

Development of Computer Intelligent Control System Based on Modbus and WEB Technology

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Abstract: With the increasing popularity of intelligent computer control systems in our country, the accuracy and efficiency of intelligent control in the current computer control systems have attracted more and more attention. Modbus and WEB technology have a simple chassis format, compact and powerful functions. On this basis, based on the current research status of intelligent computer control technology, this article analyzes the problem of optimizing intelligent computer control systems based on Modbus bus and WEB technology in the application process, and improves the intelligent computer control systems based on Modbus bus and WEB technology.

Keywords: Modbus Bus; WEB Technology; Computer Intelligent Control System

1. Introduction

Fieldbus technology is a field device interconnection network communication technology that was developed in the early 1990s and applied to the field of process automation and manufacturing automation [1]. It integrates many achievements such as automation control technology, network communication technology, and computer technology. Since 2000, my country has begun to carry out research on the application of industrial fieldbus technology in the field of low-voltage electrical appliances. At present, a pattern of coexistence of multiple buses has been formed [2]. With the continuous improvement of power grid security and power quality requirements, fieldbus technology will be widely used in the field of low-voltage power distribution to realize intelligent power distribution systems and greatly improve the protection level of low-voltage smart components. Especially in recent years, intelligent low-voltage switch appliances (such as intelligent universal circuit breakers, intelligent molded case circuit breakers, intelligent dual power controllers, intelligent motor protectors and starters) have developed rapidly [3]. High-tech products that integrate technology, network technology and information technology with modern mechatronics.

Systems based on the Modbus protocol generally adopt the master-slave mode. There is only one master in the network. The communication is carried out in a query-answer mode. The master sends a message to the slave, and the slave responds to the host's query after receiving the message correctly or according to the master's message. The response action [4]. Moreover, the system communication settings can only be initialized by the host. Communication data transmission in the network is a frame as a unit, and the message is composed of a start bit, device address, function code, data, CRC check, and end character in a corresponding format to form a message frame. In a standard Modbus network, the system generally can use two communication modes, ASCII and RTU. This system uses RTU (Remote Terminal Unit) communication mode.

The intelligent power distribution system based on Modbus protocol integrates various sites to realize centralized monitoring and management, which not only improves the protection level of power distribution, but also improves the efficiency of management. It is simple, economical, and easy to program. At present, the developed distribution automation monitoring system based on Modbus protocol has been in operation in the distribution room of Hangshen Group for more than two years. The electric distribution devices are all domestic products, and the baud rate is 19.2kbit/s. Manage, monitor and control more than 20 sites including the company's comprehensive building, mold workshop, circuit breaker workshop, assembly workshop, elevator, and contact cabinet. For more than two years, the operation has been stable and reliable, which has played a decisive role in the automation management of the group's power distribution room. The system composition is shown in Figure 1:

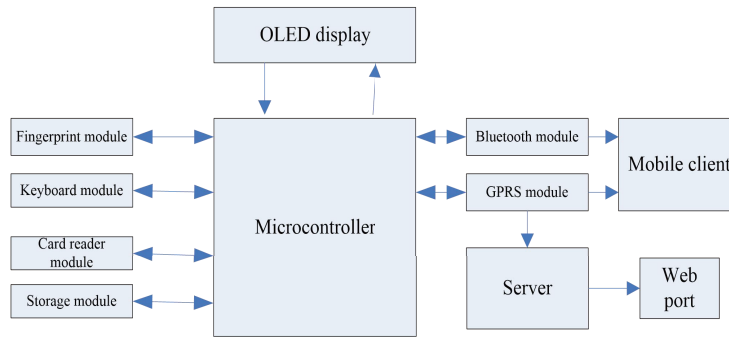


Figure 1. Computer control system composition

In short, with the development of computer technology, communication technology and control technology, the traditional industrial control field is undergoing an unprecedented change and is beginning to develop in the direction of networking, especially the computer intelligent control system represented by fieldbus. Obtained a broad space for development [5].

