

LARGE-SCALE BUILDING ENERGY METERING SYSTEM

TECHNICAL FIELD

The present invention relates to the field of energy metering technologies, and in particular, to a large-scale building energy metering system.

BACKGROUND

Energy metering is used for reflecting quantized data of energy conservation and emission reduction, plays a decisive role, and is also used as a management tool and means. Energy metering data is acquired, diagnosed, and analyzed to implement effective management. Scientific and accurate metering data can guide the use of building energy, thereby achieving an objective of energy saving and consumption reduction.

The development of the Internet of things has brought a change to an energy metering method and form, and acquisition, transmission, and processing of metering data have gradually turned to digitalization and informatization, so that the efficiency, accuracy, and systematization of a metering operation is improved.

With the progress of society and continuous improvement of people's living standards, new energy in large-scale buildings is increasingly widely used, and also imposes a higher requirement for the use and management of new energy in buildings. Therefore, in consideration with energy conservation and environmental protection, a demand for energy metering in large-scale buildings is also increasing.

SUMMARY

An objective of the present invention is to provide a large-scale building energy metering system that can implement distributed computing and data storage for energy metering.

To achieve the above objective, the present invention provides the following technical solution.

A large-scale building energy metering system includes a monitoring module and a monitoring platform; the monitoring platform includes a transport layer, a data layer, and a service layer; the monitoring module implements data interaction with the monitoring platform through the transport layer; the transport layer performs data communication with the data layer through a unified data service interface; the monitoring module includes a building auto-control monitoring device, a power transformation and distribution monitoring device, an environmental monitoring device, a wind-solar complementary solar power supply monitoring device, an air conditioning terminal monitoring device, and an illumination monitoring device; the transport layer includes multiple types of interfaces; the data layer includes a data acquisition and processing unit and an intelligent terminal unit; and the service layer includes an energy

consumption monitoring unit and a device operation and maintenance unit;

the data acquisition and processing unit periodically obtains, through each interface at the transport layer, monitoring data acquired by the monitoring module, and performs multiple screening, filtering, and analysis processing on the monitoring data;

the intelligent terminal unit uninterruptedly obtains an operating status and alarm information of each monitoring device in the monitoring module through each interface at the transport layer;

the energy consumption monitoring unit is configured to perform energy consumption multilevel metering, energy consumption subentry metering, energy statistics collection, and presentation and generation of various energy report forms on processed monitoring data; and

the device operation and maintenance unit is configured to obtain the operating status and the alarm information of each monitoring device, acquire the alarm information, and provide a notification to a relevant responsible personnel in a timely manner.

Optionally, the service layer further includes an intelligent control unit; and the intelligent control unit is configured to output a corresponding intelligent control mode according to a user requirement, and send the intelligent control mode to each monitoring device to control the monitoring device to operate according to the intelligent control mode.

Optionally, the service layer further includes an energy consumption analysis unit, and the energy consumption analysis unit is configured to analyze the processed monitoring data according to historical energy consumption data by using a standard value as reference, and output an energy saving control scheme.

Optionally, the data layer further includes a data center; the data layer performs data interaction with the service layer through the data center; the data center obtains the processed monitoring data and the operating status and the alarm information of each monitoring device, and persistently stores the processed monitoring data and the operating status and the alarm information of each monitoring device in the data center.

Optionally, the data acquisition and processing unit is constructed based on an XML-based support protocol extended data acquisition frame; and the XML-based support protocol extended data acquisition frame includes the unified data service interface, an XML protocol converter, a data matching processor, a data checking backup device, a data Hash cache area, a thread scheduler, and a protocol selector, where

the unified data service interface is a uniform interface for publishing data access to the outside; the XML protocol converter includes XML files for describing a unified code and different protocol data processing and different communications protocol XML description files; the data matching processor is configured to parse the unified code, perform protocol conversion

on monitoring data of different protocols according to configuration file information, and match the unified code with processed monitoring data; the data checking backup device is configured to check and backup original data and the processed monitoring data; the data Hash cache area is used to cache the original data and the processed monitoring data; the thread scheduler is configured to perform thread scheduling on different protocols and different monitoring devices according to a requirement of an XML protocol file; and the protocol selector is configured to perform protocol screening, and specify a communications protocol according to an operating parameter of a thread, so as to be connected to a monitoring device according to a format of the specified communications protocol.

Optionally, data communication is implemented between the monitoring module and the transport layer by using an MQTT communications protocol.

