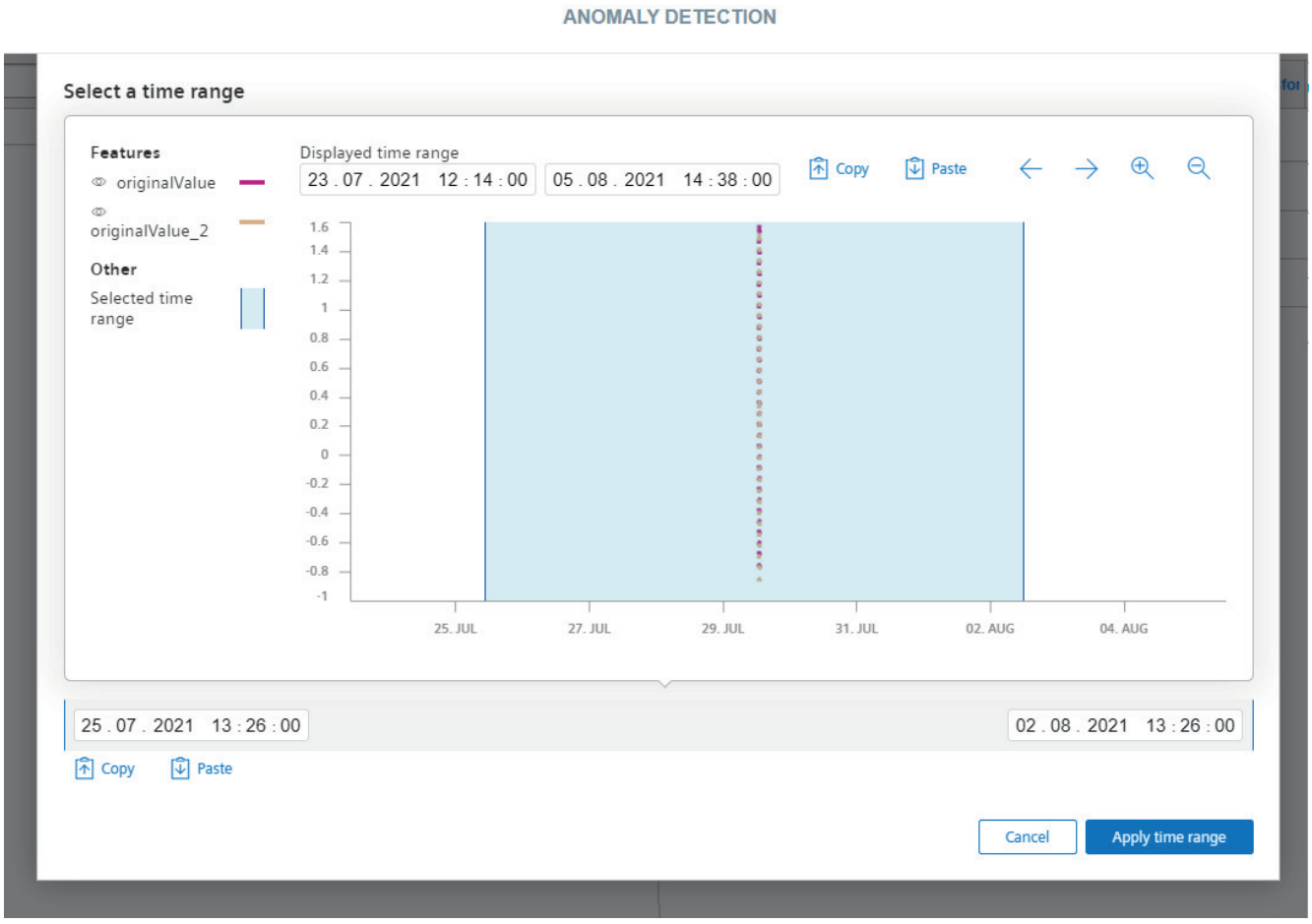
5.2.2.1 Specifying the model name

Give each model a unique name. Enter the name in the edit field. The edit field is preset with the name "Unnamed model".

5.2.2.2 Selecting a time range

In the "Select time range" area you select a time range that contains the data for creating the anomaly model.

The blue highlighted area in the diagram shows the selected time range for model generation.



Requirement

- The "Database" tab is open.

Procedure

To select a time range, follow these steps:

1. Click "Edit" in the "Time range for model creation" area.
   The "Select time range" dialog opens.
2. You have the following options to change the displayed time range:
   - Change the date and the time by entering them manually.
   - By clicking on "+" you zoom in to the displayed time range. To zoom out, click "-".
   - To jump forward or backward in the displayed time range, click the arrow buttons. The jumps correspond to the length of the selected time range.

   Alternatively, you can paste a previously copied time range by using the "Copy" and "Paste" function.

3. The currently selected time range is highlighted in blue in the graphic. The start and end times are marked dark blue.
   You have the following options:
   - You define a time range by entering the start and end date manually.
   - When you click on day, month, year, hour, minute or second, you can change the selected time range with "+" or "-".

   Note

   Note that the selected time range must contain data values of all selected characteristics in order to obtain usable data for the calculation of the anomaly data model. If possible, the selected time range should not contain any anomalies.

4. Click "Apply time range".

Result

You have selected a time range that contains the data for the anomaly calculation.

5.2.2.3 Selecting variables

In the "Variable selection" step, you select an asset and the relevant variables as the data basis for generating an anomaly model.

Requirement

- The "Database" tab is open.
- There is at least one asset that contains variables for selection.

Procedure

To select variables for creating an anomaly model, follow these steps:

1. Click "Add variable".
2. Select an asset.
3. Select variables that will serve as the data basis for building the anomaly model.
4. Click "OK".

Result

You have defined variables that contain values on which the anomaly model is based.

The variables have different colors, with variables of the same aspect having similar colors from a color group. This coloring is also used in the visualizations. You can change the color of a feature node in the "Data transformation" step.

5.2.2.4 Defining the sampling rate

The sampling rate defines the frequency at which the values of the variable are queried (start time is 00:00) If a value of the variable is available at the sampling rate times, it is used. If, for example, the sampling rate time falls between two time stamps, the values between the two data points are interpolated. If the time of the sampling rate and the time stamps are too far apart, it is recommended to decrease the sampling rate.

The sampling rate is specified in milliseconds. The default setting is 1000 milliseconds.

Requirement

- The "Data feed" tab is open.

Procedure

You have the following options for defining the sampling rate:

- Enter the desired value manually.
- Alternatively, you can click on the text box and then use the up or down arrow to reach the desired value.

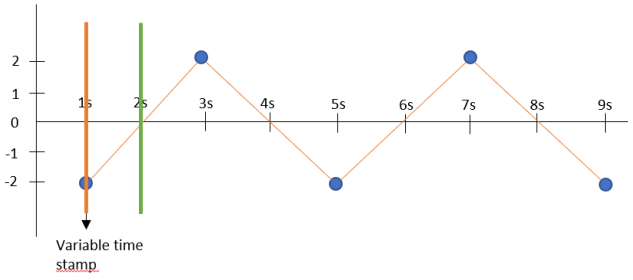
Result

You have defined a sampling rate that defines the frequency at which the values are interpolated.

Example

In this example, you see that the time stamp of a variable is made available from an asset after 1 second, after 3 seconds, after 5 seconds, and so forth. If you defined a sampling rate of 2 seconds (2000 milliseconds), this time falls between two time stamps. This means that the two time stamps of 1 second and 3 seconds are interpolated and the value is 0 at the sampling rate time (green line).

