Features of Meiden Cloud Service

Yoshiharu Sanada

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Abstract

Since 2016, we have been providing a Meiden cloud service with remote monitoring and facility management functions that use Internet of Things (IoT) technology.

Meiden Cloud Service is provided as a Software as a Service (SaaS) and can be used in tandem with a network. Since the customer does not need to install dedicated IT systems, the initial cost can be reduced, and maintenance work and future equipment purchases can be reduced. There is also the benefit of being released from IT facility management operations and future IT facility renewal planning.

The remote monitoring service utilizes the expertise and track records of dedicated monitoring systems in the fields of power, industry, and water processing. By combining with dedicated on-site terminals, it realizes a function comparable to the conventional monitoring system.

1 Preface

Meiden Cloud Service began providing remote monitoring services ahead of other services and various functions have been added to the service since.

This paper introduces the features of the various services, focusing on the added functions.

2 Remote Monitoring Service

2.1 Monitoring Function

The system provides the same functions as conventional dedicated monitoring equipment as a cloud-based service. **Table 1** shows the monitoring functions of the remote monitoring service.

The operational status of electrical and mechanical equipment is collected on the cloud, and multiple facilities are centrally monitored. For example, when a failure or abnormality occurs in a facility, an alert is displayed on the screen, an alarm is issued, and e-mails are sent to the registered users. This makes it possible for the operation of the facility to be checked using a tablet PC or other mobile IT device.

Table 1 A List of Monitoring Functions

We are offering various functions equivalent to those of conventionally provided dedicated monitoring equipment.

Functions	Specifications
Operational status	Display of present ON-OFF status of circuit breakers and switches as well as present status of measured values such as incoming current and voltage.
Prompt alarm	Pop-up display of "Fault Prompt" at the upper part of monitoring screen upon the occurrence of failure. Sounding of alarm signal.
Alarm summary	Display of a list of unidentified failure information about equipment with continued failure.
Alarm notice	Transmission of alarming e-mails upon the occurrence of failure to the designated e-mail addresses previously specified.
Upper/lower limit monitoring	Monitoring of measured values of currents when they exceed the upper or lower limits.
Graphic screen	Indication of system configuration, equipment status, failures, and measured values in an easily understandable graphic screen tailored to the customer's request.

2.2 Analytical Function

There are various functions, such as an event recording function, by which errors caused in the past are time-serially displayed. In addition, trend comparison function by which different trends are compared, and form processing function by which daily and monthly information is also gathered and
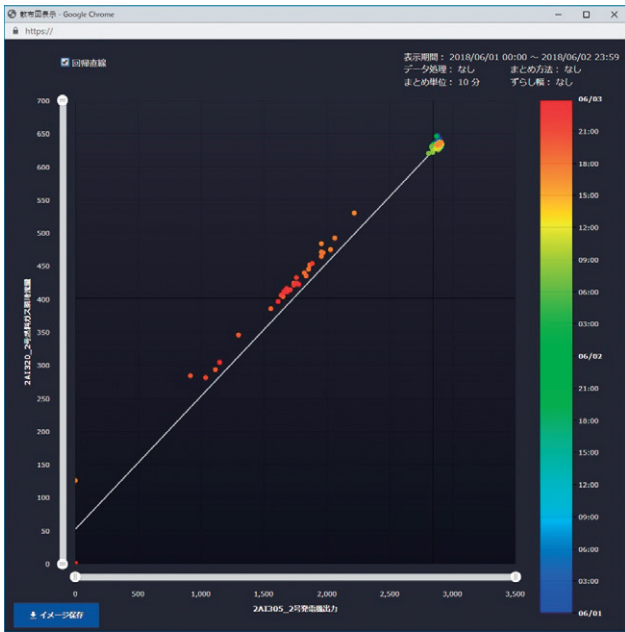
Correlative relationship between two parameters is shown in a scatter plot diagram.

displayed. As such, simple analytical approaches for customers are offered. Some of these functions are introduced below.

2.2.1 Correlation Analysis

In many cases, facility maintenance personnel are grasping points of influence at the time of the facility malfunction based on past experiences. Correlation of these points is, therefore, put into a form of a scatter plot diagram graph. If correlation values and kurtosis are numerically displayed at the same time, it is then possible to grasp the clear criterion for error sensing. As a result, less experienced maintenance personnel can be supported when making an analytical evaluation.

In addition to simple comparison of time-serial data, when evaluating fuel cost of generators, a scatter plot diagram is produced with the axis of ordinates for fuel input and the axis of abscissas for generated electric power. By doing this, the correction between both data blocks can be grasped and clear analytical evaluation about fuel cost can be determined. **Fig. 1** shows an example of a scatter plot diagram.

2.2.2 Occurrence Frequency of Events

Types of events like equipment start-stop, occurrence of errors, and recovery from malfunction are selected, and situations of event occurrence are gathered according to time zone and day of the week. By doing so, whether the occurrence of an
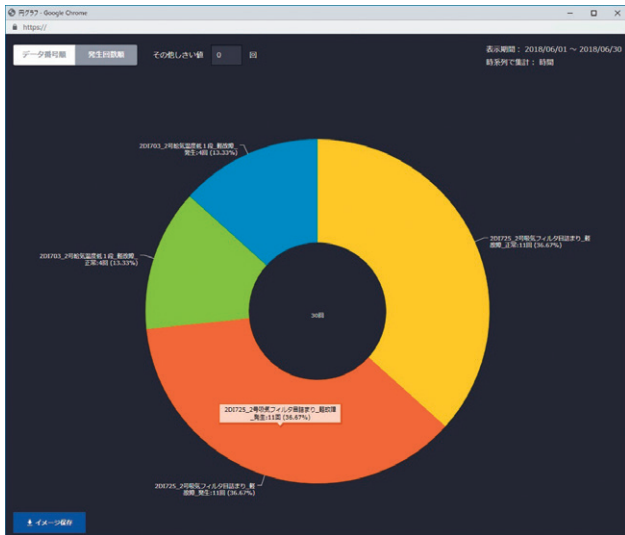
The number of times of events occurring in a specified period is shown in a pie chart.