Optionally, the transport layer includes a building device auto-control gateway interface, a power transformation and distribution monitoring interface, an environmental monitoring interface, a wind-solar complementary solar power supply monitoring interface, an air conditioning terminal monitoring interface, and an illumination monitoring interface;

the building device auto-control gateway interface is in butt joint with the building auto-control monitoring device and is configured to implement uploading and protocol conversion of central air-conditioning data;

the power transformation and distribution monitoring interface is in butt joint with the power transformation and distribution monitoring device and is configured to implement uploading and protocol conversion of building electric power data;

the environmental monitoring interface is in butt joint with the environmental monitoring device and is configured to implement uploading and protocol conversion of building environmental data;

the wind-solar complementary solar power supply monitoring interface is in butt joint with a PLC control interface of the wind-solar complementary solar power supply monitoring device and is configured to implement uploading and protocol conversion of building power supply data;

the air conditioning terminal monitoring interface interacts with a fan coil controller of the air conditioning terminal monitoring device and is configured to implement uploading and protocol conversion of operation time data of each central air-conditioner in a building; and

the illumination monitoring interface interacts with a power supply circuit controller of the illumination monitoring device and is configured to implement uploading and protocol conversion of building illumination data.

Optionally, the wind-solar complementary solar power supply monitoring device monitors

and records real-time electrical quantity of a wind-solar complementary solar power supply apparatus by using a data monitoring and control system based on a programmable logic controller.

According to specific embodiments provided in the present invention, the present invention discloses the following technical effects:

The present invention provides a large-scale building energy metering system, where the system includes a monitoring module and a monitoring platform; the monitoring platform includes a transport layer, a data layer, and a service layer; the monitoring module implements data interaction with the monitoring platform through the transport layer; the transport layer performs data communication with the data layer through a unified data service interface; the monitoring module includes a building auto-control monitoring device, a power transformation and distribution monitoring device, an environmental monitoring device, a wind-solar complementary solar power supply monitoring device, an air conditioning terminal monitoring device, and an illumination monitoring device; the transport layer includes multiple types of interfaces; the data layer includes a data acquisition and processing unit and an intelligent terminal unit; the service layer includes an energy consumption monitoring unit and a device operation and maintenance unit; the data acquisition and processing unit periodically obtains, through each interface at the transport layer, monitoring data acquired by the monitoring module, and performs multiple screening, filtering, and analysis processing on the monitoring data; the intelligent terminal unit uninterruptedly obtains an operating status and alarm information of each monitoring device in the monitoring module through each interface at the transport layer; the energy consumption monitoring unit is configured to perform energy consumption multilevel metering, energy consumption subentry metering, energy statistics collection, and presentation and generation of various energy report forms on processed monitoring data; and the device operation and maintenance unit is configured to obtain the operating status and the alarm information of each monitoring device, acquire the alarm information, and provide a notification to a relevant responsible personnel in a timely manner. Therefore, the system provided in the present invention has advantages such as distributed computing and storage for energy data metering, and maintenance of monitoring devices.

BRIEF DESCRIPTION OF THE DRAWINGS

To describe the technical solutions in the embodiments of the present invention or in the prior art more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments. Apparently, the accompanying drawings in the following description show merely some embodiments of the present invention, and a person of ordinary skill in the art

may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a structural block diagram of a large-scale building energy metering system according to an embodiment of the present invention; and

FIG. 2 is a structural block diagram of a data acquisition and processing unit according to an embodiment of the present invention.

DETAILED DESCRIPTION

The following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely a part rather than all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

An objective of the present invention is to provide a large-scale building energy metering system that can implement distributed computing and data storage for energy metering.

To make the foregoing objective, features, and advantages of the present invention clearer and more comprehensible, the present invention is further described in detail below with reference to the accompanying drawings and specific embodiments.

In the present invention, new energy of large-scale public buildings is comprehensive utilized, and an energy-saving operation and maintenance platform is combined with demonstration project construction, so as to ensure that the system provided in the present invention can be put into operation during an execution period.

FIG. 1 is a structural block diagram of a large-scale building energy metering system according to an embodiment of the present invention.

As shown in FIG. 1, the large-scale building energy metering system provided in this embodiment of the present invention includes a monitoring module and a monitoring platform, where the monitoring platform includes a transport layer, a data layer, and a service layer; and the monitoring module performs data communication with the transport layer by using an MQTT communications protocol. The monitoring module implements data interaction with the monitoring platform through the transport layer; and the transport layer performs data communication with the data layer through a unified data service interface.