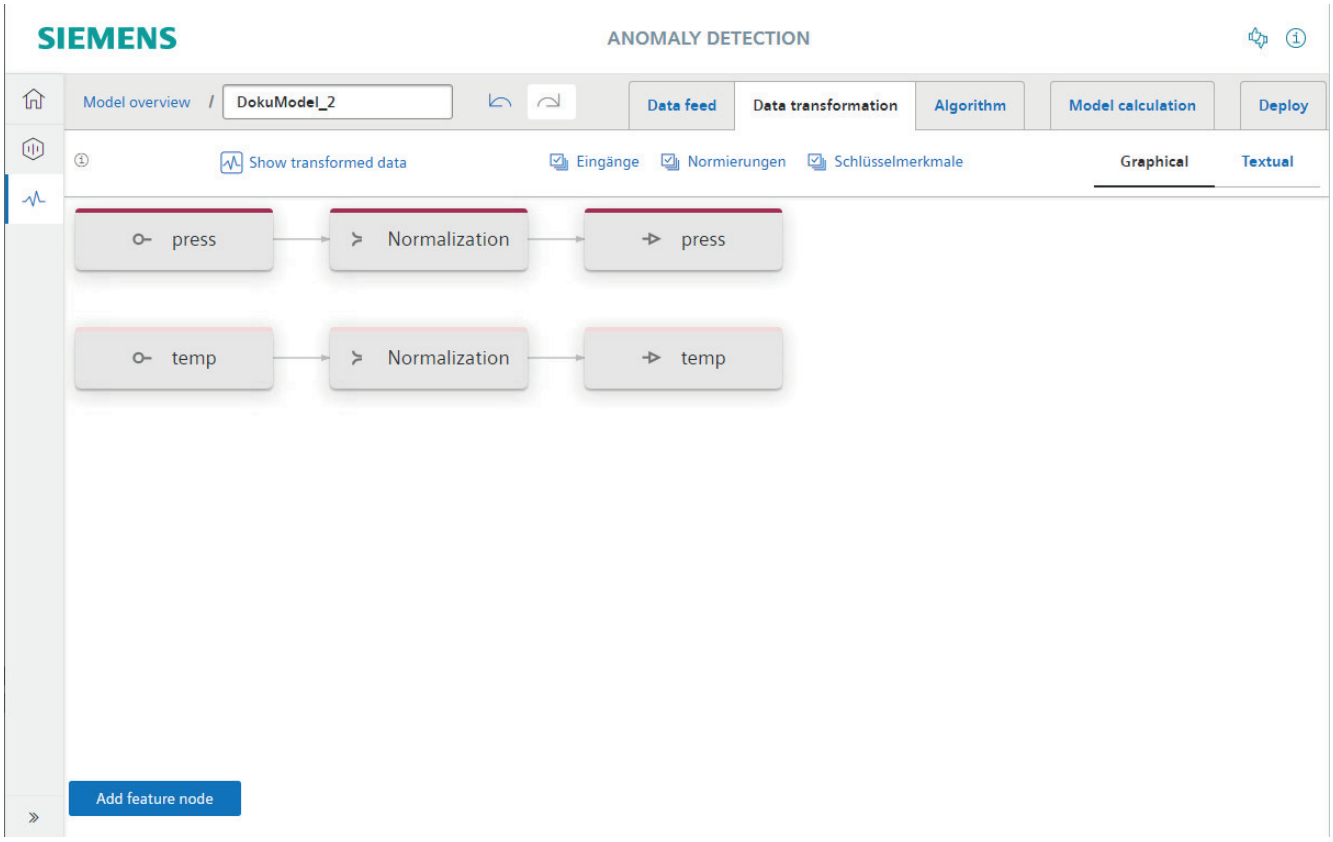
To avoid this distorted value, it is recommended to decrease the sampling rate, e.g. to 1 second (1000 milliseconds). This is represented by an orange line in the example below. The sampling rate now supplies the value of the time stamp because there is no interpolation.



5.2.3 Defining the data transformation

5.2.3.1 Overview

In the "Data transformation" step you define the characteristics on the basis of which the anomaly model is created. To prepare the data for the calculation according to your ideas, you can add characteristics to the data transformation node. You can create the definition of the characteristics either graphically or textually.



In the graphical definition of characteristics, the data sources and characteristics are shown as nodes. You can insert additional nodes between existing nodes. The nodes are connected with arrows.

By default, the graphical characteristic definition is displayed in which the selected variables are indicated with the node "Normalization" scaled. You can find additional information on creating the data transformation in the section Creating a data transformation graphically (Page 27).

See also

dhall specification (https://dhall-lang.org)

5.2.3.2 Creating a data transformation graphically

To create the data transformation graphically, follow these steps:

1. Select one node whose data should be processed by a characteristic.
2. Click on the arrow to the right of the node.
   The shortcut menu "Insert node" appears.

3. Select the node to be inserted.
   The following nodes are available:
   - Fourier
   - Integration

     Note

     Modes of the integration node

     - Normal
       Continuous formation of a sum
     - With reset
       Continuous formation of a sum. As soon as the input value goes to 0, the output value is reset to 0.
     - With inertia
       Integrator with inertia Summing is continued only if the continuous sum is greater than the previous maximum. If the continuous sum is less than the previous maximum, the continuous sum is output.

     As soon as you link the reset input of the integration node, the node automatically becomes an "Integration with reset" node, and no further modes can be selected.

   - Maximum
   - Minimum
   - Normalization

     Note

     Normalization of values is recommended in most cases.

     To derive all the normalizations from the time series in the next step, click the "Normalization" button and select "Derive from time series data...".

     Values for scale factor and translation can also be derived from the time series.

   - Product
   - Subtraction
   - Sum
   - abs (absolute value)
   - atan (arctangent)
   - ceil (round-up function)
   - cos (cosine)
   - cosh (hyperbolic cosine)
   - exp (exponential function with base e)
   - exp10 (exponential function to base 10)
   - floor (round-down function)
   - sin (sine)

– sinh (hyperbolic sine)

Note

Trigonometric functions

For the trigonometric functions, angles are expected to be expressed in radians (rad).

4. Depending on the property of the node, the following options are available on the right side of the screen:
   – Constant factor: Multiplication factor for the selected node.
   – Scaling Factor: Value around which the original value of node is to be scaled.
   – Offset: Value by which the original value of the node is to be offset.
   – Constant: Value that is added to the original value of the node.
   – Derive from time series data: The scaling factor and the offset can be determined automatically here using a range of values from the time series.
   You can change the time range or apply it unchanged.
   – A mathematical function: You can change the mathematical function of the selected node.
   – Color: You can change the color of a feature node. To do this, specify a valid hexadecimal color code.
   – Frequency: Frequency value for the Fourier transformation.
   – Window size: Window size for the Fourier transformation.
5. If the left area of a node is marked with an arrow, add an incoming connection. If the right area of a node is marked with an arrow, add an outgoing connection. To do this, click on the arrow in each case.
   Nodes that cannot be used as incoming or outgoing connections are grayed out.
6. Select the node to be used as an incoming or outgoing connection.
7. If required, add additional characteristics.
   – To do this, click "Add feature node" at the bottom of the screen.
   – Choose an output node that will serve as the basis for the characteristic.

Tips for effective procedure

- Click "Show transformed data" to see a graphical preview of the transformed data.
- Select a node to highlight the sub-graph associated with the node.

Deleting nodes

You delete a node by selecting it and clicking the "Remove this node" button on the right of the screen.

Multiple selection

Group selection

A group selection is available in the menu ribbon at the top for the following node types:

- Inputs
- Normalization
- Features

When one of these node classes is selected, all nodes of the selected class are selected.

Depending on the selected node class, the following actions are available on the right side of the screen:

- **Insert normalization right**
  Select a time range or apply the prefilled values. Normalization nodes that are based on the data of the selected time range are inserted to the right of the selected node.
- **Insert normalization left**
  Select a time range or apply the prefilled values. Normalization nodes that are based on the data of the selected time range are inserted to the left of the selected node.
- **Delete (only for normalization)**
  All normalization nodes are removed.
- **Derive from time series data (only for normalization)**:
  Derive the parameters from the same time range for all normalization nodes by clicking the "Derive from time series data" button. Define a time range or confirm the preselected time range. By clicking on "Apply values", the parameters are applied to all normalization nodes.

Selecting with keys

Alternatively, you can select more than one node simultaneously by pressing and holding down the [Ctrl] or [Shift] key and selecting the desired nodes. You can use this function, for example, to delete multiple nodes of different classes simultaneously.

Explanation regarding the "Integration" node

Mode "Normal":

Continuous formation of a sum

Mode: Normal		
Time	**Input value**	**Output value**
1	2.5	2.5
2	3	5.5
3	4.5	10
4	-2	8
5	1	9

Mode "With reset":

Continuous formation of a sum. The output value is reset to "0" as soon as the signal at the output supplies the value "0". All other values are ignored.

