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A Campus Building Energy Consumption Monitoring System Based on B/S Architecture

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Abstract: ***The system architecture adopts the B/S (Browser/Server) structure. The client side does not require installation of any specialized software; a web browser is sufficient to access and use the monitoring system, enabling energy consumption monitoring anytime and anywhere. It offers good scalability, as future functional expansions and upgrades to the software only need to be implemented on the server side. Anyone can browse and use this system, making energy-saving promotion more extensive and effective.***

Keywords: B/S Architecture, Energy, Building, Consumption**.**

1. Introduction

With the development of China's economy and society and the increasing pressure on environmental resources, the situation regarding energy saving and emission reduction is becoming increasingly severe. While vigorously promoting energy conservation in the construction sector, the issue of high energy consumption in large buildings has become increasingly prominent. Currently, building energy consumption, industrial energy consumption, and transportation energy consumption are ranked equally as the three major 'energy-consuming sectors' in China.

Therefore, building energy conservation management is not only directly related to the achievement of China's energy-saving strategic goals but also serves as a powerful demonstration for the entire energy-saving and emission-reduction effort. The prerequisite for achieving building energy savings is mastering building energy consumption data, understanding and analyzing energy usage issues, which also highlights the importance of constructing a building energy-saving monitoring and analysis platform.

Currently, China's building energy consumption monitoring and analysis software is still in its infancy; there are no very universal software solutions available. Furthermore, some customized software on the market is based on the C/S (Client/Server) structure, meaning specialized client software must be installed to monitor and analyze data. Although such systems are powerful, they can only be used and operated by professional staff. The majority of users cannot view or use this data, which is not conducive to the promotion and publicity of energy-saving work.

To address the above drawbacks, this project will develop a campus building energy-saving monitoring system based on the B/S architecture. This system aims to achieve the following:

(1) The system architecture adopts the B/S structure. The client side does not require installation of any specialized software; a web browser is sufficient to access and use the monitoring system, enabling energy consumption monitoring anytime and anywhere.

(2) Good scalability, as future functional expansions and upgrades to the software only need to be implemented on the server side.

(3) Anyone can browse and use this system, making energy-saving promotion more extensive and effective.

2. B/S Architecture Technology

The B/S structure is relative to the C/S structure. The C/S structure, namely the Client/Server structure, reduces system communication overhead by reasonably distributing tasks between the Client and Server ends, allowing full utilization of the hardware advantages of both ends. However, users must install client software and cannot use it anytime, anywhere.

The B/S structure, namely the Browser/Server structure, emerged with the rise of network technology as a variation or improvement of the C/S structure. In this structure, the user interface is entirely implemented through the browser; there is no need to implement business logic on the front end, as all business logic is placed on the server side, forming a so-called 3-tier structure.

The B/S structure does not require installing client software; only a browser is needed. The system can be used on any machine, in any location, as long as there is network access.

3. System Design

The main framework of this system: using the campus building energy consumption data acquisition subsystem as the underlying support, a data monitoring and analysis software system is established to achieve a more interactive information platform.

The basic structure of this system: a 3-tier network structure based on B/S architecture. The upper-level software is divided into two parts: client-side software and server-side software, with the backend being the database server. The overall system structure diagram is shown in Figure 1.

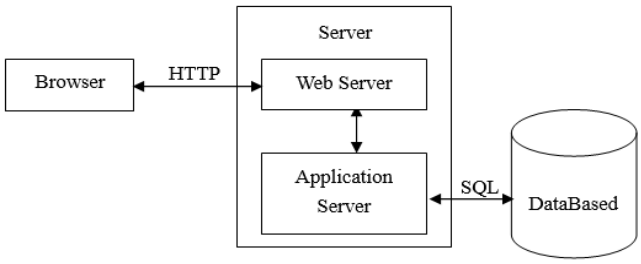

Figure 1: Technical Architecture of B/S

4. Function Design

This system is the upper-computer part of building energy consumption management. Targeting campus buildings, it performs monitoring and analysis processes for various energy consumption data based on successful data acquisition. It achieves online monitoring and dynamic analysis of energy consumption within large buildings. This system shows monitoring data in real-time, intuitively reflecting and comparing the values, trends, and distribution of various collected data and statistical data. It also analyzes, summarizes, integrates, and publishes classified and itemized energy consumption data after processing, providing a basis for energy-saving control and decision-making.

This system mainly includes the following contents:

(1) Real-time monitoring of energy consumption data

Displays in real-time the instrument parameters of each monitoring point collected by the system's acquisition stations. Users can query energy consumption monitoring status in real-time.

(2) Historical query of energy consumption data

Queries historical data for any energy consumption data over any specified time period.

(3) Analysis of building classified energy consumption

While completing data processing and uploading, the system performs classified analysis of building energy consumption. Building energy consumption is classified into the following six categories: electricity consumption, water consumption, gas consumption, centralized heating consumption, centralized cooling consumption, and other energy application amounts. It also includes sub-item analysis for various energy consumptions, statistical analysis of energy consumption status, building energy consumption display and promotion, etc.

The architecture of function design is shown in Figure 2:

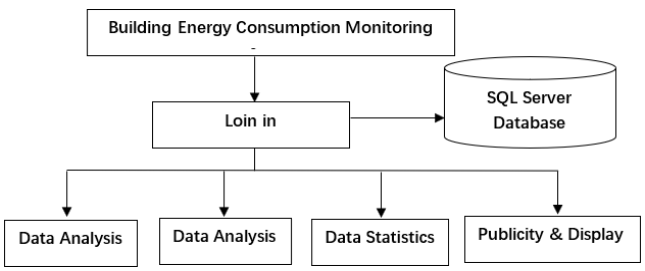

Figure 2: the Architecture of Function Design

5. Implementation

This system is a campus building energy-saving monitoring system based on the B/S architecture. Since the client side only requires a browser, no code needs to be written for the client; all business logic is written on the application server side. This system uses .NET 9 as the development platform and Visual Studio 2022 as the development tool to write web pages.

During the development process, the DataGrid component was primarily used to display data tables, while the Chart component was used to display data curves.

Because the B/S side involves substantial business logic requiring repeated database access, to reduce code redundancy, this system adopts a modular programming design philosophy and designs a universal data access class, DB. Considering the security of the public data access class, all attributes of the DB class are set to private. To facilitate calls from other classes within the system, the attributes of the data retrieval methods and database update methods in the DB class are set to public.

6. Conclusion

The example of the "Campus Building Energy-Saving Monitoring System Based on B/S" uses the B/S (Browser/Server) mode to develop a data monitoring and analysis system, migrating the data analysis process to the Web. This allows users to view and analyze data without installing specialized client software, simply by opening a browser. Thus, this operation can be performed anytime on any networked personal computer, or even data monitoring and analysis can be conducted via a mobile phone carried by the user. Through the implementation of this system, it can vigorously promote energy-saving work in the construction field, make energy-saving publicity more extensive and effective, and also greatly enhance people's awareness of energy conservation and environmental protection.

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