The monitoring module includes a building auto-control monitoring device, a power transformation and distribution monitoring device, an environmental monitoring device, a wind-solar complementary solar power supply monitoring device, an air conditioning terminal monitoring device, and an illumination monitoring device.

The transport layer includes multiple types of interfaces. The transport layer includes a building device auto-control gateway interface, a power transformation and distribution monitoring interface, an environmental monitoring interface, a wind-solar complementary solar power supply monitoring interface, an air conditioning terminal monitoring interface, and an illumination monitoring interface.

The building device auto-control gateway interface is in butt joint with the building auto-control monitoring device and is configured to implement uploading and protocol conversion of central air-conditioning data; the power transformation and distribution monitoring interface is in butt joint with the power transformation and distribution monitoring device and is configured to implement uploading and protocol conversion of building electric power data; the environmental monitoring interface is in butt joint with the environmental monitoring device and is configured to implement uploading and protocol conversion of building environmental data; the wind-solar complementary solar power supply monitoring interface is in butt joint with a PLC control interface of the wind-solar complementary solar power supply monitoring device and is configured to implement uploading and protocol conversion of building power supply data; the air conditioning terminal monitoring interface interacts with a fan coil controller of the air conditioning terminal monitoring device and is configured to implement uploading and protocol conversion of operation time data of each central air-conditioner in a building; and the illumination monitoring interface interacts with a power supply circuit controller of the illumination monitoring device and is configured to implement uploading and protocol conversion of building illumination data.

In the wind-solar complementary solar power supply system, the following two electric power generation manners are integrated: wind power generation and photovoltaic power generation, and two energy storage manners are used: hydrogen gas energy storage (including hydrogen production and converting hydrogen gas to electric energy) and fuel cell energy storage. To improve reliability and stability of the wind-solar complementary solar power supply system and reduce monitoring workload, it is necessary to establish a high-quality and high-efficiency automatic data acquisition and analysis system through software configuration. In the present invention, PC-based configuration software is used to develop a host operation interface, and a widened intelligent instrument is used as a lower computer to acquire data. A host and the lower computer perform communication through a fieldbus and an RS-232.

Therefore, the wind-solar complementary solar power supply monitoring device in this embodiment of the present invention monitors and records real-time electrical quantity, such as a current and a voltage, of a wind-solar complementary solar power supply apparatus by using a

data monitoring and control system based on a programmable logic controller (PLC). Some specific devices used in the wind-solar complementary solar power supply monitoring device include a CPU unit including a PLC, an analog module, a direct current acquisition device, parallel direct current transformers, a rectifier, and the like. By using the wind-solar complementary solar power supply monitoring device, a current value and a voltage value can be read and recorded very easily.

The data layer includes a data acquisition and processing unit, an intelligent terminal unit, and a data center. The data layer performs data interaction with the service layer through the data center.

The data acquisition and processing unit periodically obtains, through each interface at the transport layer, monitoring data acquired by the monitoring module, and performs multiple screening, filtering, and analysis processing on the monitoring data; the intelligent terminal unit uninterruptedly obtains an operating status and alarm information of each monitoring device in the monitoring module through each interface at the transport layer; and the data center obtains processed monitoring data and the operating status and the alarm information of each monitoring device, and persistently stores the processed monitoring data and the operating status and the alarm information of each monitoring device in the data center.

The service layer includes an energy consumption monitoring unit, an intelligent control unit, an energy consumption analysis unit, and a device operation and maintenance unit.

The energy consumption monitoring unit is configured to perform energy consumption multilevel metering, energy consumption subentry metering, energy statistics collection, and presentation and generation of various energy report forms on the processed monitoring data. The device operation and maintenance unit is configured to obtain the operating status and the alarm information of each monitoring device, acquire the alarm information, and provide a notification to a relevant responsible personnel in a timely manner. The intelligent control unit is configured to output a corresponding intelligent control mode according to a user requirement, and send the intelligent control mode to each monitoring device to control the monitoring device to operate according to the intelligent control mode. The energy consumption analysis unit is configured to analyze the processed monitoring data according to historical energy consumption data by using a standard value as reference, output an energy saving control scheme, and provide a feasible energy saving method for a user. The energy consumption analysis unit is further configured to perform analysis on an energy-saving potential of the user.

FIG. 2 is a structural block diagram of a data acquisition and processing unit according to an embodiment of the present invention.