Mode: With reset		
Time	**Input value**	**Output value**
1	0	0
2	1	1
3	1	2
4	1	3
5	0	0
6	1	1
7	1	2
8	1	3
9	1	4
10	1	5
11	0	0
12	1	1
13	2	3
14	0	0

Mode "With inertia":

When the value is "0", the internal counter is reset to "0". The value at the output is not reset.

Mode: With inertia (when value = 0, counting starts again)		
Time	**Input value**	**Output value**
1	0	0
2	3	3
3	2	5
4	0	5
5	1	5
6	0	1

Mode: With inertia (special case: run length encoding, only binary numbers)		
Time	**Input value**	**Output value**
1	0	0
2	1	1
3	1	2
4	1	3
5	0	3
6	1	3
7	1	3
8	1	3
9	1	4
10	1	5

Mode: With inertia (special case: run length encoding, only binary numbers)		
Time	**Input value**	**Output value**
11	0	5
12	1	5
13	1	5
14	0	2

Integration with reset

As soon as the reset input of the integration node has also been linked, the node automatically becomes an "Integration with reset" node. This node calculates a run length encoding with inertia and reset.

The value "0" at the reset input resets the value at the output.

Mode: Integration with reset input			
Time	**Input value**	**Reset**	**Output value**
1	0	1	0
2	1	1	1
3	1	1	2
4	1	1	3
5	0	0	0
6	1	1	1
7	1	1	2
8	1	1	3
9	1	0	0
10	1	1	1
11	0	0	0
12	1	0	0
13	1	0	0
14	0	0	0

5.2.3.3 Creating a data transformation textually

As an alternative to the graphic data transformation, you can also program the sequence of the definition. You use the dhall programming language for this purpose.

For more information on the dhall specification, refer to https://dhall-lang.org.

Example code

```
-- The expression in fd.dhall is a collection of the functions needed to create
-- nodes in the feature DSL.
--
-- Using pseudo-signatures for readability, these are:
--
-- * Input : Text -> Optional Categorization -> FeatureDefinition
--
-- * Categorization: one of the following:
--     - none
--     - digital: Double -> Double -> Categorization, where the two input values
--       correspond to True and False
--     - textMap: List { from : Text, to : Double } -> Double -> Categorization
--
-- * Normalization: Double -> Double -> FeatureDefinition -> FeatureDefinition
--
--   Takes a scale, a translation, and a predecessor node and returns the
--   next node in the graph.
--
-- * Max: List FeatureDefinition -> FeatureDefinition
-- * Min: List FeatureDefinition -> FeatureDefinition
-- * Sum: List FeatureDefinition -> FeatureDefinition
--
--   These all take a list of nodes and return a common successor.
--
-- * Product: Double -> List FeatureDefinition -> FeatureDefinition
--
--   Like the ones directly above, but the product node additionally takes a
--   constant, scalar factor.
--
-- * Feature: Text -> FeatureDefinition -> FeatureDefinition
--
--   Signifies one "end" of the graph by essentially tagging a previous node
--   with a name.
--
--
-- When creating a feature graph in the UI, the corresponding Dhall code is
-- built automatically. Thus the easiest way to get a grip on creating a feature
-- graph with the Dhall DSL is by manually building a transformation and then
-- reading the Dhall representation.
--
-- These always start by importing the described top-level wrapper (albeit with
-- a slightly different path in the UI):
let fd = ../../data-preparation/dhall-feature/fd.dhall
-- We specify an Input (that is, a variable) that has ID "pressure_1". When
-- adding an Input to the graph editor in the UI, its ID is automatically
-- inserted in the Dhall editor.
let pressure = fd.Input "pressure_1" fd.Categorization.none
-- A variable having 4 different textual values that are mapped to numbers.
let someTextualInput =
      fd.Input
        "some-textual-variable"
        ( fd.Categorization.textMap
            [ { from = "low", to = 2.3 }
            , { from = "medium", to = 5.9 }
```

```
            , { from = "higher", to = 17.0 }
            , { from = "max", to = 99.03 }
            ]
            -- The default value that is used during detection if a value not in
            -- the list appears.
            -1.0
        )
-- Append a Normalization node to "pressure".
let normalizedPressure = fd.Normalization 2.5 1.1 pressure
-- Append a Normalization node to the textual, categorized variable.
let normalizedTextualInput = fd.Normalization (-3.14) 0.0 someTextualInput
-- A node that represents the maximum of the two incoming normalized values.
let myMax = fd.Max [ normalizedPressure, normalizedTextualInput ]
-- Give the maximum a name.
let maxFeature = fd.Feature "my-max" myMax
-- We may want to get the output of the pressure itself as feature, too.
let pressureFeature = fd.Feature "pressure" normalizedPressure
-- This is the final graph representation. We have two outgoing features, one
-- being the pressure (normalized), the other the maximum of the normalized
-- pressure and the normalized textual variable that we mapped to numbers.
in [ maxFeature, pressureFeature ]
```

5.2.3.4 Example: Creating data transformation for differential pressure

Scenario

You have recorded the pressure upstream and downstream of a pump and would like to incorporate the differential pressure into the model.

This example shows how you can do this.

Requirement

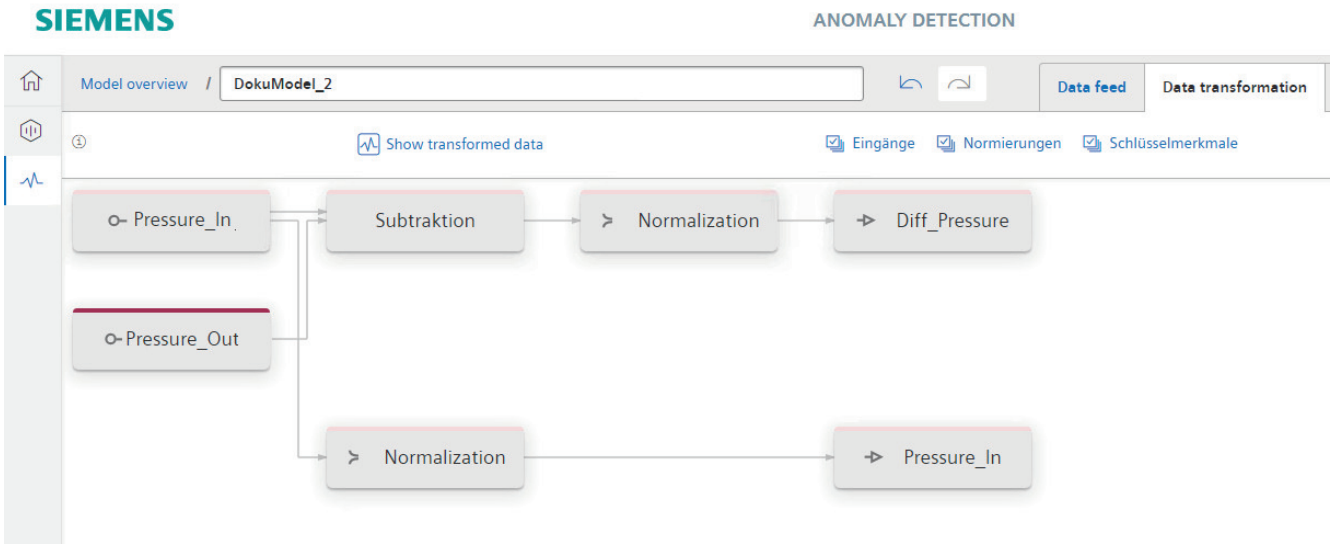
- You have created the database of the model.
- In the variable selection in the "Database" step you have selected a variable that contains the pressure of the pump input, e.g. "Pressure_Input".
- In the variable selection in the "Database" step you have selected a variable that contains the pressure of the pump output, e.g. "Pressure_Output".
- The "Data transformation" tab is open.

Procedure for the graphical creation of a data transformation

To create the data transformation for the differential pressure graphically, follow these steps:

1. Select the "Pressure_In" node.
2. Insert a new "Subtraction" node after the "Pressure_In" node.
3. Select the "Subtraction" node.
   Select the "Pressure_Out" mode as the second incoming node.

4. Insert a "Normalization" node after the "Subtraction" node.
5. If required, give the characteristic for the differential pressure a descriptive name.



