Research on Supply and Demand Forecast of Regional Integrated Energy System Based on Computer Internet of Things Technology

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Abstract. With the development of technology, the demand of integrated energy is increasing in our country. However, the corresponding energy consumption rate and energy utilization rate are too different. Therefore, an intelligent energy management and control system has been proposed, which is based on the Internet of Things technology. This paper also gives the system structure and main functional modules so that energy efficiency can be improved better.

Keywords: Architecture, Internet of Things, ER Diagram, MVC Design Pattern

1. Introduction

In recent years, with the continuous development of globalization, the information industry has undergone three major changes. The emergence of the Internet of Things has raised the developmental level of information technology and it continues to promote its application process. At the same time, our country’s energy problems have gradually become prominent. Some related personnel integrate the Internet of Things technology into the energy management and control work, it is hoped that the intelligent process of energy management and control can be promoted to a certain extent.

2. Application architecture analysis of smart energy management and control system

At this stage, the energy management of large-scale industrial parks is mainly to arrange manual meter reading, and to summarize the meter reading data and tabulate according to the needs. There are simple
meter reading and power detection systems, and the information collection efficiency is low, and the resource sharing ability is weak. Effective and timely real-time monitoring of functional energy consumption, and lack of statistics, sorting and analysis of massive data, and lack of data foundation for effective decision-making mechanisms. The Internet of Things is considered to be another technological revolution following the Internet wave [1]. Therefore, with the technical support of the Internet of Things, the intelligent energy management and control system constructed can repeatedly play the role of the intelligent monitoring equipment that has been built and will be constructed, and realize the comprehensive IoT of the functional energy use environment of large-scale enterprise parks, thereby ensuring the data collected Timeliness, accuracy and safety provide a scientific basis for subsequent comprehensive decision-making. The Internet of Things is the use of radio frequency identification (RFID), infrared sensors, global positioning systems, laser scanners and other information sensing equipment, according to the agreed agreement, to connect items and the network for information exchange and communication, in order to achieve intelligent identification, A network of location, tracking, monitoring and management The overall framework of the intelligent energy management and control system can be implemented based on the IoT architecture system. The Internet of Things includes three layers: perception extension layer, network layer, business and application layer. The overall platform architecture is shown in Figure 1 [2].

![Figure 1. Overall architecture](image)

2.1. Perception extension layer

The perception layer collects and converts information, and finally collects the perceived information. Its key technologies are mainly sensing technology and short-distance networking technology. In the intelligent energy management and control system, various smart meters, primary energy monitoring sensors, power system equipment monitoring sensors, environmental temperature monitoring sensors, humidity monitoring sensors, and ordinary energy consumption monitoring sensors are used at the energy production, dispatching and consumption sites, and through actuators, PLC control system and embedded control system provide the original input of information and the necessary scheduling execution capabilities. Industrial gateway products integrated with advanced multi-protocol conversion technology are used to perform protocol conversion for short-distance communication methods with different underlying protocols and different transmission rates, data collection, and transmission of collected data to the network layer.
2.2. Network layer

The network layer mainly realizes the transmission of information. The data of different protocols in the perception extension layer is converted to the Internet through the industrial network, so as to realize the long-distance transmission of the monitored data from the sensor location to the data monitoring center [3]. The heavy-duty industrial park builds a local area network system by laying optical fibers, transmits the data on the gateway to the data center, and realizes the interconnection and intercommunication of information in the entire park by accessing the Internet.

2.3. Business and application layer

The business and application layer is mainly to realize the storage, analysis and management of the collected data. The intelligent energy management and control system adopts multi-protocol conversion technology to collect energy consumption, energy supply and environmental parameters from various workshops in the park, and connects to the data monitoring network through the data acquisition network to realize periodic energy data detection and environmental status monitoring functions. Various energy data and production data are analyzed and processed by the monitoring system software, and the results can be inquired and dispatched after logging in through the office network, and an interface for extending third-party applications is reserved. Establish a mass storage system with data recall function. These data are used for future modeling and a comprehensive optimization model of the production process; when the energy consumption of each equipment unit work and the work assignment of each equipment in the overall production process are known, apply Based on the data-based production process scheduling optimization method, an optimization model can be established, and finally the optimal solution can be found by the optimization algorithm [4].

3. Design and analysis of intelligent energy management and control system

The intelligent energy system is based on the park energy management and control system. It is structured into two levels: park management and enterprise management. In addition to the unification of energy supply and energy use data between the two levels, there are also park energy supply and enterprise energy use. Interaction and coordination between the plates. At the enterprise level, the online monitoring and statistical reports established are aimed at the energy use system. At the same time, the energy use of the enterprise is determined according to the production plan, and the enterprise energy use is reported to the park. In addition, with the goal of reducing the maximum power consumption as much as possible, an optimization algorithm (linear programming) is used to optimize the production plan. At the park level, the online monitoring and statistical reports established are aimed at the energy supply system, and the maximum total energy consumption cannot exceed the maximum capacity of the energy supply to dispatch the energy consumption of the enterprise, while reducing the maximum power consumption as much as possible to reduce The declared capacity of the power grid improves the utilization of equipment. In addition, the park energy management system also monitors the status of energy supply equipment. Based on the above requirements, the system can be divided into the following functional modules.