As shown in FIG. 2, the data acquisition and processing unit is constructed based on an XML-based support protocol extended data acquisition frame; and the XML-based support protocol extended data acquisition frame includes a unified data service interface, an XML protocol converter, a data matching processor, a data checking backup device, a data Hash cache area, a thread scheduler, and a protocol selector.

(1) The unified data service interface (UWSI): it is a uniform interface responsible for publishing data access to the outside. Access personnel can perform data communication only by finding the data access interface through a web service, and data needed by the access personnel can be conveniently obtained in combination with a unified code of data. This fully reflects good universality of this acquisition frame.

(2) The XML protocol converter (XMLPC): it includes XML files for describing the unified code and different protocol data processing and different communications protocol XML description files, and these XML files determine extendibility of the acquisition frame. The protocol converter is responsible for parsing these configuration files, and simultaneously implements data conversion of different protocols, obtains the unified code and communications protocol information, and provides the information for a DMP and a TS.

(3) The data matching processor (DMP): it is configured to parse the unified code, perform protocol conversion on device data of different protocols according to configuration file information, and match the unified code with processed monitoring data. Therefore, the DMP is a premise of ensuring good versatility of the acquisition frame, implements mapping between the unified code and the processed monitoring data, is also a processor for original data and the processed monitoring data, and plays a link role.

(4) The data checking backup device (DCBD): on one hand, it is configured to perform checking on the original data and the processed monitoring data, to ensure correctness of data when the data is provided externally; and on another hand, it is configured to perform backup on the data to prevent a fault or lost of the data.

(5) The data Hash cache area (HC): it is a hash memory area that changes dynamically in real time, and used for caching acquired data. It is equivalent to a mapping of data in a data numerical control device in a memory. After multiple threads perform data acquisition on the device, the data is stored in the cache, and is updated in real time, where update frequency may be configured. When access personnel accesses the interface to read data, the DMP can directly extract relevant information from the HC, so that real-time performance of the data is ensured.

(6) The thread scheduler (TS): it performs thread scheduling on different protocols and different monitoring devices according to a requirement of an XML protocol file, so as to perform

data acquisition. A thread parses a specific protocol, organizes an instruction according to a format of the specific protocol, controls communication, and implements specific communication with the numerical control device.

(7) The protocol selector (PS): it is responsible for protocol screening, and specifies a specific communications protocol according to an operating parameter of a thread, so as to be connected to the numerical control device according to a format of the specific communications protocol and implement data communication.

The XML protocol converter parses out a protocol and an acquisition device that are needed to be used, and provides data conversion and protocol conversion information. The thread scheduler automatically acquires data from a device by scheduling an acquisition thread, and updates the Hash cache area in real time. When access personnel needs to acquire data, the access personnel obtains required data from the cache area through a web service interface after data processing by the data matching processor and data backup and checking by the data checking backup device.

In the present invention, a large-scale public building is used as an entry point; a main technical solution is constructed based on a new energy technology and an Internet of Things technology; and a demonstration project is used as a checking and evaluation method. In this way, a large-scale public building new-energy comprehensive utilization and energy-saving operation and maintenance system formed by Internet of Things access, a communications interface, a wide area network, data acquisition, data processing, an intelligent service, and an upper-layer application is established, which has advantages such as distributed computing and storage for energy data metering, and maintenance of monitoring devices.

Each embodiment of the present specification is described in a progressive manner, each embodiment focuses on the difference from other embodiments, and the same and similar parts between the embodiments may refer to each other.

Several examples are used for illustration of the principles and implementation methods of the present invention. The description of the embodiments is used to help illustrate the method and its core principles of the present invention. In addition, those skilled in the art can make various modifications in terms of specific embodiments and scope of application in accordance with the teachings of the present invention. In conclusion, the content of this specification shall not be construed as a limitation to the present invention.