Procedure for the textual creation of a data transformation

To create the data transformation for the differential pressure textually, follow these steps:

1. In the upper right corner of the "Data transformation" tab, click "Textual".
   The editor for the textual creation of the data transformation is opened.
2. Enter the following sample code:

```
let fd = ./fd.dhall
let v0 = fd.Input "9e85c6a425774f90abcce5c30ed24cc5" fd.Categorization.none
let v1 = fd.Input "7912bbb92de44a5abf2b1e90d6af2f0c" fd.Categorization.none

let v2 = fd.Subtraction v0 v1

let v3 = fd.Normalization 42.541897 232.57895 v2

let v4 = fd.Feature "Differenzdruck" v3
let v5 = fd.Feature "Druck_Eingang" v0

in [v4, v5]
```

Result

You have created the characteristic "Differential pressure", which represents the transformed differential pressure between the input and output of a pump.

5.2.4 Defining the algorithm

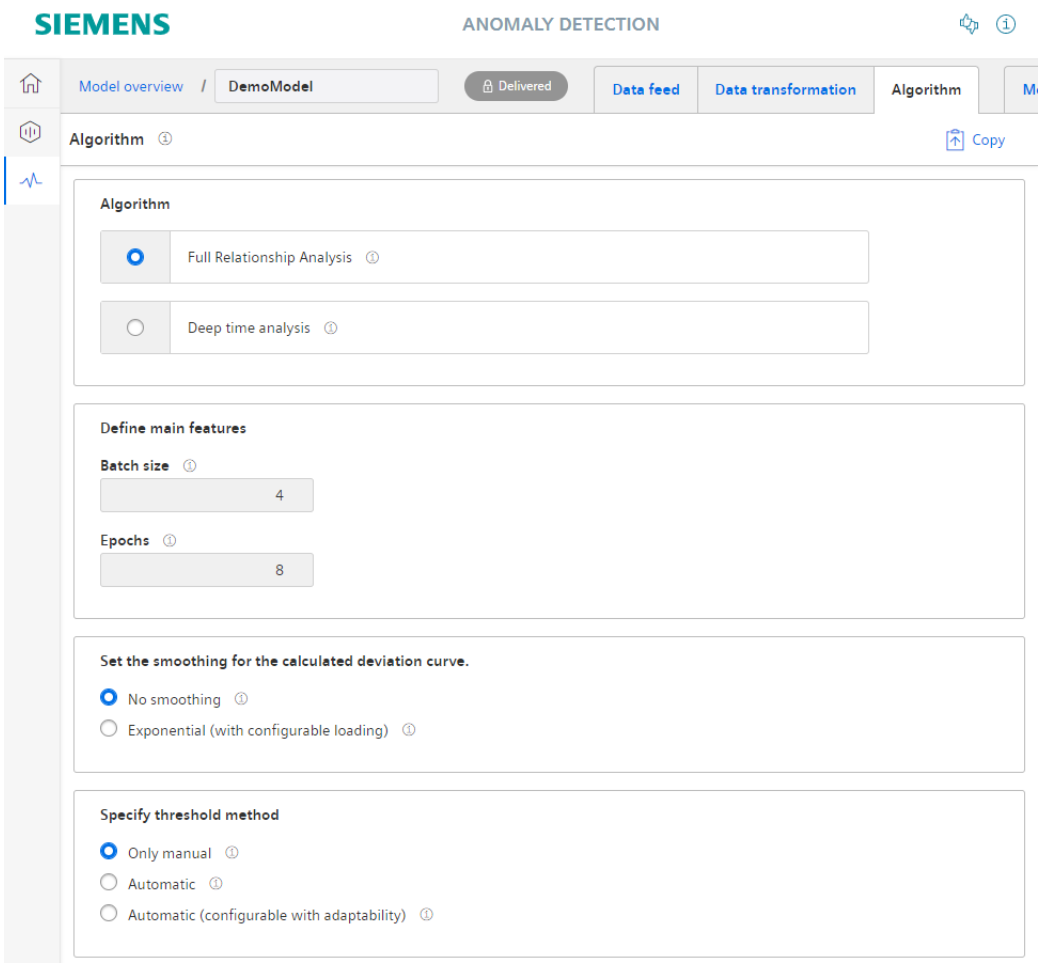
5.2.4.1 Overview

You have the following options in the "Algorithm" step:

- Select the desired algorithm.
- Define the main features.
- Specify whether the curve of the calculated deviation should be smoothed and, if necessary, determine the loading of the smoothing.
- Specify the method for the threshold determination.

Note

Note that the selection of the parameters and the amount of usable data significantly influence the result of the anomaly model. The more usable data are available, the more precisely the anomaly model can be calculated. The individual parameters have an effect on the quality of the prediction, but also influence the runtime of the model calculation.



5.2.4.2 Defining basic parameters

To set the basic model parameters for creating the anomaly model, follow these steps:

Algorithm

Select between "Full relationship analysis" and "Deep time analysis".

The relationship analysis uses a simple encoder-decoder architecture.

The time-dependent analysis is based on a more complex encoder-decoder architecture with an explicit understanding of time.

Note

Processor dependency of the time-dependent analysis

Note that the selection option "Deep time analysis" is processor-dependent and is only offered when the corresponding processors are used. For example, the option is not available for devices of the type SIMATIC IPC227 (Nanobox).

Relationship analysis

Define basic parameters

1. Under "Batch size", enter the size of the batch for which the anomaly is to be calculated.

   Note
   Explanation of terms: Batch

   The input data from the data configuration are divided into groups of the same size depending on the batch size specified. These groups are called "Batches". Note that a large batch size usually takes up more work memory.

2. Enter the number of epochs under "Epochs".

   Note
   Explanation of terms: Epoch

   An epoch is a training run across the entire input time series. The calculation time grows linearly with the number of epochs. The network quality grows tendentially with the number of epochs, but this effect will wear out quickly.

Time-dependent analysis

Parameters of the time-dependent analysis

1. Enter a batch size under "Batch size". The batch size determines the number of data points that are used for a training run. The network weights are adjusted after each training run.

   Note
   Explanation of terms: Batch

   The input data from the data configuration are divided into groups of the same size depending on the batch size specified. These groups are called "Batches". Note that a large batch size usually takes up more work memory.

2. Enter the number of epochs under "Epochs".

   Note
   Explanation of terms: Epoch

   An epoch is a training run across the entire input time series. The calculation time grows linearly with the number of epochs. The network quality grows tendentially with the number of epochs, but this effect will wear out quickly.

3. Enter a "Window size".
   The window size determines how many data points the network can display at a glance. The time needed for calculation increases with the window size during training as well as during operation.

4. Specify the "Depth" of the network.
   The time needed for calculation and the quality of the resulting network increases with the depth.
5. Advanced settings

Note

To prevent errors when creating a network, changes in the "Advanced settings" should only be made by specialists who have sufficient knowledge in the area of "Neural networks".

Define basic parameters

1. Under "Batch size", enter the size of the batch for which the anomaly is to be calculated.

Note

Explanation of terms: Batch

The input data from the data configuration are divided into groups of the same size depending on the batch size specified. These groups are called "Batches". Note that a large batch size usually takes up more work memory.

2. Enter the number of epochs under "Epochs".

Note

Explanation of terms: Epoch

A complete run of all batches for anomaly calculation is an optimization cycle and is called "Epoch". A high number of epochs can lead to a better predictive quality of the model, but it increases the calculation time for the anomaly model.

5.2.4.3 Defining smoothing

You can define smoothing that is applied to the curve of the calculated deviation. This is done, for example for high-frequency curves, to prevent every blip in the curve from being evaluated as an individual anomaly.

Procedure

To define smoothing, follow these steps:

1. In the "Set the smoothing for the calculated deviation curve" area, acivate "Exponential (with configurable loading)".
2. In the "Loading" text box, enter a value greater than 0 and less than 1 for the loading of the smoothing. The lower the value you select, the greater the smoothing will be.
   Click "Reset to default" to reset the value.

Result

You have defined smoothing for the curve of the calculated deviation.

5.2.4.4 Specifying the threshold method

The following options are available to specify the procedure for determining the threshold:

- Automatic
  The threshold is automatically calculated based on previous deviation values. In the event of long-term high conformity errors, the automatic threshold is adjusted so that new deviations can be detected.
- Automatic (configurable with adaptation inertia)
  The threshold is automatically calculated based on previous deviation values. If there are persistent high deviations, the automatic threshold is adapted in order for new deviations to be detected.
  Under "Adaptability" you specify how quickly the model should adapt to prior deviations. A higher value includes more deviation values from the past. The threshold adapts more slowly.

