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Construction and Typical Application of Intelligent Low Voltage Electrical Appliances Cloud Platform

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Abstract

Cloud platform is the product of deep integration of new generation information and communication technology, artificial intelligence technology and so on. By building a cloud management system suitable for intelligent electrical appliance applications, this paper focuses on solving the system-level intelligence and component information visualization of low-voltage distribution system, and realizes the interconnection of objects, services and people. Through cloud edge coordination and other ways to improve equipment data analysis, improve productivity, enhance reliability, and provide a new driving force for the development of enterprises.

Keywords

Fieldbus, intelligent electrical appliance, cloud platform.

1. Introduction

Intelligent low-voltage electrical equipment is an important part of the low-voltage distribution network. More than 80% of the electric energy in the power network is consumed by the user, of which more than 65% is industrial load, and 80% of the distribution fault comes from the user-end electrical equipment. Its reliable operation directly affects the power safety of manufacturing enterprises and public supporting facilities. The establishment of intelligent low-voltage distribution operation and maintenance management system based on cloud platform can make power transmission, distribution, control, protection and management networked and intelligent between power transformer and power equipment. Intelligent power distribution is an important part of the business scene of the Internet of things (IoT). The construction of low-voltage electrical appliances cloud platform management system is a key step to realize new communication technologies such as "big cloud things transfer intelligence" and to penetrate and deeply integrate with the new generation power system.

Up to now, although domestic enterprises have begun to carry out research, construction and application of relevant cloud platforms, there is still much room for improvement in performance, market share and popularity compared with similar foreign products, while the gap in the construction of relevant intelligent low-voltage distribution operation and maintenance management system is mainly reflected in the lack of compatible products, general ease of use, host computer / mobile phone ecology is relatively single, and so on. This paper mainly uses fieldbus technology and edge computing technology to construct and apply intelligent low voltage electrical apparatus monitoring system, focusing on solving the system-level intelligence and component information visualization of low voltage intelligent low voltage distribution system, constructing intelligent electrical appliance cloud platform based on industrial Internet platform, and realizing remote, rapid and accurate diagnosis and monitoring of typical intelligent electrical appliance faults. It enables users to query the data and usage of the intelligent power distribution system through the Internet.

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2. The Structure of Cloud Platform

Generally speaking, the architecture of cloud platform can be divided into four levels, namely, data storage operation layer, logic control layer, data access layer and data application layer, in which the data storage operation layer is mainly responsible for the comprehensive operation of the data uploaded by the intelligent terminal. and store the results of the operation. The logic control layer is mainly responsible for the execution of the scheduling algorithm and the completion of the scheduling task, the scheduling algorithm will be connected to cloud platform, the scheduling task will be responsible for processing a large amount of power data, and the scheduling task will be divided into several separate task units. the task unit is dynamically assigned and the computing task is completed by the hardware resources in the cloud platform. The data access layer undertakes the network access function, and the data application layer provides a data analysis model, which can carry out deeper operation and information mining of the data. At present, the mainstream cloud service providers in the market provide public cloud service models for users. Users can choose their own cloud service specifications and obtain their own cloud servers, which is cheaper, more flexible and convenient, and will provide complete cloud service monitoring data. Users only need to log in to the cloud service provider's monitoring platform to view relevant information such as virtual machine running status and resource utilization. However, public cloud services are designed for a multi-tenant environment, which will make some potential vulnerabilities and attacks affect the use of other users, making it impossible to guarantee security and data privacy. Private cloud can guarantee users in terms of security and data privacy, while cloud service monitoring platform is not as perfect as public cloud service.

In this paper, IOT-FAST cloud platform is used for intelligent electrical data acquisition, which is an equipment data acquisition and control development tool based on graphical user interface. Support for drag and drop operations, interactive design tools to assist users in the development of PC applications without restrictions. The predefined code blocks are componentized and configured to form nodes, and then each node is connected to form a "Flows" to execute tasks, and the connected nodes are usually a combination of input nodes, processing nodes and output nodes to help users develop applications without threshold zero programming.

3. Application Configuration of Typical Intelligent Electrical Equipment

At present, most intelligent low-voltage electrical equipment has Modbus communication function. Considering the adaptability of the actual industrial field application and the replaceable core of the scheme, this paper chooses the intelligent meter as the typical electrical equipment for cloud platform configuration application communication. Other intelligent electrical equipment, such as intelligent contactors and intelligent power measuring instruments, only need to have the ability of Modbus communication, which can be used for cloud platform control.

DDSU666 single-phase electronic watt-hour meter (guide rail) is developed to meet the requirements of power system, communication, building and other power monitoring and energy metering. The meter can real-time monitor and display the voltage, current, power, frequency, electric energy and other parameters in the power system. Through the combination of IoT-Fast cloud platform, we can realize the function of real-time monitoring and reporting power factor, current, frequency, power, voltage and other electrical parameters. In order to realize the monitoring and measurement of CHNT watt-hour meter, the acquisition control system will be configured. According to the protocol, the Modbus acquisition control will be pulled from the acquisition engine on the left. The Modbus capture control is shown in Fig. 1.

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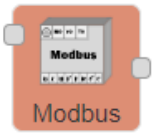

Fig.1 Modbus acquisition control

Enter the configuration interface and set the relevant parameters according to the address table shown in Table 1. Select the 03 function code. Then configure the collected point, and the identifier of the point is used to associate with the cloud platform; the function name serves as a note; the unit ID is the device number; the address must be based on the protocol, for example: phase A voltage address is 2000H, and finally enter the IP address, port and Telnet communication mode.