What is claimed is:

1. A large-scale building energy metering system, wherein the large-scale building energy metering system comprises a monitoring module and a monitoring platform; the monitoring platform comprises a transport layer, a data layer, and a service layer; the monitoring module implements data interaction with the monitoring platform through the transport layer; the transport layer performs data communication with the data layer through a unified data service interface; the monitoring module comprises a building auto-control monitoring device, a power transformation and distribution monitoring device, an environmental monitoring device, a wind-solar complementary solar power supply monitoring device, an air conditioning terminal monitoring device, and an illumination monitoring device; the transport layer comprises multiple types of interfaces; the data layer comprises a data acquisition and processing unit and an intelligent terminal unit; and the service layer comprises an energy consumption monitoring unit and a device operation and maintenance unit;

the data acquisition and processing unit periodically obtains, through each interface at the transport layer, monitoring data acquired by the monitoring module, and performs multiple screening, filtering, and analysis processing on the monitoring data;

the intelligent terminal unit uninterruptedly obtains an operating status and alarm information of each monitoring device in the monitoring module through each interface at the transport layer;

the energy consumption monitoring unit is configured to perform energy consumption multilevel metering, energy consumption subentry metering, energy statistics collection, and presentation and generation of various energy report forms on processed monitoring data; and

the device operation and maintenance unit is configured to obtain the operating status and the alarm information of each monitoring device, acquire the alarm information, and provide a notification to a relevant responsible personnel in a timely manner.

2. The large-scale building energy metering system according to claim 1, wherein the service layer further comprises an intelligent control unit; and the intelligent control unit is configured to output a corresponding intelligent control mode according to a user requirement, and send the intelligent control mode to each monitoring device to control the monitoring device to operate according to the intelligent control mode.

3. The large-scale building energy metering system according to claim 1, wherein the service layer further comprises an energy consumption analysis unit, and the energy consumption analysis unit is configured to analyze the processed monitoring data according to historical energy consumption data by using a standard value as reference, and output an energy saving control scheme.

4. The large-scale building energy metering system according to claim 1, wherein the data layer further comprises a data center; the data layer performs data interaction with the service layer through the data center; the data center obtains the processed monitoring data and the operating status and the alarm information of each monitoring device, and persistently stores the processed monitoring data and the operating status and the alarm information of each monitoring device in the data center.

5. The large-scale building energy metering system according to claim 1, wherein the data acquisition and processing unit is constructed based on an XML-based support protocol extended data acquisition frame; and the XML-based support protocol extended data acquisition frame comprises the unified data service interface, an XML protocol converter, a data matching processor, a data checking backup device, a data Hash cache area, a thread scheduler, and a protocol selector, wherein

the unified data service interface is a uniform interface for publishing data access to the outside; the XML protocol converter comprises XML files for describing a unified code and different protocol data processing and different communications protocol XML description files; the data matching processor is configured to parse the unified code, perform protocol conversion on monitoring data of different protocols according to configuration file information, and match the unified code with processed monitoring data; the data checking backup device is configured to check and backup original data and the processed monitoring data; the data Hash cache area is used to cache the original data and the processed monitoring data; the thread scheduler is configured to perform thread scheduling on different protocols and different monitoring devices according to a requirement of an XML protocol file; and the protocol selector is configured to perform protocol screening, and specify a communications protocol according to an operating parameter of a thread, so as to be connected to a monitoring device according to a format of the specified communications protocol.

6. The large-scale building energy metering system according to claim 1, wherein data communication is implemented between the monitoring module and the transport layer by using an MQTT communications protocol.

7. The large-scale building energy metering system according to claim 6, wherein the transport layer comprises a building device auto-control gateway interface, a power transformation and distribution monitoring interface, an environmental monitoring interface, a wind-solar complementary solar power supply monitoring interface, an air conditioning terminal monitoring interface, and an illumination monitoring interface;

the building device auto-control gateway interface is in butt joint with the building

auto-control monitoring device and is configured to implement uploading and protocol conversion of central air-conditioning data;

the power transformation and distribution monitoring interface is in butt joint with the power transformation and distribution monitoring device and is configured to implement uploading and protocol conversion of building electric power data;

the environmental monitoring interface is in butt joint with the environmental monitoring device and is configured to implement uploading and protocol conversion of building environmental data;

the wind-solar complementary solar power supply monitoring interface is in butt joint with a PLC control interface of the wind-solar complementary solar power supply monitoring device and is configured to implement uploading and protocol conversion of building power supply data;

the air conditioning terminal monitoring interface interacts with a fan coil controller of the air conditioning terminal monitoring device and is configured to implement uploading and protocol conversion of operation time data of each central air-conditioner in a building; and

the illumination monitoring interface interacts with a power supply circuit controller of the illumination monitoring device and is configured to implement uploading and protocol conversion of building illumination data.

8. The large-scale building energy metering system according to claim 7, wherein the wind-solar complementary solar power supply monitoring device monitors and records real-time electrical quantity of a wind-solar complementary solar power supply apparatus by using a data monitoring and control system based on a programmable logic controller.