  Note

  To prevent errors after model creation, a large variety of input variables should be used, and the selected time range should contain at least 2000 values during automatic threshold calculation. If these criteria cannot be met, select manual threshold calculation.

- Manual only
  You specify the threshold manually.

5.2.5 Calculate model

5.2.5.1 Overview

The anomaly model is calculated and graphically displayed in the "Model calculation" step.

① Displayed time range
② Display of the model
③ Copy / Paste displayed time range
④ Forward / Backward in the displayed time range
⑤ Zoom into / Zoom out from displayed time range
⑥ Calculate model
⑦ Set threshold
⑧ Legend
⑨ Model comparison

The following options are available:

(1) Displayed time range

The "Displayed time range" area ① displays the data of the last hour. You have the option of changing it manually.

(2) Representation of the model

The calculated anomaly model is shown in the "Display of the model" area ② in the following two views:

- Calculated deviation: Graphical display of the deviations from the calculated model for the features.
- Characteristics: Graphic display of the transformed data.

Note

Depending on the volume of data on which the model is based, the random data used in the neural network, and the parameters set; it can happen that different anomaly models result from the same data configuration basis.

(3) Copy / Paste of displayed time range

In this area ③ you can copy the displayed time range or paste a previously copied time range of another model into the current model.

(4) Forward / Backward in the displayed time range

In this area ④ you can jump forward or backward in the displayed time range by clicking the arrow buttons. The jumps correspond to the length of the selected time range.

(5) Zoom into / Zoom out from displayed time range

In this area ⑤ you zoom into the displayed time range by clicking the Plus button. You zoom out by clicking the Minus button.

(6) Calculate model

The "Calculate model" area ⑥ provides information about the model calculation. You can reset the model by clicking the "Reset model" button.

The following information is displayed:

- Successful generation of the model
- Model generation time
- Training loss: Measure for the learning success of the network. A low calculated loss indicates that the network is able to well represent the model data. If the calculated loss is high or varying, recalculation of the model using "Reset model" is recommended.

You can find additional information on the model calculation in the section Calculate model (Page 43).

(7) Set threshold

In the "Set threshold" area ⑦, you have the following options:

- Use automatic threshold
- Set threshold manually

You can also change the threshold in the graph itself. You can find additional information on this in the section Setting the threshold (Page 44).

(8) Legend and features

The "Legends and features" area ⑧ shows the legend of the graph and lists the features. You have the option of hiding or showing individual features by clicking the button  .

(9) Model comparison

You open the model comparison in the "Model comparison" area ⑨. You can find additional information on the model comparison in the section Comparing models (Page 47).

See also

Overview (Page 19)

5.2.5.2 Calculate model

To obtain a calculation based on the created database, calculate the underlying model.

Requirement

- The data for the basis of the model calculation is complete.
- The "Model calculation" tab is open.

Procedure

To have the anomaly model calculated, click the "Calculate model" button.

Note

Note that the calculation of the model can take a few seconds to several days. A progress indicator displays the status of the calculation steps.

Result

After the model has been successfully calculated, the anomaly model is displayed graphically.

See also

Deploying a model (Page 48)

5.2.5.3 Setting the threshold

Set a threshold that marks the normalization range for the anomaly calculation.

Requirement

- The data for the basis of the model calculation is complete.
- The "Model calculation" tab is open.

Procedure

You have the following options for setting a threshold:

- You can explicitly specify the threshold manually in the "Set threshold" area.
- If you have set an automatic threshold method in the "Algorithm" tab, you can use the automatic threshold.
- Alternatively, you can set the value directly by clicking the desired value on the y-axis of the "Calculated deviation" graph.

Result

You have defined a threshold value that marks the normalization range for the anomaly calculation.

5.2.5.4 Resetting model calculation

If you want to create a new model draft based on a calculated model draft, you can reset the previously created model. This can be useful, for example, if you are not satisfied with the calculation result and want to change parameters.

Requirement

- The data for the basis of the model calculation is complete.
- The "Model calculation" tab is open.
- A calculated draft model is available that has not yet been deployed.

Procedure

To reset a model draft, follow these steps:

1. In the right section of the screen, click "Reset model".
   A dialog opens.
2. Confirm resetting the model.
   You have the option of changing the underlying data in the specific tabs.
3. To calculate a new model, click "Calculate model".

Result

You have reset the previously created draft model.

5.2.6 Deploying a model

If you do not want to make any more changes to the calculated model, you can deploy it. The result of the deployment is a secured model. The model cannot be changed after deployment. The model continuously receives data from the connected assets and the anomaly calculation is performed on this basis.

Procedure for deploying the draft model

To deploy a model, follow these steps:

1. Change to the "Deploy" tab.
   The deployment status of the model is displayed.
2. Click "Deploy".
   The status of the model changes to "Deployed Live".

You can find more information on deploying a model draft in the section Deploying a model (Page 48).

5.3 Filter models and model drafts by status

You can filter models and draft models by status. The following filter options are available:

- Drafts
- Deployed
- Not deployed
- Archived

The status of a model is queried at regular intervals. If the status cannot be determined temporarily, a charging indicator is displayed.

Requirement

- The "Model generation" view is open, and the model overview is visible.
- There are models or model designs.

Procedure

To filter the overview of models and model drafts according to status, follow these steps

1. Click on "Filter" in the header of list view.
2. Mark the desired filter criteria with a check mark.

Result

The overview list shows the models and draft models that correspond to the filter criterion.

5.4 Duplicating models or draft models

You can duplicate both delivered models and model drafts that have not been deployed.

If you duplicate a model that has already been deployed, the result is a draft model. During the duplication process, you can change individual parameters of this draft model. To make it a permanent model, you have to deploy the draft model again.

Requirement

- The "Model generation" view is open.
- There is at least one model or draft model.

Procedure

To duplicate a model or a draft model, follow these steps:

1. Select the model that is to be duplicated.
   An information area for the selected model opens in the right-hand area of the screen.
2. In the information area under "Actions", click "Duplicate".
   The "Database" tab opens. A "(copy)" is appended to the name of the original model. You can change the name if required.
3. Adapt the parameters of the draft model according to your ideas.
4. Calculate the model. The duplicate appears in the overview list.

Result

You have created a duplicate of a model or a draft model. The duplicate is a draft model that you can deploy upon request.

5.5 Deleting a draft model

You can only delete draft models.

Models that have already been deployed cannot be deleted.

It is not possible to undo a draft model.

Requirement

- The "Model generation" view is open.
- At least one draft model is available.

Procedure

To delete a draft model, follow these steps:

1. Select the draft model that is to be deleted.
   An information area for the selected model opens in the right-hand area of the screen.
2. In the information area under "Actions" click "Delete".
   A dialog appears in which you are asked whether you really want to delete the draft model.
3. Confirm the deletion by clicking "Delete".
   The draft model is deleted.

Result

You have permanently deleted the draft model.

5.6 Comparing models

You can compare models or model drafts with one another.

Requirement

- The "Model generation" view is open.
- There are at least two models or draft models.

Procedure

If you want to compare models with one another, follow these steps:

1. Select the model that you want to compare with another model.
   An information area for the selected model opens in the right-hand area of the screen.
2. In the information area under "Model comparison", click "Open model comparison...".
   The "Model comparison" interface appears.
3. In the right section of the screen, click "Add model for comparison".
   A dialog with a list of all models available for comparison appears.

4. Select the model that you want to compare with the original model.
5. Click the "Select" button.
   The graphs of both models appear in different colors in the model comparison.

The procedure for comparing draft models is identical.

Result

You have created a model comparison of both models in which the anomalies of the models are shown in different colors.

5.7 Deploying a model

To turn a draft model into a permanent and fixed model, deploy it. The model cannot be changed after deployment. The model continuously receives data from the connected assets and the anomaly calculation is performed on this basis.

Deployed models can be stopped, logged and retrieved.

Requirement

- At least one draft model is available.

Procedure

To deploy a completely calculated model without errors, follow these steps:

1. Select the model that is to be deployed.
   An information area for the selected model opens in the right area of the screen.
2. In the information area under "Actions" click "Deploy".
   The status of the model is changed to "Permanent - Live".