The number of times of events occurring in a specified period is shown in a bubble chart in circle sizes and occurring time.

event is unevenly distributed to a specific day of the week or time zone can be visually grasped. **Fig. 2** shows a pie chart and **Fig. 3** shows a bubble chart.

3　Facility Management Service

3.1　Equipment Ledger

This is a function for managing customer equipment information on the cloud where equipment ledger information can be created, edited, and deleted. In addition, equipment that is no longer used (due to replacement or disposal) can be managed as retired equipment. **Fig. 4** shows the equip-

(a) Upper part

(b) Lower part

| **Fig. 4** | **Equipment Ledger Screen** |

Screens displaying information of each equipment are shown. In (a), a facility photo and property information are displayed. In (b), a list of machine history and related documents concerned with ledger equipment is shown.

ment ledger screen.

A special template for each type of equipment, such as pumps, is provided. It provides the ability to create a uniformed ledger to support the operation of certain equipment based on the ledger. As one of important equipment information, on-site photo data can be registered. In the event of equipment failure, information on the relevant equipment can be promptly retrieved and investigated.

If new equipment is added to the site, construction-related documents and instruction manuals are generally delivered to the end user. With this function, these various document files can be registered for individual ledger facilities and machine history units. By centrally managing the information related to the facility together with the ledger information and machine history information, we support the maintenance work of the customer's facility.

When considering the introduction of new equipment installed last year in Facility A to Facility B, for example, if the information on construction documents, acquisition price, failure history, repair history, etc., is already registered in the equipment ledger of Facility A, a series of effective information can be easily extracted from the beginning of the new facility introduction. This will speed up the process of examining the introduction of equipment.

3.2 Machine History Display

This function is intended to manage machine history information such as equipment failure, repair, inspection, and installation. Since information about mechanical failure, repair, and inspection belongs to a history of a machine unit, registration and editing are carried out based on a screen shown in **Fig. 4** (b). In the case of construction history for the maintenance of multiple facilities, however, registration is made based on the machine history list screen. In this case, however, a single machine history is linked with a configuration where multiple machines are registered. For an individual machine history display screen, a table of related machines constructed at the same time is displayed so that mutual history information can be analyzed.

3.3 Document Management

As shown in **Fig. 4** (b), this function manages instruction manuals and a completion book including completion drawings in the unit of each facility in order to register failure and repair records in each unit of failure and repair service.

Apart from the function of document registration in a facility unit, this function enables registration, deletion, copying, and moving of folders and files from a document list screen. In addition, when a registered document must be registered for another facility, all the related documents can be automatically updated by simply modifying the original file with an association function of the registered document.

A list of inspection support functions is shown.

Functions	Specifications
Establishment of inspection table	Each inspection item is defined and multiple inspection items are put in groups, finally assembled into a single inspection table.
Inspection table	Inspection table is set up based on a calendar screen in month unit. A list of planning conditions and point of contact person is displayed.
Inspection record	Only an inspection table is shown where correlations can be identified between log-in user and inspector so that an actual inspection result can be recorded.
Inspection result for reference and editing	Future inspection plan and past inspection result are displayed on a calendar screen in monthly units.
Inspection result	This function enables the generation of outputs in the form of a single page of inspection ledgers with the result of multiple inspection tables assembled together. It is possible to establish a format of, and generate an output of, inspection ledgers.

By making an access setting for each customer, a designated administrator can use this function for editing and as a point of contact with the customer, so that it can be managed in such a way that they can have only "reference access".

3.4 Inspection Support

For inspection work conventionally performed by using paper, this function is used to provide inspection by actively using electronic devices such as smart-phones.

If an electronic device is used, challenges such as "illegible letters", "inspection omission", and "inspection sheets are cumbersome" can be resolved. **Table 2** shows a list of inspection support functions and **Fig. 5** shows an inspection record screen.

There are many cases where a network is not developed at an inspection site. In this function, necessary information can be downloaded to an electronic device in advance and can be used without a network. In addition to displaying the previous

(a) Menu   (b) Numerical inspection

Fig. 5 Inspection Record Screen

In (a), a screen of a list of inspection tables is shown. (Inspection tables only concerned with log-in user are displayed.)
In (b), an inspection screen is shown, to be displayed after an inspection table has been selected. It is arranged in a size of a smart phone.

value, past inspection values and trends can also be shown to understand the history of the past.

4 Postscript

This paper introduced functions of remote monitoring and facility management services offered by Meiden Cloud Service. We are also developing a prototype of an equipment health assessment support function based on the "Guideline for Diagnosis of Deterioration of Telecommunications Facilities (Draft)" promoted by the Ministry of Land, Infrastructure, Transport and Tourism. We are also improving and adding various functions. We will continue to provide comprehensive services.

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