2. Software design of computer intelligent control system

2.1 Development environment construction

This system uses KEIL MDK5 as the system development tool, which is the best development tool for the Cortex-M3 core processor. This tool integrates the μ Vision5 development environment and Real View compiler, has the function of automatically configuring the startup code, and downloads the program through SWD. The speed can reach 50M, and the use of Simulation equipment to simulate the environment can speed up the development progress of the product. MDK5 regards MDK Core as an independent installation package, and no longer puts all device support and device drivers in one installation package, but downloads the device support package needed for development through the network [6].

2.2 Modbus bus library functions

As an ARM core chip, STM32F10xx has a large number of registers, and it is more cumbersome to directly configure the registers to implement functions. So ST company developed the STM32 library for this problem. It encapsulates the relevant function registers of STM32 and provides developers with function interface calls. Developers can call these function interfaces to complete the required functions without directly configuring STM32 register. Another advantage of using library functions is that the software code written using library functions is more readable. The comparison between the library development method and the register method development is shown in Figure 2:

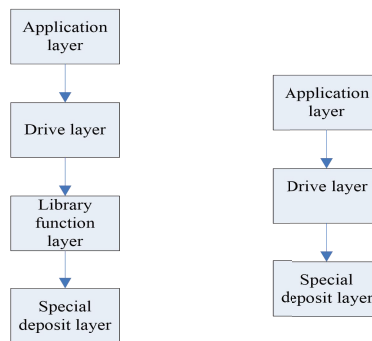


Figure 2. Comparison of development methods

2.3 Database design

The database used in this system is the relational database MySQL, which focuses on storing user login information and system door opening record information. According to the database design principle, two relational tables are established in the database, namely the user information table and the unlocking record table. User JDBC (Java Data Base Connectivity) is a Java API that executes SQL statements [7]. It uses the Java language to regulate how the client accesses the application program interface. It can be used in a variety of relational databases and specific operations in the database, the client program does not need to be concerned, this

is implemented by the database manufacturer, which acts as an intermediary between the java program and the database [8]. The interaction relationship is shown in Figure 3.

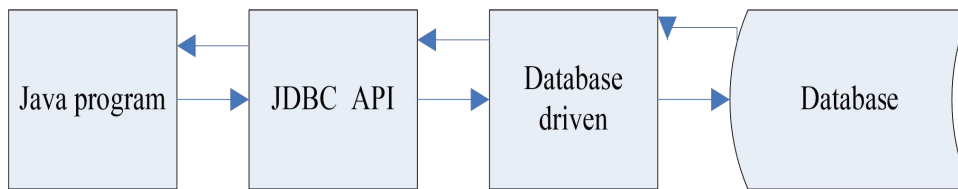


Figure 3. Interaction

3. Real-time and safety analysis of computer intelligent control system

3.1 System real-time

At the same time, an automatic database backup mechanism is added. In addition to manually backing up the historical data of the database every period of time, it is best to add an automatic database backup job to ensure timely stop loss and recovery in the event of a database failure [9]. According to statistical data and expert experience, the weight of the evaluation factors is obtained, and the membership function of each factor is as shown in formula (1) for a group of evaluation factors:

$$T_s = \sum_{i=1}^n w_i f_i(I_{si}) \tag{1}$$

Among them, i represents a designated evaluation factor, and s represents a specific set of evaluation factors. After quantization, the input of the BP network is shown in formula (2):

$$I'_{si} = \frac{1}{T_s} (w_i f_i(I_{si})) \tag{2}$$

The basic credibility distribution function BPAF formula of the new method adopted in this paper is shown in formula (3):

$$m_i(j) = \frac{B_i(j)}{\sum_j B_i(j)} \tag{3}$$

3.2 System security

First, we must add user authority design to the system. According to system requirements, users are divided into different user roles, and corresponding permissions are given to restrict users' access and operation of key data. When users log in to the system, they must pass the authentication of the user name and password. The system will confirm the identity and authority of each user response, open the corresponding interface and page to the qualified users, and prevent unauthorized users from illegally logging in, and control the user's access range. Ensure the safety of the system.