Result

By delivering the draft model, you have created a fixed model that receives data from the connected assets.

Note

Upon delivery, an asset is created in the Data Service in which the evaluation results are saved. The asset is saved with the model name under the hierarchy asset "Anomaly detection".

5.8 Logging and retrieving models

You can log a model if it has already been delivered and stopped.

Requirement

- The "Model generation" view is open.
- At least one model has been delivered and stopped.

How to log a model

To log a model, follow these steps:

1. Select the model to be logged.
   An information area for the selected model opens in the right-hand area of the screen.
2. In the information area under "Actions", click "Logging".
   The status of the model is changed to "Logged".

Procedure for retrieving a model

To retrieve a model, follow these steps:

1. Select the model to be retrieved.
   An information area for the selected model opens in the right-hand area of the screen.
2. In the information area of the model under "Actions", click "Retrieve from log".
   The status of the model is reset to the original status before the logging.

Result

The model has been logged or retrieved.

5.9 Importing CSV files

You can create a new asset and fill it with data using the CSV data import.

Requirement

- Model generation is open.
- Data exists in a valid CSV format.
- In Data Service: note that the storage time period of the root asset data must not be shorter than the time stamp of the CSV file to be imported. If the storage time period of the root asset is less than the storage time period of the imported asset, the imported data is not stored for the time period difference.

Note

Valid CSV format

The first column of the CSV file must contain the time stamps in ISO format (according to ISO 8601) with the following syntax:

YYYY-MM-DDThh:mm:ss.fffZ.

Example: "2021-12-31T23:59:00.123Z"

The Coordinated Universal Time (UTC) is used as the time zone. It is assumed that the fractions of a second are indicated with an accuracy of at least 3 decimal places. There are no requirements for a defined start date.

The first column is followed by any number of columns with data, separated by a comma ",". The line break is coded with Line Feed (LF) \n as ASCII character hexadecimal 0A. Alternatively, CR LF, i.e. \r\n, is possible, thus the control character for Carriage Return (CR \r hexadecimal 0D) followed by LF.

The data is purely numeric, decimal separator is the dot "." (no digit grouping using thousands separator, etc.). Data that cannot be represented numerically is coded with "NaN" (Not a Number) (e.g. invalid sensor data). In addition, Booleans and categorizable text strings are not allowed.

The first row of a CSV file is a header row with unique column names. The column names do not have white spaces or line breaks and are assigned one-to-one to the corresponding documentation. The first entry in the header is "timestamp". The number of column names is identical to the number of data values in the following rows.

Example:

timestamp,press,temp

2020-10-29T10:18:36.000Z,0,-7

2020-10-29T10:18:36.157Z,0.17,-6.83

2020-10-29T10:18:36.315Z,0.33,-6.67

The data is an (uninterrupted) series of (almost) chronologically equidistant samplings that contain no leap seconds. The CSV files are supplied as UTF-8 or ASCII as a subset of UTF-8.

Procedure

To import data from a CSV file, follow these steps:

1. Click the "Go to CSV data import" button at the bottom of the screen.
2. Click "Select file" and navigate to the storage location of the CSV file.
3. Give the newly created asset a unique name.
4. Click "Import CSV file".
   The new asset is created with the imported CSV data.
5. If you want to import additional CSV files, click the "Reset form" button and repeat steps 1 to 4.

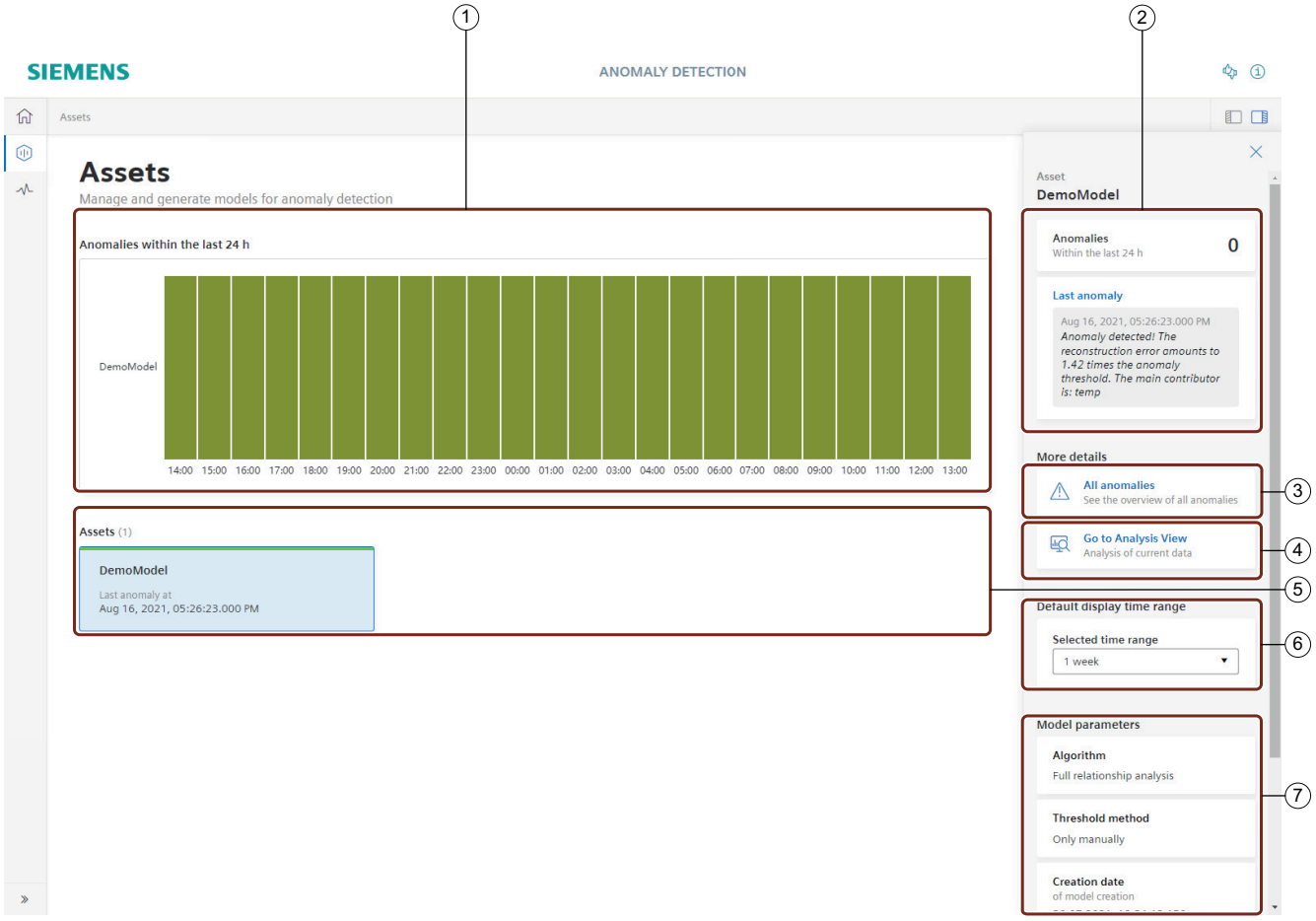
Result

You have created a new asset that contains the data of the imported CSV file.