Table 1 Address Table of Basic Real-time Measurements

Address	Name	Data Type	Read-write attribute
2000H	Phase A voltage Ua	Float	R/W
2002H	Phase A current Ia	Float	R/W
2004H	Instantaneous total active power P	Float	R/W
2006H	Instantaneous total reactive power Q	Float	R/W
2008H	Instantaneous total apparent power S	Float	R/W
200AH	Power factor PF	Float	R/W
200CH	RESERVED	Float	R/W
200EH	Frequency of the power grid	Float	R/W

Pull out the timer and debug controls in the common control, and build the control configuration diagram shown in Fig. 2. Based on the data flow connection, the data flows from left to right. When the timer is triggered, the device is collected along the connection line, and the returned results follow the connection line to the debug control on the right, and the debug control will display the results in the debugging window.

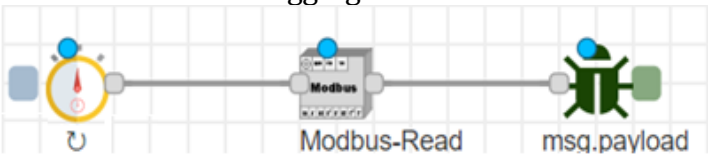

Fig.2 Modbus control collection configuration

4. Cloud platform Construction and Picture configuration

The cloud platform can classify and display the data collected by the collection and control system, set the alarm threshold, query historical data and other functions. Select a custom category on the IOT-FAST cloud platform configuration page, and add data points for collection and control in the custom parameters. Create an escalation group in the grouping defined by the function and add the current group. Data information such as A-phase voltage, A-phase current, instantaneous total active power, grid frequency and so on can be viewed in the reported packet.

After the completion of data collection, you can also build corresponding products and devices on the cloud platform to achieve the purpose of monitoring and control, and finally display data on the configuration Kanban, thus achieving a closed-loop process from 0 to 1, giving full play to the value of the IoT platform. The cloud configuration design is completed through five steps:

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new project, building scene, element scene design, data binding, preview release and so on. The cloud configuration screen of the electric energy meter is shown in Fig.3.

Fig.3 Screen configuration of watt-hour meter

5. Test

CHNT single-phase rail watt-hour meter uses Modbus protocol, 485 lines to transmit data, and converts serial port into TCP communication through serial port server. The serial server needs to assign an IP address and port, and open the software of the serial server for device management.

Connect the USB to RS485 line to the communication port of the CHNT watt-hour meter, connect the USB end to the USB interface of the computer, use 220V power supply to connect to the power interface of the CHNT watt-hour meter, and power it up. Configure the parameters of the computer side, select the network card of the Ethernet interface, and configure the parameters of IPv4. Configure the IP address and gateway of the computer to 192.168.21.81 and 192.168.21.254, respectively, and the subnet mask to 255.255.255.0.

After the product and equipment have been created, test the upstream and downlink communication data to determine whether the function of the product, protocol and parsing script is correct and complete. Log in to the IOT-FAST cloud platform, select the product card to be debugged, download the device simulator, select the device type to be simulated in the simulator according to the product interaction protocol, fill in the device information, and connect to the service. On the "online debugging" page of the platform, select the debugging equipment; then select the command to be issued in the application simulator, fill in the parameter values, and then carry out the communication test; check whether the downlink data is correct in the message tracking; in the reporting data area of the device simulator, add the reported data to test the uplink communication; finally, check whether the upstream and uplink data are correct in the message tracking.

6. Conclusion

There are many kinds of intelligent electrical appliances and the engineering practice environment is complex and diverse. The intelligent low-voltage distribution operation and maintenance management system designed and put into application should be able to connect various types of intelligent electrical appliances (such as watt-hour meters, etc.), and also have good adaptability to the integration of intelligent power systems (including MCC, motor control, etc.). Based on cloud gateway, upper configuration monitoring system and so on to complete a variety of intelligent electrical equipment access. The typical electrical data of the field intelligent low voltage distribution equipment is uploaded to the cloud through the cloud platform, and the dynamic model of the field intelligent electrical equipment is established through the upper configuration control, which can predict the overall state trend of the

distribution equipment. Thus, the hidden danger of the equipment is eliminated in advance and the continuity of power supply on the site is ensured. Different from the traditional scheme, which only monitors electrical parameters, it can be combined with on-site intelligent electrical equipment structure and communication module to monitor the mechanical state of distribution equipment, so as to achieve more accurate equipment-level predictive maintenance function.

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References

[1] LIU Yang, ZHAO Rui-feng, GUO Wen-xin, et al: Design of Power Distribution System Based on Edge Computing and Energy Internet, Techniques of Automation & Applications, Vol.41 (2022) No.7, p.188-190.

[2] ZHAO Jingming, ZHANG Jie, SONG Peng, et al: An Efficient Method of Electric Power Data Acquisition System Based on CloudEdge Collaboration,

[3] Shilei Wang: Design and Application of "Fieldbus Technology" Engineering Practice Case under the Concept of OBE Education, Scientific Journal of Economics and Management Research, Vol.2 (2020) No. 5, p.147-152.

[4] HU Jingwei, ZHANG Wenwen, Deng Li, et al.Research on Operation Framework and Application of Distribution Network Based on Cloud-dege Collaboration. Electric Engineering, (2022) No. 11, p.145-147.

[5] Shilei Wang, Lingjiao Dong, Bimiao Wu: Intelligent electrical appliances and applications(Xidian University Press,China 2019), p.148-156.

[6] WANG Chengliang, GUAN Guofei, HUANG Bin, et al: Multi‐source data processing and fusion technology of low‐voltage distribution network based on edge computing, Electronic Design Engineering, Vol.29(2021)No.4,p.172-176.

[7] Information on https://www.gkiiot.com/index/index/index.