4. Computer intelligent control system design

4.1 Web-side application architecture design

The web application is the most important interactive entry for users in the entire system. In addition to querying real-time and historical capacity data of all production lines, users can also check the working conditions of collection equipment, configure production line information, manage production plans, modify system parameters, and more. Kind of function. The entire web application should have the following functions: It can identify legal user identities. According to actual requirements, users in the system will be divided into 3 levels of authority, and users of different levels have different operating access rights. For ordinary registered users, you can query the real-time and historical capacity data of each production line, production line operation status, production schedule, acquisition equipment hardware status, etc. through the web page; for more advanced office management users, you can request and system For data interaction, the operating authority it has includes the ability to configure production line information, set schedule thresholds and other collection system parameters, add and modify production plans, etc.; for the system administrator, in addition to having all the permissions, he can also manage the entire system All users in the, assign permissions as needed.

4.2 System user and authority design

Modbus/TCP adopts the C/S communication mode, and the server uses port number 502 to communicate with the listening client. This part of the program design mainly includes three parts: establishing a connection, data exchange, and closing the connection. The software design includes the design of the upper computer software and the lower computer software, mainly the lower computer software design. The lower computer communication module mainly completes the initial setting of the Ethernet port communication configuration parameters and the number of modules to receive and send data. The interface parameter initialization is mainly to configure basic parameters such as the format, baud rate, parity bit, and priority of the transmitted data frame. In the process of receiving data from the lower computer, the lower computer is first powered on, the processor initializes the parameters of each interface module, receives the data through the specified interface, and then generates the CRC code, which is compared with the CRC code in the message. If it is not the same, discard it and send error frames. If they are the same, it means that the received message is correct, then parse the message and execute the corresponding command according to the function code. The currently required permissions for this system are shown in Table 1:

Table 1. System currently required permissions

Operating	Position	Description
Basic query	0×01	Can query basic real-time production capacity; historical production capacity
Plan parameter configuration	0×02	Can modify the system parameters; can view, upload, and modify the production plan
Personnel management	0×04	Ability to add new users; assign and modify user rights
General manager	0×80	Manage the entire web application

Conclusion

This article introduces the current situation and development trend of computer intelligent control system, the application and development of Modbus field bus technology at home and abroad. This article introduces the design of computer intelligent control system. The content is the overall design of the system, including structure, cabinet design, Modbus field bus software and hardware design, configuration interface design and database design. This article introduces the realization and application analysis of computer intelligent control system. The content is Modbus field bus realization system.

References

- [1] Kermani M, Adelmanesh B. Intelligent Energy Management based on SCADA system in a real Microgrid for Smart Building Applications [J]. *Renewable Energy*, 2021, 171 (1): 51-57.
- [2] Yin ZP. Application and Development of Computer Intelligent Vision Based on Evolutionary Computation [J]. *Journal of Computational and Theoretical Nanoscience*, 2016, 13 (12): 9857-9863.
- [3] Zhao SR, Zhu B, Wu CL. Design and Development of Test Paper Intelligent System Based on DCNN [J]. *Software*, 2019, 040 (007): 192-196, 208.
- [4] Chen YB, Li ZW. Development of environmental monitoring system for Internet of things based on Mod Bus protocol [J]. *Intelligent Computers and Applications*, 2017, 007 (005): 26-30.
- [5] Lapina M, Lapin V. Software tools communication process models for Mod bus TCP/RTU for diagnostics using machine learning approaches [J]. *IOP Conference Series: Materials Science and Engineering*, 2021, 1069 (1): 12-33.
- [6] Li Z, Zhao H, Shi J. An Intelligent Fuzzing Data Generation Method Based on Deep Adversarial Learning [J]. *IEEE Access*, 2019, 7 (493): 27-40.
- [7] Rholam O, Tabaa M. Smart Device for Multi-band Industrial IoT Communications [J]. *Procedia Computer Science*, 2019, 155 (10): 660-665.
- [8] Chen FG, Lan LY, Yu YD. Design of special dehumidifier for 10 kV switchgear cabinet based on semiconductor technology [J]. *World of Electronics*, 2018, 000 (001): 59-62.
- [9] Ou GF. Intelligent disconnecting hook monitoring system based on Mod bus protocol [J]. *Instrument Technology and Sensor*, 2016, 000 (010): 79-81, 86.