Visualizing an anomaly

6

6.1 Overview



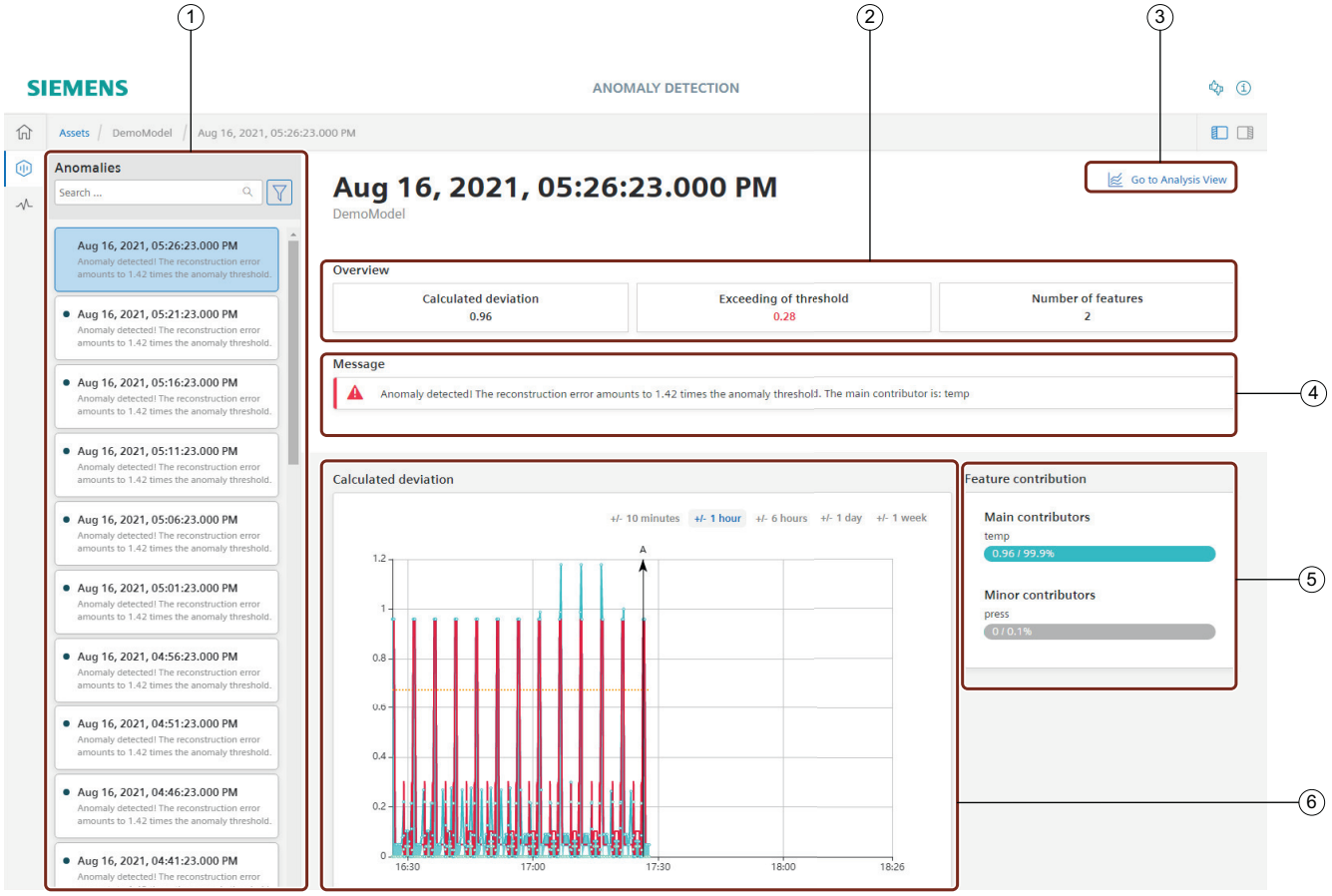
① Overview of anomalies of assets within the last 24 hours
② Number of anomalies of a specific asset within the last 24 hours and information regarding these anomalies.
③ Open list view of a specific asset
④ Open the analysis view of a specific asset
⑤ Overview of all supplied assets and their most recent anomalies
⑥ Default time range setting of a specific asset
⑦ Overview of the model parameters of a specific asset

Under "Visualize anomaly", the created assets can be visualized and managed. You have the following options:

- ①Anomalies within the last 24 hours: gives you an overview of the anomalies of the past 24 hours.
  To view an anomaly in detail, select the anomaly directly.
- You obtain additional information about anomalies in the information area of the specific asset:
  - The number of anomalies of the specific asset and information about these anomalies is displayed under ②.
  - You can activate and deactivate the Notifier.
  - You can display the anomalies in the list view ("All Anomalies") ③ or Analysis view④.
  - Under Default Time Range Setting⑥, you can specify a time range for the specific asset that you want to examine in the views. The time range can be changed later in the views.
  - You get an overview of the Model parameters Algorithm, Threshold method and Creation date⑦.
- Assets of anomaly models ⑤: Shows you all existing assets. Assets that have had at least one anomaly in the last 24 hours are highlighted in red.
  For a detailed view of the anomalies, select the specific asset.

6.2 Showing an anomaly in list view

The interface of the detailed view is divided into the following areas:



(1) Anomalies: List of all detected anomalies of the specific asset

(2) Overview: Information about the specific anomaly

(3) Go to analysis view

(4) Warning notice

(5) Contribution of the features to the anomaly (only for relationship analysis)

(6) Calculated deviation: Graphic display of the specific anomaly

(1) Anomalies

All anomalies detected in the selected assets are listed in the "Anomalies" area.

By default, the anomalies are sorted in ascending order, so the most recent anomaly is first in the list.

You can filter the anomalies based on the following criteria:

- **Status**: Select if you only want to see anomalies with the status "read" or "unread".
- **Main characteristics**: Select if you want to see only anomalies that include the key characteristics you selected.

If notifications are activated for the asset via the Notifier for Industrial Edge app, the following information is also displayed:

- **Assignment:** Select if you want to display all anomalies or only those that have been assigned to you.
- **Notifier status**: Select if you want to display only anomalies with the notifier status "Resolved" or "Unresolved".

(2) Overview

The following information is displayed in the overview:

- **Sum of all characteristics**: Displays the calculated total deviation.
- **Threshold exceeded:** Indicates the value by which the threshold value was exceeded.
- **Number of characteristics**: Specifies the number of underlying features for the anomaly calculation.

If notifications are activated for the asset via the Notifier for Industrial Edge app, the following information is also displayed:

- **Status:** Shows the processing status of the anomaly.
  If the processing status of the anomaly is "Unresolved", you can change the status to "Resolved" by clicking the symbol. Anomalies with the status "Resolved" are archived by the Notifier for Industrial Edge app.
- **Assigned:** Shows whether and to whom the anomaly has been assigned.
  If the anomaly has not yet been assigned, you can assign the anomaly yourself by clicking the icon.

(3) Switch to the analysis view

Clicking on "Switch to analysis view" opens the analysis view of the specific anomaly.

(4) Warning notice

The "Warning notice" area shows you a message with details of the anomaly.

(5) Contribution of the features to the anomaly (only for relationship analysis)

The "Contribution of the characteristics to the anomaly" area shows the proportion of the various characteristics found in the anomaly.

(6) Calculated deviation

A graphic overview of the selected anomaly is displayed in the "Calculated deviation" area.

The following options are available for display:

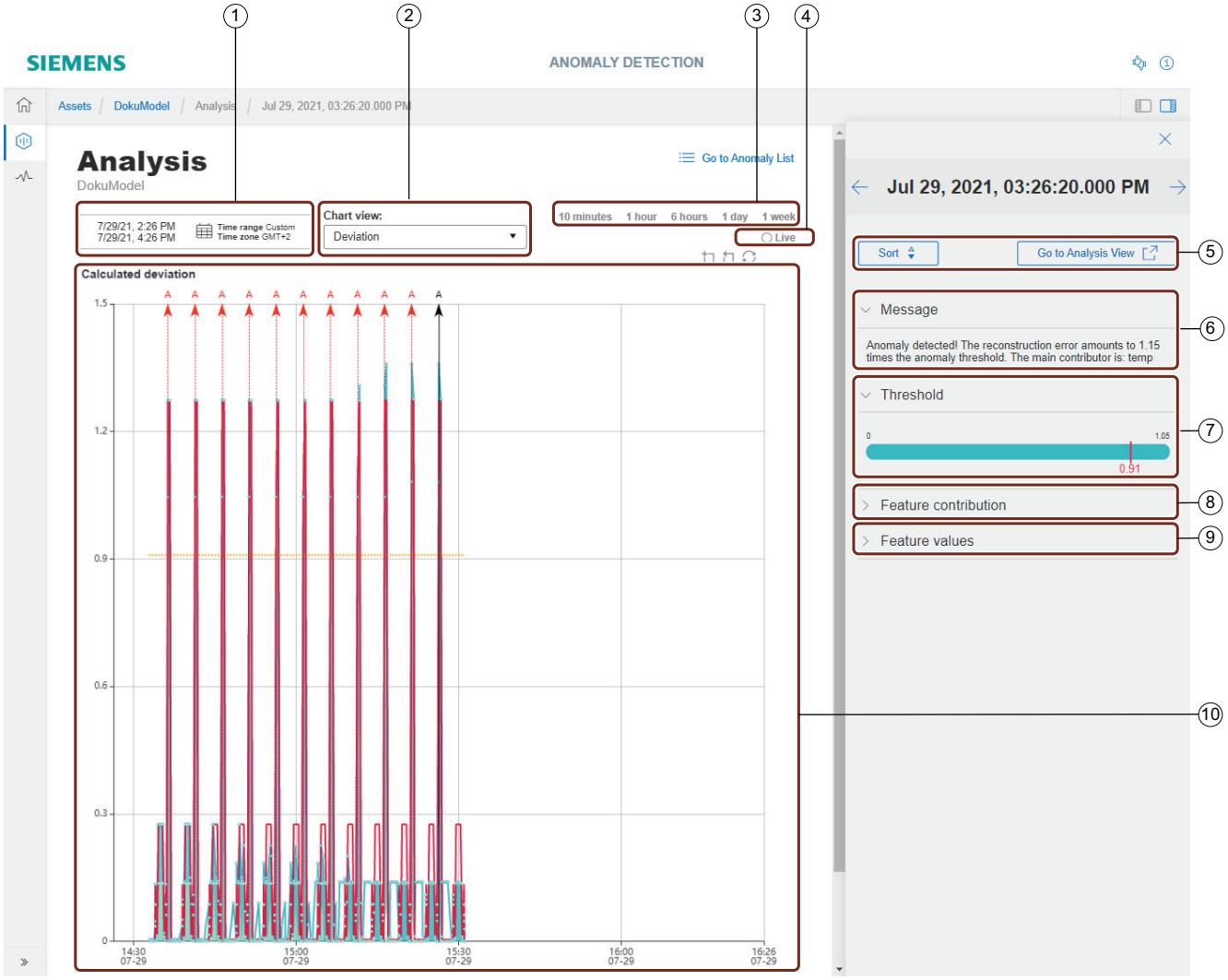
- 10 minutes: Zooms the time range to 10 minutes before and 10 minutes after the time the selected anomaly was detected.
- 1 hour: Zooms the time range to 1 hour before and 1 hour after the time the selected anomaly was detected.
- 6 hours: Zooms the time range to 6 hours before and 6 hours after the time the selected anomaly was detected.
- 1 day: Zooms the time range to 1 day before and 1 day after the time the selected anomaly was detected.
- 1 week: Zooms the time range to 1 week before and 1 week after the time the selected anomaly was detected.

See also

Activating Notifications (Page 63)

6.3 Showing an anomaly in analysis view

The "Analysis view" is divided into the following areas:



(1) Calendar time range selection
(2) Chart display: Selection of the graphs displayed
(3) Predefined time selection
(4) Live display
(5) Sort / View
(6) Warning notice
(7) Threshold
(8) Contribution of the features to the anomaly (only for relationship analysis)
(9) Values of the characteristics
(10) Graphic display of the anomaly

(1) Calendar time range selection

In the "Calendar time range selection" area, select a period for which you want to display any anomalies that have been detected. You have the following options:

- User-defined: In the calendar that appears, select the start and end dates of the period for which you want to display all anomalies that have been detected
  Or
- Day/Month/Week/Year: In the calendar displayed, select the period for which you want to display all anomalies that have been detected.
- Last ... minutes/hours

(2) Chart display

In the chart display you can choose between the following views:

- Conformity error
  Displays a diagram showing the anomalies currently being calculated.
- Conformity error + characteristic values
  Displays a diagram that contains the currently calculated anomalies and the underlying scaled time series data.
- Conformity error + characteristic values + raw values
  Displays a diagram that contains the currently calculated anomalies, the underlying transformed time series data and the unscaled raw data of the assets.

Note

Display of the relationship analysis

The conformity errors of the features are displayed one above the other in the conformity error chart of the relationship analysis. In order that the sum of all deviations is reflected in the total deviation, the total deviation was scaled, i.e. multiplied by the number of characteristics compared to the average deviation when the model was calculated. The threshold has also been adapted accordingly. If you have, for example, selected a threshold value of 1.1 in the model calculation and 5 characteristics are used for the creation, the threshold value in analysis is displayed as 5.5.

This also applies to the other views in the anomaly visualization

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The following zoom options are available to you to zoom into a specific chart area:

- Zoom function: Allows you to zoom in on a selected area.
- Undo: Undoes the last zoom steps step-by-step.
- Reset: Resets all zoom steps so that the originally selected area is visible again.

(3) Predefined time selection

In the "Predefined time selection" area, select a predefined period for which you want to display any anomalies that have been detected.

You have the following options:

- 10 minutes
- 1 hour
- 6 hours
- 1 day
- 1 week

The time information always relates to a period based on the current point in time.

If the asset is currently being supplied with data from the connected assets, this is indicated by the lighting up of the display **(4) "Live"**.

(5) Sort / View

- "Sorting": By clicking on "Sort" you can change the sorting of the characteristic contribution within the graph.
- Only for time-dependent analysis: "View": By clicking on "View" you switch to the details view of the specific anomaly.

Notifier

The "Notifier" area is only displayed if you have installed the Notifier for Industrial Edge app on the same IED and have activated notifications.

In the "Notifier" area you have the following options:

- "Status" display: Indicates whether an anomaly has the status "resolved" or "unresolved".
- "Assigned" display: indicates whether the anomaly has the status "not assigned", "assigned to myself" or "assigned".
- Resolve: If an anomaly has the status "unresolved", you can change the status by clicking "Resolve".
- "Assign to yourself": If an anomaly has the status "not assigned", you can change the status by clicking on "Assign to yourself".

(6) Warning notice

The "Warning notice" area shows you a message with details of the anomaly.

(7) Threshold value

The following information is displayed in the "Threshold value" area:

- Display of the threshold value you have defined
- Display of the value by which the calculated conformity errors of the characteristics exceed the threshold value you have specified

In the graph, the threshold value appears as orange horizontal dashed lines line.

(8) Contribution of the features to the anomaly (only for relationship analysis)

All the features involved in the anomaly and their contribution to the specific anomaly are displayed in the "Contribution of the features to the anomaly" area.

The characteristics are shown in different colors and are shown in the graph in the same way.

(9) Values of the characteristics

The scaled and transformed values of the characteristics are displayed in the "Values of the characteristics" area.

(10) Graphic display

The anomalies that have occurred in the set time range are displayed in the "Graphic display" area:

- Different characteristics are shown in different colors.
- The threshold value is represented by a orange dashed horizontal line.

If notifications are activated for the asset via the App Notifier for Industrial Edge, the following information is also displayed:

- Anomalies marked with a red arrow have status "unresolved".
- Anomalies marked with a green arrow have status "resolved".

When you click on the anomaly arrow, the color of the arrow changes to "black" and the information area on the right-hand side of the screen shows information about the specific anomaly.

Legend

The legend is located on the right-hand side of the screen and is visible when you close the window above.

You can activate and deactivate the display of the individual characteristics by clicking on the characteristic.

See also

Activating Notifications (Page 63)

Activating Notifications

7

For each asset you can activate notifications which are displayed in the Notifier for Industrial Edge app and sent directly to the desired mobile device.

Note

Notifier for Industrial Edge

The Notifier must also be installed on the same Industrial Edge Device (IED) so that you can activate the "Activate notifications" function.

In the list view of the assets with anomalies you can filter the listed assets after activating the notifications according to status "Solved" or "Not solved" and according to assignment.

For more information on the range of functions of the Notifier app, refer to the documentation "Notifier for Industrial Edge (https://support.industry.siemens.com/cs/document/109781418/notifier-for-industrial-edge?dti=0&lc=en-WW)".

Requirement

- The app Notifier for Industrial Edge (version 1.2 or higher) is installed on the Industrial Edge Device.
- At least one anomaly model is deployed.

Procedure

To activate the "Activate notification" function, follow these steps:

1. Switch to the "Visualization" tab.
2. Click on the desired asset that you want to activate notifications for.
   The overview of the asset opens on the right-hand side of the screen.
3. In the "Notifier" area, activate the notifications by clicking the button.
   As soon as the function is activated and an anomaly is detected for the asset, a notification is triggered and sent to the mobile device.

Result

You have activated notifications via Notifier for Industrial Edge.