3.1. System function module
The intelligent energy management and control system includes seven functional modules: system management, basic information management, product process management, energy monitoring, energy optimization management, energy use plan management, and energy report management [5].

1) System management. This module includes three sub-modules: user management, role management, and resource management. It provides different roles for different users, and then assigns different resource permissions. It is a typical user-role-permission management system, ensuring the safety and reliability of the system.

2) Basic information management. This module includes five sub-modules: enterprise information management, park energy classification management, equipment information management, metering point management, and collection item management. Enterprise administrators maintain the basic information of the equipment according to the company’s equipment updates. Park administrators can manage basic corporate information based on the companies stationed in the park. At the same time, due to the park’s diverse energy supply system, including solar power, grid power, and firepower Power generation and other energy, so energy classification management must be carried out. The management of measurement points and collection items can conveniently realize the management of the bottom sensor and the selection of collected data items, and provide corresponding data for different functional blocks of the upper level [6].

3) Product process management. This module includes two sub-modules: product management and process information management. Each product of a heavy equipment enterprise is assembled from several components. The processing flow of each component is divided into several steps, and each step is divided into several procedures. The processing procedure is the most basic link of production and needs to be determined. The processing equipment is completed within the specified time after the standard production process, and its production energy consumption depends on the power of the production equipment and the standard production time. In this way, when the production process of a component is determined, its production energy consumption can be determined based on a standard value, and the actual production energy consumption (excluding environmental energy consumption) will not exceed the standard value [7]. Combined with the specific production plan, the daily production energy consumption in the plan can be obtained, thereby predicting the company's monthly production and processing energy consumption; based on the historical environmental energy consumption data, an appropriate environmental energy consumption prediction model can be established to predict the production environment Energy consumption, and then predict that the enterprise energy consumption is the sum of the energy consumption of production and processing and the energy consumption of the production environment.

4) Energy monitoring. This module includes three sub-modules: energy supply system monitoring, solar energy monitoring and energy consumption system monitoring. According to the energy source of the park, real-time monitoring of the energy supply of the park and the energy consumption of each enterprise and recording data, providing data support for the park's energy supply forecast. Within the enterprise, the real-time energy consumption of each device can be monitored and data recorded, providing data support for the enterprise's process optimization and production planning and scheduling.

5) Energy optimization management. This module includes two sub-modules: enterprise energy planning and energy optimization scheduling. The enterprise schedules production according to orders
and market forecasts, and manually formulates production plans. The system predicts the energy consumption plan of the enterprise based on the production tasks in the production plan and the corresponding production process and production equipment information in the process library. At the same time, the enterprise can submit the manual production plan through the energy optimization scheduling module. The system optimizes the production process according to the historical data of the system, and combines all the enterprise energy consumption plans issued by the park, and intelligently adjusts the production plan under the condition of ensuring the construction period. Obtain the optimal plan of the enterprise's energy use plan, and the enterprise uses this plan as a reference to work out the final plan [8].

6) Management of energy supply and consumption. This module includes a sub-module for summarizing energy supply and consumption. The system will provide a long-term, continuous energy management platform to transform energy management from a current short-term behavior into a long-term behavior that is supported by system data and related to plant management at all times. The user can set the energy consumption baseline of all management equipment and processes. If the actual energy consumption exceeds the energy consumption baseline, the system will provide an alarm. Park management personnel can determine the maximum power of the park’s electrical load based on the production energy use declarations of the companies in the park, and then coordinate with the companies to control the maximum power below the energy consumption baseline.

7) Energy report management. This module includes three sub-modules: park energy consumption statistics report, park energy supply statistics report and enterprise energy consumption statistics report. Relying on the historical data of the system, on the one hand, various forms of reports are generated according to user needs to provide users with the most direct and vivid report services; on the other hand, the large amount of historical data obtained is collected and analyzed to provide products for the enterprise The optimization of the production plan, the adjustment of the production plan and the forecast of the energy supply and consumption of the park provide a basis [9].

3.2. database design

Data warehouse is the core of the system, and its application level directly affects the reliability and stability of the system. The database conceptual design integrates the external views formed by different users' descriptions of the real world to form a global conceptual model, which can then be transformed into a database schema. In the conceptual design stage, it is particularly important to produce a conceptual model that has nothing to do with computer hardware and DBMS on the basis of demand analysis [10]. There are many ways to represent the conceptual model, and the most commonly used is the entity connection method (E-R diagram). There are many entities involved in the database of the intelligent energy management and control system, and this article only gives part of the entity relationship diagram. Figure 2 is an E-R diagram of the database structure related to product technology and company acquisition sensors.
4. Conclusion

With the development and progress of society, the demand of energy is increasing, but the utilization rate is getting smaller and smaller. Based on this, relevant personnel should reasonably control and manage energy demand. These issues are complex and changeable. At present, applying the Internet of Things technology to energy control is one of the better solutions. Through hard work, I believe that we can improve energy efficiency better in the future.

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